Technology-Based Education and Training Concept Plan

5 May 1997

Defense Acquisition University

Defense Acquisition University

Technology-Based Education and Training Plan

CONCEPT DOCUMENT

MAY 5, 1997

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PURPOSE

The Defense Acquisition University (DAU) is committed to providing high-quality education and training to the members of the Department of Defense (DoD) acquisition community. Emerging technologies provide DAU with the ability to increase access to its courses while promoting effective learning experiences for individuals.

This document presents an overview of DAU's Technology-Based Education and Training Plan. This plan is the culmination of an extensive analysis process that began with the following previous studies: DAU Remote Learning Feasibility Assessment—Field Research (January 1994), The DAU Education Media Selection Guide Summary Report (January 1995), and Report on Distance Learning Technologies (March 1995).

VISION STATEMENT

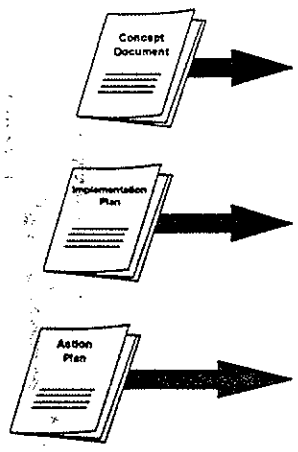
DAU's vision for technology-based education and training is as follows:

DAU Technology-Based Education and Training Vision Statement

Provide an educational program that fully supports a culture of continuous learning and allows convenient, cost-effective access to education, training, performance support, and expert advice to all members of the acquisition community.

PLAN COMPONENTS

The Technology-Based Education and Training Plan includes the following three components:



This Concept Document includes the overall concept of operations.

The Implementation Plan provides a more detailed description and rationale for the concepts presented in this document.

The Action Plan presents the tasks and resources required to implement the Plan. The Action Plan is for use by the Implementation Team.

INTRODUCTION

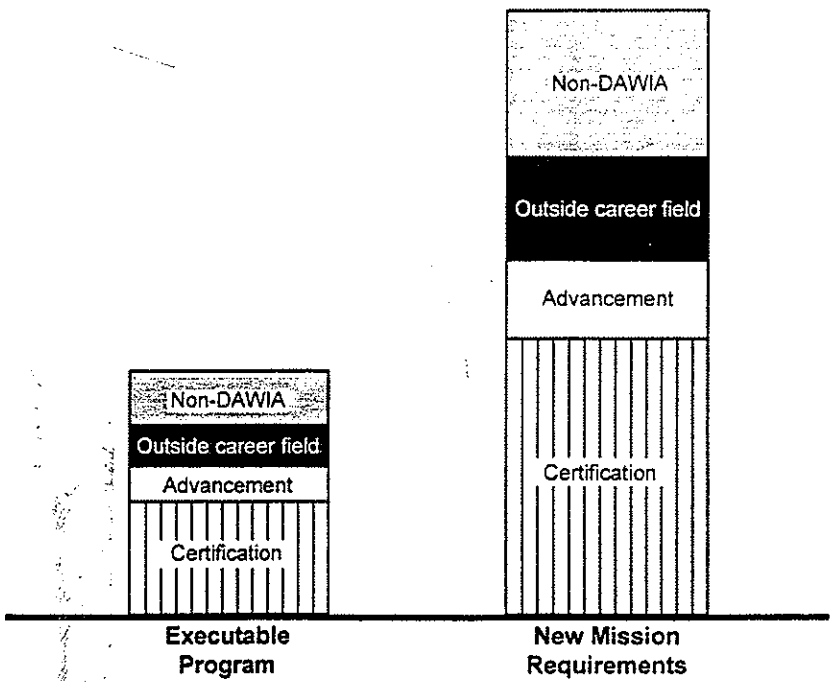
BACKGROUND

Education and training have traditionally been delivered in a classroom setting. In the past, technology has been used to improve the quality of classroom delivery. Emerging technology allows for the delivery of courses over the World Wide Web or in a stand-alone mode using a CD-ROM. Advancements in computer technology now allow for the delivery of quality training in the learner's work setting. In those cases where classroom delivery is still best for ensuring learning, it can be delivered by the traditional "one-room classroom" or can reach larger audiences through video teletraining. As discussed below, transitioning to technology-based learning may be the only way DAU can meet its expanding education and training mission requirements while still providing quality learning experiences.

REQUIREMENTS

Operating at full capacity, DAU courses serve approximately 34,000 individuals each year. Currently, DAU is meeting all requirements that the DoD components can execute. It is projected that the new mission requirement is nearly double that executable level, and new mission requirements further increase the demand for DAU courses. Figure 1 illustrates the increasing requirements being placed on DAU.

Figure 1. DAU Mission Requirements



INTRODUCTION

REQUIREMENTS (CONTINUED)

DAU has identified the following requirements for expanding the use of technology-based instruction:

FULL DAU CAPACITY COULD BE USED TO MEET CERTIFICATION REQUIREMENTS ALONE

- **Certification Training**

  Using data from the Defense Acquisition Workforce Improvement Act (DAWIA) Management Information System, DAU has determined that the annual demand for certification training to meet current job requirements exceeds 36,000 training events. Approximately half that number of individuals currently attend DAU certification courses each year. This limited enrollment may be because the combination of acquisition workforce downsizing and increasing workloads makes it difficult to release personnel to attend training away from the work site. Technology-based delivery methods are needed to increase both capacity and access to certification courses. Technology-based instruction will allow DAU to provide certification training to all who need it.

CAREER ADVANCEMENT TRAINING COULD DOUBLE WITH EXPANDED CAPACITY

- **Career Advancement Training**

  Currently, approximately 15 percent of individuals enroll in DAU courses to prepare themselves for career advancement by taking advanced courses in their career fields. DAU projects that the number of individuals taking courses could double with expanded capacity. Providing opportunities for career advancement is an important asset for maintaining a motivated and professional acquisition workforce.

INCREASED DAU CAPACITY IS NEEDED TO KEEP PACE WITH CONTINUING EDUCATION NEEDS

- **Cross Training and Continuing Education (Outside Career Field)**

  In addition to certification and career advancement, DAWIA personnel also enroll in courses for cross training and continuing education outside their career fields. Presently, 22 percent of those who enroll in DAU courses are DAWIA personnel who are outside the career field(s) for which the course is required for certification. Approximately two-thirds of those certified at Levels Two and Three have not attended the courses that are now required for certification at those levels. Continuing education is required to ensure that those previously certified are educated about new policies and business practices. These new requirements for continuing education will increase the demand for access to training across the different career fields. To meet these demands, DAU needs to increase its capacity.

REQUIREMENTS (CONTINUED)

ADDITIONAL CAPACITY IS NEEDED TO SERVE NON-DAWIA PERSONNEL

TECHNOLOGY-DELIVERED TRAINING INCREASES CAPACITY WITHIN CURRENT BUDGET LIMITS

BENEFITS

Additional requirements include the following:

- **Non-DAWIA Personnel**

  Significant numbers of non-DAWIA personnel are turned away from DAU courses for lack of capacity. The Under Secretary of Defense for Acquisition and Technology has expanded DAU's mandate to include serving the entire acquisition community. This mandate, which potentially could involve an audience substantially larger than the DAWIA workforce itself, can only be met through increased capacity.

- **Operating Within Current Resources**

  DAU must expand its capacity while not increasing overall operating costs. The expanded use of technology-based instructional delivery methods will allow DAU to reinvest resources to increase capacity while maintaining, or improving, the quality of learning.

Effective technology-based education and training yield many benefits for the learner and the organization. The key to effective technology-based instruction is course design. Techniques that work well in the classroom often do not translate into effective video teletraining or Web-based instruction. In addition, most benefits are derived when the course design uses a mixture of technologies. For example, the knowledge portions of a course could be delivered using Web-based instruction, followed by a video teletraining session where an interactive exercise could be facilitated among the learners at different sites.

Assuming effective course designs, DAU anticipates educational benefits will accrue from transitioning courses to Web-based/CD-ROM and video teletraining delivery, including:

- **Promoting Learning**

  The report titled "The 'No Significant Difference' Phenomenon" (Russell, 1997) includes more than 214 research reports, summaries, and papers on distance learning. This body of research shows that comparisons between classroom-based instruction and distance learning show either no difference in learning achievement or superior learning when delivered using technology. Attachment A contains a list of these studies.

BENEFITS (CONTINUED)

- **Ensuring Consistent and Current Training**

  Technology can be used to ensure that every learner receives training that is consistent and current. New policies and other changes can be communicated to learners and course graduates instantaneously.

- **Providing Continuing Education Opportunities**

  Technology-delivered training provides a mechanism for continuing education using "push system technologies" to broadcast relevant information to former students based on their training profiles.

- **Reducing Training Costs**

  Technology enables DAU to reduce the cost of training delivery and allows for the reinvestment of those dollars to meet expanded mission requirements.

Additional benefits from Web-based/CD-ROM delivery include:

- **Enhancing the Learning Experience**

  Adults learn best when they can exercise control over the learning situation. Technology-based instruction allows learners to:

  ◊ Select where the learning takes place (office, learning center, home). Individuals are no longer required to travel to attend courses and miss key events in the workplace or in their personal lives.

  ◊ Control when the learning takes place. Learners can take a course when they need the information to complete a critical work assignment or prepare for advancement. They are no longer required to wait for course openings.

- **Accommodating Differing Skill Levels**

  Learners can choose how fast or how slow they proceed through the materials. In a classroom, instructors often pace their delivery to meet the needs of the "average" learner.

- **Allowing Instructors To Focus on Learning**

  Courses using technology-based delivery allow instructors to focus on enhancing learning rather than completing administrative functions of testing and tracking learner progress.

INTRODUCTION

OVERALL STRATEGY

DAU's overall implementation strategy includes the following:

- Leveraging existing and emerging information technologies to meet both resident and distance learning requirements in a climate of reduced resources.
- Outsourcing to the private sector where those sources will provide best value to the Government.
- Investing in reinventing and refining Consortium members' roles to meet the educational/professional intent of DAWIA and to serve the entire acquisition community.

PROGRAM GOALS

The overall goals for the technology-based training and education plan are:

Program Goals

- Maintain or improve the quality of the DAU curriculum.
- Transition classroom-based instruction to educationally sound technology-based delivery both in and out of the classroom.
- Increase acquisition workforce participation in DAU learning activities each year.
- Reinvest course delivery resources in information technology operations, research, learning enhancements, and workforce performance support.
- Incorporate information technology in all courses by the end of FY 2000.

PROGRAM METRICS

DAU has established metrics for measuring the success of the technology-based education and training program. These metrics are listed in the table on the following page.

CONCLUSION

Smart use of technology is a performance multiplier that will allow DAU to provide quality education and training to a larger audience of the acquisition community.

Table 1. Program Metrics

No.	Metric	FY 96 Benchmark	Goal	Measurement	Method of Measurement	Action
1	Standard Operating Procedures and Systems Infrastructure Implemented	None	FY 97-Completed FY 98-Enhanced	Documentation of Processes and Systems	Review by the Steering Committee	DAU Program Director
2	Number of Courses Offered Using Technology-Based Delivery	1 Course	FY 98-10 courses FY 99-25 courses FY 00-50 courses	Number of Courses Offered	Review of DAU Course Catalog	DAU Program Director
3	Number of Members of the Acquisition Community Completing Courses	23,000	FY 98-15% increase FY 99-15% increase FY 00-15% increase	Completions per Year	Course Management Completion Data Files	DAU Operations Director
4	Average Cost per Learner per Course (for all DAU Courses)	$1,330	FY 98-9% decrease FY 99-9% decrease FY 00-9% decrease	Cost per Learner per Training Event	DAU Financial Management Process	DAU Resource Management Director
5	Evaluation of Reaction, Learning, On-the-Job Behaviors, and Organizational Results	End-of-Course Feedback, Graduate and Supervisor Surveys	90% of Comments for Needed Improvement Acted Upon	Reaction, Learning, Behavior, and Organizational Results Evaluated for Certification and Assignment-Specific Courses	Course Evaluation Data for Levels 1-4 of the Kirkpatrick Evaluation Model	DAU Academic Affairs Director

CURRICULUM TRANSITION PROCESS

CURRICULUM TRANSITION PROCESS

OVERALL STRATEGY

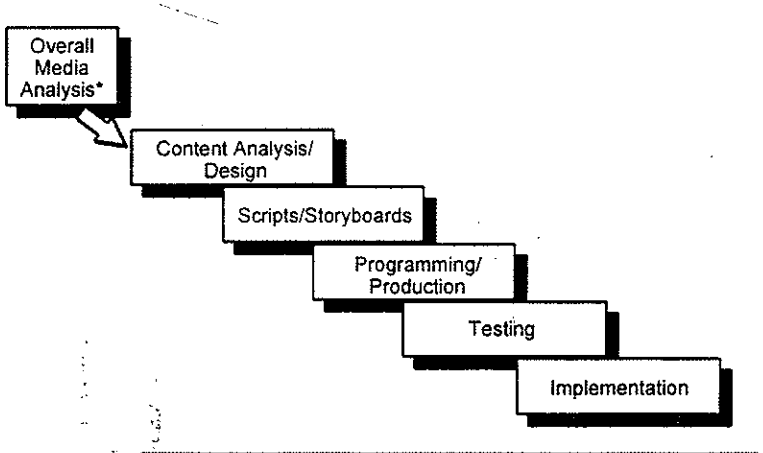
The overall curriculum transition strategy is based on the February 27, 1997, mandate from the Under Secretary of Defense for Acquisition and Technology to use technology to deliver quality training to learners in a cost-effective way. This mandate accelerates the use of technology in course delivery by setting forth the following goals:

- At least 10 percent of DAU courses will be converted to the use of information age technologies before the end of FY 97, and
- An additional 15 percent will be converted by the end of FY 98.

The mandate also has a stretch goal for DAU to offer all courses in a technological mode if analyses identify that cost savings will result without sacrificing quality.

INSTRUCTIONAL DESIGN APPROACH

To meet this mandate, the curriculum transition process must balance sound instructional design approaches with innovative techniques that allow for rapid prototyping. As illustrated below, each step in the rapid prototype model begins before the prior step is completed. For example, as soon as a high-level design is completed and a portion of the content is analyzed and validated, the project team begins developing storyboards. Production then begins on storyboards as they are approved.



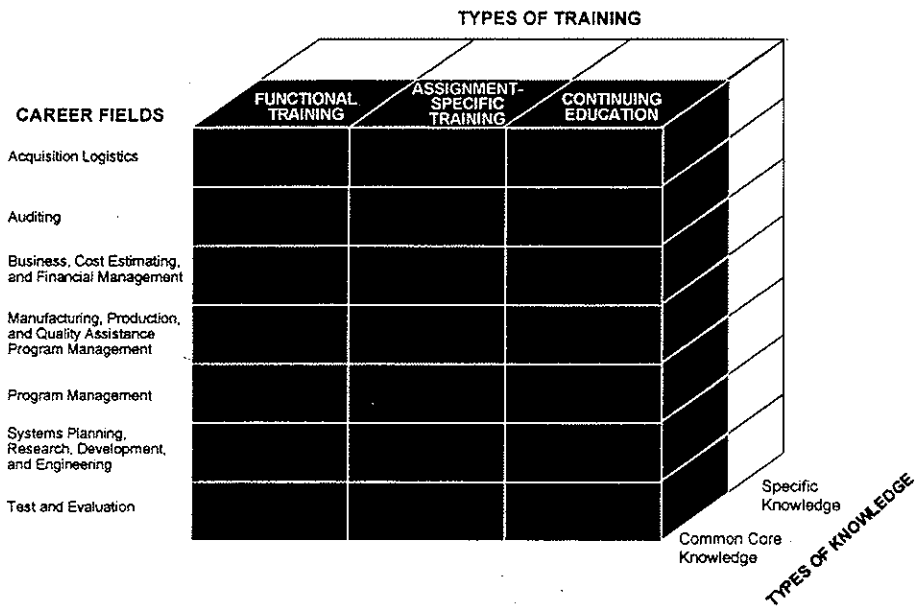
* Note: The DAU President makes the final decision about media based on the performance outcomes, course objective, and input from the Implementation Team.

Rapid prototyping reduces potential risks by having stakeholders review materials early in the process when changes can be made more cost effectively. Early reviews of completed course materials can reduce the development cycle by at least one-third.

DAU CURRICULUM KNOWLEDGE BASE

Conversion to technology-based training methods will allow DAU to reuse common content elements across both certification and continuing-education courses. As illustrated below in Figure 2, a DAU curriculum knowledge base will be established. Course content will be organized into a database structure. The structure will allow courses to share common content areas if appropriate (see the shaded cells below). An example of a content area that may appear in the shaded cells is acquisition ethics because this topic is taught in all career fields and in all types of training courses. Course maintenance costs are less when common content areas are developed and maintained using this database approach.

Figure 2. DAU Knowledge Base



CURRICULUM TRANSITION PROCESS

TRANSITION SCHEDULE

A sequence has been established for beginning the transition of courses to technology-based instruction. The following chart shows, by quarter, the number of courses for which the process will be initiated. Attachment B lists the course titles by quarters.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
FY 97		5	5	5
FY 98	5	6	5	5
FY 99	6	5	6	6
FY 00	6	6		

Criteria

The following criteria were used to sequence the courses:

- Readiness of the content based on the DAU academic review cycle.
- Highest potential return for reinvestment (learner quota times total number of training contact hours).
- Clustering and sequencing of key content areas by levels and career fields.
- Instructor, Functional Board, and DAU staff workload considerations.

MEDIA SELECTION

DAU will use a media selection model based on the Multi-Attribute Matrix (MAUM) Model used at the United States Air University. This model was developed by Hannafin and Peck (1988).

The model uses a media rating system to analyze required learning levels and ranks alternative media options for delivery. After an orientation process and demonstrations of the potential uses of technology, each panelist will rate a series of statements about the course. Next, the facilitator will lead a discussion on the rating results. The panel will consider these comments and make final ratings. This process will take one day per course.

The facilitator will be an independent third party and will not be involved in the subsequent course transition efforts. The panel will present its recommendations to the DAU President. The DAU President will make the final media selection decision.

MEDIA SELECTION CRITERIA

Listed below are sample criteria that will be used in the media selection process:

- Target Audience Characteristics: The target audience characteristics include the learning styles/preferences, motivation levels, and pretraining skill levels.
- Types of Performance Outcomes: A series of questions will be used to help panelists sort performance outcomes into psychomotor (procedural), cognitive (declarative), or affective domains.
- Levels of Outcomes: Performance outcomes will be rated on the levels of learning required and will be based on a modified version of Bloom's Taxonomy. The taxonomy will be expanded to include job performance dimensions.
- Learning Difficulty: The level of difficulty of the content will be rated.
- Types of Stimulus: The types of visual and auditory stimulus elements needed to learn the content and perform the job tasks will be identified.
- Group Versus Individual Performance: Each outcome will be identified as requiring group versus individual task performance.
- Instructor Feedback: The levels and types of instructor feedback needed for learning the content will be rated.

MEDIA OPTIONS

Whenever it is feasible to do so, DAU will use multiple delivery options. The guiding principle is to "develop once and use many times and in many ways." Media selections should allow for the maximum flexibility.

The Web-based delivered courses will be designed so that they can be repackaged as needed for stand-alone delivery on a CD-ROM. Video teletraining courses will be designed so that they can be delivered either in two-way video/audio or one-way video/two-way audio mode. In addition, Web-based resources will be used to support video teletraining.

EVALUATION PROCESS

The purpose of the evaluation stage is to ensure that the learners can achieve the performance outcomes. Evaluation includes the following two phases:

- Formative Evaluation: Formative evaluation is the systematic collection of information for improving an instructional product before it is implemented fully.
- Summative Evaluation: Summative evaluation is an assessment of effectiveness of an instructional product after it has been implemented.

FORMATIVE EVALUATION: TECHNOLOGY-BASED TRAINING

In a traditional design/development approach, formative evaluation is conducted after the instructional product has been developed fully. In developing technology-based products, formative evaluation should not wait until the end of the development process. DAU will conduct formative evaluations at the following key milestones:

- Content Analysis: The content analysis will be validated by Functional Board experts and instructors.
- Storyboards/Scripts: The content presented in these deliverables will be evaluated by Functional Board experts and instructors. DAU instructional staff will evaluate and recommend the instructional approach.
- Trials: As lessons are completed, formative evaluation sessions will be conducted with a representative sample of the target audience. This evaluation will focus on learning effectiveness and usability of the materials. A full operational trial will be conducted before the course is finalized.

SUMMATIVE EVALUATION: TECHNOLOGY-BASED INSTRUCTION

Summative evaluation for technology-based instruction does not differ from summative evaluation conducted on other forms of instruction. A thorough summative evaluation should measure:

- Training Transfer: An assessment should be made to determine how well new knowledge and skills are applied in the work setting. (This type of evaluation is often referred to as Kirkpatrick's Level 3 evaluation.)
- Organizational Goals: An assessment should be made to determine if organizational goals have been met. (This type of evaluation is often referred to as Kirkpatrick's Level 4 evaluation.)

Currently, DAU conducts surveys to collect feedback on training transfer and organizational goal attainment from graduates and their supervisors.

MANAGEMENT FRAMEWORK

MANAGEMENT FRAMEWORK

OVERALL STRATEGY

DAU will centrally manage the technology-based education and training program with involvement from key stakeholders. The overall management structure will have three primary objectives:

- Proactively identify, assess, and resolve technology-based education and training issues.
- Ensure solutions are integrated successfully into the ongoing operational environment.
- Measure achievement of metrics and implement a continuous improvement process.

MANAGEMENT STRUCTURE

DAU will form an organizational structure comprised of a Steering Committee and Implementation Team to implement the Technology-Based Education and Training Program. The following tables summarize the functions and memberships of these organizational structures.

Steering Committee

Functions: The Steering Committee's primary functions include:

- Resolving implementation issues affecting all stakeholders.
- Overseeing timely and effective implementation of the Technology-Based Education and Training Program.

Membership: DAU President, Chair

Two Functional Board Representatives
One DACM Representative

Consortium Representatives
DSMC
IRMC
AFIT
ALMC
NFCTC

Additional information on the Steering Committee's responsibilities, areas of focus, and operating procedures can be found in the Implementation Plan document.

MANAGEMENT STRUCTURE (CONTINUED)

Implementation Team

Functions: The Implementation Team's primary functions include:

- Implementing the Program.
- Identifying new requirements and integrating them into the Program.

Membership: DAU Program Director, Chair

DAU Staff Member Representatives
- Academic Affairs
- University Operations
- Resource Management
- Acquisition Reform
- Communication Center

Two Consortium Representatives
One DACM Representative

Additional information on the Implementation Team's responsibilities, areas of focus, and operating procedures can be found in the Implementation Plan document.

ROLES AND RESPONSIBILITIES OF OTHER KEY PLAYERS

Summarized below are the roles and responsibilities of other key players:

Functional Boards

- Identify critical knowledge and skills requirements for career fields.
- Specify requirements for performance support systems.
- Provide functional experts for validation of the technical content.

Directors of Acquisition Career Management (DACMS)

- Oversee timely and effective implementation of the Technology-Based Education and Training Program.
- Ensure that target learners have access to required technology-based courses.
- Track course registrations through new technology-based systems.
- Support efforts to market technology-based courses.

Consortium Members

- Assign instructors to course development teams.
- Provide instructors to facilitate the delivery of technology-based education and training.
- Ensure and assess learning.
- Provide course updates.

PROGRAM RISKS AND RISK REDUCTION STRATEGIES

DAU has identified the potential risks associated with achieving each program metric and developed strategies for minimizing those risks. The following tables summarize the risks and strategies.

Metric: Standard Operating Procedures and Systems Infrastructure Implemented

Risk: DAU is developing courses using emerging Web technologies. These technologies are evolving rapidly. A balance must be struck between standardizing procedures and systems and allowing for adaptation of these emerging technologies.

Strategy: To minimize risk, DAU has researched best practices followed by industry leaders, universities, and other Government agencies. (See the Technology-Based Education and Training Implementation Plan for a summary of this research.) DAU will base its standard operating procedures and systems on these best practices. In addition, DAU will institute a continuous improvement process to monitor procedures and systems implementation. DAU will assess the procedures and systems at least once each quarter. In addition, lessons learned and performance data will be collected for each course transition effort. Improvements to procedures and systems will be made on an as-needed basis.

Metric: Number of Courses Offered Using Technology-Based Delivery

Risk: DAU is planning to migrate a minimum of four to five courses to technology-based instruction per quarter. Keeping concurrent efforts on schedule, and within budget, is a potential management risk.

Strategy: To minimize risk, DAU has established an Implementation Team. The Implementation Team will set up systems for overseeing concurrent course production. These systems will:

- Use rapid prototyping models to minimize risk by trying new techniques on small subsets of course materials.
- Include a central database of design tools to maximize the reuse of course elements.
- Assign functional experts and instructors to each team to ensure the integrity of the content as it is being developed.

PROGRAM RISKS AND RISK REDUCTION STRATEGIES (CONTINUED)

Metric: Number of Members of the Acquisition Community Completing Courses

Risk: There are two risks associated with achieving this metric. First, potential learners must be made aware that courses can be accessed using technology-based instruction. Second, systems must be in place to encourage learners to complete courses after they enroll in them.

Strategy: To minimize the first risk, DAU is implementing marketing techniques to communicate information about technology-based courses to potential target audiences. Second, to ensure a high course completion rate, DAU is:

- Developing an aggressive marketing campaign.
- Implementing automatic tracking of course completion rates, and personalized notices to remind learners about course completion timeframes.
- Developing supervisor tips for fostering technology-based learning in the workplace.
- Pilot testing all courses with representatives of the target population to ensure that instructional methods will engage learners and will motivate them to complete the courses.
- Providing a toll-free helpline to assist learners.

Metric: Average Cost per Learner per Course

Risk: The potential risk is that costs will be higher than anticipated.

Strategy: To minimize this risk, DAU:

- Has developed detailed cost schedules and tracking procedures for all course transition activities.
- Has created a strategy for financing curriculum transition efforts through reinvestment of savings gained from delivering courses in a technology-based mode.
- Has tested the reinvestment model on seven selected courses.
- Is establishing Memorandums of Understandings (MOUs) with other governmental organizations to capitalize on existing resources (e.g., video teletraining sites).
- Is outsourcing activities to obtain the best value.
- Is establishing a configuration management process for the review/approval of all proposed systems changes.

PROGRAM RISKS AND RISK REDUCTION STRATEGIES (CONTINUED)

Metric: Evaluation of Reaction, Learning, and On-the-Job Behaviors

Risk: The potential risk is that evaluation data are not available for determining if learning has occurred.

Strategy: To minimize this risk, DAU is implementing formative and summative evaluation processes based on the Kirkpatrick Four-Level Evaluation Model. DAU will:

- Measure reaction (Level 1), learning (Level 2), and on-the-job behaviors (Level 3) for all technology-based courses.
- Measure organizational results (Level 4) for the entire program.
- Develop action tracking systems and follow up on all evaluation results that suggest the need for improvements.

RESOURCE MANAGEMENT

OVERALL STRATEGY

The overall resource management strategy for implementing this Plan is to capitalize on existing human and financial resources. This section summarizes how DAU plans to manage these resources.

HUMAN RESOURCES

Studies of successful distance learning projects consistently stress the importance of training and supporting instructors while they transition from classroom to technology-based instruction. DAU will establish systems to select, train, and support instructors.

Listed below are sample strategies that DAU will use to prepare administrative staff and instructors for technology-based delivery of courses:

- Guides: Guides will contain step-by-step instruction on how to use the new technologies.
- Workshops: Workshops will be offered to introduce and demonstrate the use of the new technologies.
- Coaching: Coaching will be conducted by contracted personnel. Course transition efforts will include tasks for supporting instructors during the first offering of a course and on an as-needed basis after that.
- Web-Based Instructor Resources: DAU will create a Web site where instructors can learn more about technology-based instruction by downloading documents, exchanging information, and accessing other technology-based training sites.
- Information Push Systems: DAU will employ "push systems" for sending information/messages to administrative staff and instructors based on the topic areas taught or the types of technology used. (Example: Pointcast™ news distribution on the Web.)

FINANCIAL RESOURCES

Most technology-based training programs require a significant up-front investment in technologies to accommodate course deliveries. These startup costs range from satellite uplinks and downlinks to the procurement of customized Web servers and user or learner platforms. DAU's program, however, will take advantage of a vast video teletraining network, existing consortium computer resources, and computer systems available to the acquisition workforce. Course design will optimize these existing delivery resources and avoid large startup costs traditionally associated with these types of programs.

By virtue of the accelerated schedule outlined in the Technology-Based Education and Training Implementation Plan, DAU has the unique potential to reinvest resources planned for classroom delivery to support the transition of classroom-based training to technology-based delivery.

This "reinvestment" approach is unique because the majority of Government-initiated distance education programs take years to realize quantifiable cost savings/cost avoidance.

DAU's expected course loadings for acquisition training exceed the normal Government training environment. Because DAU provides training to an unusually large number of individuals per course, the rate of return on each converted course can be realized within 12 months. However, this return is dependent upon two key factors: (1) cost and time to develop each converted course, and (2) learner throughput for the courses.

Therefore, it is safe to assume that a successful reinvestment strategy can be adopted that focuses on the quantifiable dollars associated with cost avoidance derived from reduced and/or eliminated learner and instructor travel and per diem. DAU will use the cost avoidance to expand the University's course transition capabilities and technological infrastructure to deliver more training (increasing capacity 15 percent per year) while maintaining level program funding.

REINVESTMENT STRATEGY

DAU will use the following reinvestment strategy:

- DAU will use current FY 97 budget resources to begin the conversion of FY 97 and FY 98 courses. The initial course(s) will be used to examine the effectiveness of the proposed course delivery scenarios and provide a baseline for required personnel requirements and expected costs associated with these delivery alternatives. During this evaluation period, the classroom-based alternatives will still be offered to accommodate requirements that precede the complete transition of these courses to technology-based delivery.
- Upon completion of this evaluation period, DAU will have compiled sufficient cost data (and conversion time estimates) to develop individual course comparison scenarios, along with an accurate conversion schedule for the remainder of DAU courses. These comparison models will be used to extrapolate the expected delivery costs (DAU funded) over the outstanding DAU courses per fiscal year.
- The current DAU POM request for FY 99 and FY 00 has sufficient resources to cover the delivery of converted FY 97 and FY 98 technology-based courses and the conversion of the remaining courses from FY 99 through FY 01.
- Once the aforementioned model for technology-based courses has been refined and validated, the course conversion "waterfall" will be revised to enable DAU to use projected classroom-based budgets in FY 99, and the out-years for technology-based course conversion and delivery requirements.

DAU is confident that the returns associated with this program will more than justify the startup costs required for its inception.

SYSTEMS INFRASTRUCTURE MANAGEMENT

SYSTEMS INFRASTRUCTURE MANAGEMENT

OVERALL STRATEGY

DAU will centrally manage a single, integrated systems infrastructure to support technology-based education and training requirements. Training and education requirements will drive the design of the systems infrastructure.

OPERATING PRACTICES

DAU will develop the proposed systems architecture in accordance with DoD and industry standards for open systems, interoperability, and reuse. The architecture will be based on the following key system development concepts:

- Interoperability: DAU will ensure interoperability through compliance with DoD Technical Architecture for Information Management (TAFIM) and Joint Technical Architecture (JTA) strategies.
- Commercial-Off-The-Shelf (COTS) Products: DAU will maximize the use of COTS and Nondevelopmental Items as required by the DoD 5000 series directives and instructions.
- Software Reuse: DAU will create a database to allow for reuse of cross-cutting content elements, programming code, graphics, and other elements that can be used in the majority of courses.
- Common Data and Object Environments: DAU will comply with the common data and object environments initiatives.
- Disciplined Systems Development and Rapid Prototyping Development Methodologies: DAU will strike a balance between disciplined systems development and rapid prototyping development methodologies. Existing task order contracts will be used to speed the process and ensure fair competition at best value.

DAU will not attempt to develop new in-house telecommunications or systems support infrastructure, but will obtain such services from existing Government or commercial providers.

Recognizing the rapid advances in technology, DAU will plan for evaluating and integrating technologies as they mature, avoiding investments that will likely be overtaken before recovering their costs.

ATTACHMENT A

EFFECTIVENESS OF DISTANCE LEARNING

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

The following studies on the effectiveness of Distance learning were compiled by Thomas L. Russell, North Carolina State University, Director, Office of Instructional Telecommunications.

Date, Author, Study Title	Finding
1996 Garson, G. D. The Political Economy of Online Education. (unpublished paper) North Carolina State University.	"Studies of computer-mediated education in university settings do not find they 'speed up' learning or make students 'perform better.' Typically, evaluation studies find no difference with traditional education."
1996 Goldberg, M. W. CALOS: First Results From an Experiment in Computer-Aided Learning. University of British Columbia, Canada.	"Students that had access to only WWW-based material or the lectures performed roughly the same. It is encouraging that it seems possible for a WWW-based offering to be as effective as a traditional lecture-based course."
1996 McClure, P. A. Technology Plans and Measurable Outcomes. Educom Review. (May/June) Vol. 31, No. 3, 29-30.	"One reason why online education is 'supposed' to be less expensive education in the minds of many administrators is because evaluation studies do not show it to be pedagogically more effective..."
1996 Moore, M., and Kearsky, G. Research on Effectiveness. Chapter 4-Distance Education: A Systems View. Wadsworth Publishing, ISBN 0-534-26496-4.	"Comparing the achievement of learners (as measured by grades, test scores, retention, job performance) who are taught at a distance and those taught in face-to-face classes is a line of research going back more than 50 years. The usual finding in these comparison studies is that there are no significant differences between learning in the two different environments, regardless of the nature of the content, the educational level of the students, or the media involved...reasonable to conclude (1) there is sufficient evidence to support the idea that classroom instruction is the optimum delivery method; (2) instruction at a distance can be as effective in bringing about learning as classroom instruction; (3) the absence of face-to-face contact is not in itself detrimental to the learning process; and (4) what makes any course good or poor is a consequence of how well it is designed, delivered, and conducted, not whether the students are face-to-face or at a distance."
1996 Wilson, D. L. Self-Paced Studies. Chronicle of Higher Education, Vol. XLII, No. 21 (Feb. 2) A19-A20.	"Grades and performance of the online learners proved neither better nor worse on the average than traditional section students."
1996 Witherspoon, J. P. A "2+2" Baccalaureate Program Using Interactive Video. DEOSNEWS, Vol. 6, No. 6, ISSN 1062-9416. Pennsylvania State University.	"...the average grades of Fountain Valley classes were marginally to half-a-grade better than those of their campus-bound counterparts."
1995 Barry, M., and Runyan, G. A Review of Distance-Learning Studies in the U. S. Military. The American Journal of Distance Education, 9(3): 37-47.0	"All studies in the table reported no significant differences between resident and distant groups. It appears from the studies reviewed here that student achievement in distance learning courses is comparable to student achievement in resident courses...Studies conducted in military settings tend to show no significant difference in achievement between distance learners and resident learners..."
1995 Dexter, D. J. Student Performance Based Outcomes of Televised Interactive Community College Distance Education. Doctoral dissertation, Colorado State University.	"There is no significant difference between the campus-based students and the distance learners in terms of final course grades."
1995 Hiltz, S. R. Impacts of College-Level Courses via Asynchronous Learning Networks: Focus on Students. Sloan Conference on Asynchronous Learning Networks. Philadelphia.	"In looking at how interesting the course content was, the differences among delivery modes are not significant...results [grades] support the hypothesis of equal or better performance. Some preliminary results for all courses showed no significant differences...Once again, as for the combined results, there are no statistically significant differences..."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1995 Hodge-Hardin, S. L. Interactive Television in the Classroom: A Comparison of Student Math Achievement Among Three Instructional Settings. Doctoral dissertation, East Tennessee State University.	"Results showed no significant difference in math achievement among the three groups. There were also no differences in student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site..."
1995 McCleary, I. D., and Egan, M. W. Program Design and Evaluation: Two-Way Interactive Television. Video-Based Telecommunication in Distance Education, Pennsylvania State University, Readings in Distance Education, Number 4.	"...off-campus students were compared to on-campus students...Neither group was significantly different from the other on their pre-test performance. The same is true of both groups on the objective post-test measure. The t-test revealed no significant difference between the groups..."
1995 Sorensen, C. K. Evaluation of Two-Way Interactive Television for Community College Instruction. ACEC Conference, Ames, Iowa.	"...there are generally no differences in achievement between students in traditional classes and those in distance-delivered classes, or between distance students at remote sites and those at origination sites where a teacher is present."
1995 Souder, W. E. The Effectiveness of Traditional Vs. Satellite Delivery in Three Management of Technology Master's Degree Programs. Video-Based Telecommunication in Distance Education, Pennsylvania State University, Readings in Distance Education, Number 4.	"This study has shown that distance learners can perform as well as or better than traditional learners in management of technology master's degree programs, as measured by exams, term papers, and homework assignments."
1994 Flaskerud, G. The Effectiveness of an Interactive Video Network IVN Extension Workshop. DEOSNEWS, Vol. 4, No. 9, ISSN 1062-9406, Pennsylvania State University.	"Participants in the IVN workshop learned marketing concepts as well as those in the regular workshop."
1994 Gerhing, G. A Degree Program Offered Entirely On-Line: Does It Work? Tel-Ed '94 Conference Proceedings, pp. 104-106.	"...the on-line education programs at the University of Phoenix are proving to be equally as effective (and in many cases, more so) as the real-time classes taught on campus."
1994 McGreal, R. Comparison of the Attitudes of Learners Taking Audiographic Teleconferencing Courses in Secondary Schools in Northern Ontario. Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, pp. 11-23.	"The results of this study support the original hypothesis that there would be no significant difference among the students taking distance education courses...there really is no significant difference between the remote and non-remote groups."
1994 Scheiderman, K. Respiratory Therapy Technician Program: Evaluation of Technical Program. California College of Health Sciences, unpublished.	"...89% of the employers considered the performance of CCHS [primarily print-based] graduates to be the 'same' or 'better' than that of graduates of other programs [classroom-based]."
1994 Schlosser, C. A., and Anderson, M. L. Distance Education: Review of the Literature. Research Institute for Studies in Education, Iowa State University.	"...students learn equally well from lessons delivered with any medium, face-to-face or at a distance...hundreds of media comparison studies that indicated, unequivocally, that there is no inherent significant difference in the educational effectiveness of media...Further comparison of the effectiveness was not needed. The specific medium does not matter...Students learning at a distance have the potential to learn just as much and as well as students taught traditionally."
1994 Threlkeld, R., and Brzoska, K. Research in Distance Education. Distance Education: Strategies and Tools. Educational Technology Publications.	"Studies of media preference are common in comparing face-to-face instruction to telephone-based instruction. In general, there are no differences in preferred media. When faced with the option of traveling to a live class, students prefer learning by telephone."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1993 Jurasek, K. A. Distance Education via Compressed Video: An Evaluation of the Attitudes and Perceptions of Students and Instructors. Iowa State University.	"...students at the distance classroom had a significantly more positive attitude than students at the origination site. There was no significant difference in the average grades earned by the students at the two sites."
1993 Knott, T. D. Distance Education Effectiveness. U. S. Distance Learning Association ED Journal, J7-16.	"...in the French IV class...no difference was found between the traditionally taught students and all DE students...There was no difference found in mean final grade between the traditional class and the DE-primary class."
1993 Souder, W. F. The Effectiveness of Traditional Vs. Satellite Delivery in Three Management of Technology Master's Degree Programs. The American Journal of Distance Education, Vol. 7, No. 1.	"This study has shown that distance learners can perform as well as or better than traditional learners in management of technology master's degree programs, as measured by exams, term papers, and homework assignments. Thus, this study adds to the burgeoning evidence that distance learners should not be viewed as disadvantaged..."
1992 Bauer, J. W., and Rezabek, L. L. The Effects of Two-Way Visual Contact on Student Verbal Interactions During Teleconferenced Instruction. AECT National Convention Research and Theory Proceedings.	"...no significant differences between the audio and the traditional [face-to-face] group in either restricted or expanded thinking questions...no significant differences between the audio and the audio-video group, or between the audio and the traditional group."
1992 Dillon, C. and Walsh, S. The Comparative Learning Benefit of One-Way and Two-Way Videoconferencing for Distance Education Applications. The University of Oklahoma.	"Few found significant differences in learning benefit..."
1992 Figueroa, M. L. Understanding Students Approaches to Learning in University Traditional and Distance Education Courses. Journal of Distance Education, 7(3), 15-28.	"There were no significant differences in reading achievement between the two groups."
1992 Jones, J. I., Simonson, M., Kemis, M., and Sorensen, C. Distance Education: A Cost Analysis. Iowa State University of Science and Technology.	"...distance education is effective when effectiveness is measured by achievement, by attitudes, and by cost-effectiveness...Student achievement in interactive distance education classes has been as good as or better than that of students learning from traditional teaching methods."
1992 Olcott, D. Instructional Television: A Review of Selected Evaluation Research. Oregon State University.	"Most studies comparing traditional classroom instruction with ITV have shown no significant differences in student achievement...instructional television appears to produce comparable academic achievement to traditional classroom instruction."
1992 Russell, T. L. Television's Indelible Impact on Distance Education: What We Should Have Learned From Comparative Research. Research in Distance Education.	"No matter how it is produced, how it is delivered, whether or not it is interactive, low-tech or high-tech, students learn equally well with each technology and learn as well as their on-campus, face-to-face counterparts..."
1992 Simpson, H., Pugh, H., and Parchman, S. Use of Video-Teletraining to Deliver Hands-on Training: Concept Test and Evaluation. TN-92-14. San Diego, CA: Navy Personnel R&D Center.	"...observations indicated that the learning processes occurring in the off-line laboratories were very similar to those in traditional resident laboratories."
1992 Thompson, A. D., Simonson, M. R., and Hargrave, C. P. Educational Technology: A Review of the Research. Associate for Educational Communications and Technology.	"Many media practitioners who had a professional interest in demonstrating the superiority of mediated instruction were stunned to read that research indicated that instructional media were not inherently 'better'...The literature clearly demonstrates that for every study that shows the new medium is better, another study shows the opposite."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1992 Williams, A. T. The Efficacy of Premium Broadband Video Conferencing in Teaching Cardiac Arrest Skills: A Comparative Study. Columbia Pacific University, Dissertation.	"Statistical analysis of the data showed that there was no difference in performance of the two skills between those who received in-class instruction and those who received instruction through video conferencing."
1991 Cheng, H. C., Lehman, J., and Armstrong, P. Comparison of Performance and Attitude in Traditional and Computer Conferencing Classes. The American Journal of Distance Education. 5(3), 51-64.	"...no significant differences between the treatment groups examined in the study. Further, at the end of the course, there were no significant differences among the groups in attitude toward the subject matter."
1991 Dillon, C. L., and Harwell, D. Tele-communications in Oklahoma: A Summary of Research. The University of Oklahoma.	"Historically, the introduction of each new medium of instruction is accompanied by research designed to determine if it is as effective as traditional instruction...Each new wave of comparison studies brings similar results--no significant difference..."
1991 Gehlauf, D. N., Shatz, M. A., and Frye, T. W. Faculty Perceptions of Interactive Instructional Strategies: Implications for Training. The American Journal of Distance Education, Vol. 5, No. 3.	"One of the first issues to be investigated was whether students were getting the same education in the technologically delivered classes as in the traditional classroom...there are no significant differences in academic performance for students in the two settings."
1991 Johnson, J. L. Evaluation Report of the Community College of Maine Interactive Television System. University of Southern Maine.	"No significant differences ($p<.01$) were found between the students in origination sites and those in receive sites."
1991 McNeill, B. J., and Nelson, K. R. Meta-analysis of Interactive Video Instruction: A Ten-Year Review of Achievement Effects. Journal of Computer-Based Instruction, Vol. 18, No. 1, pp. 1-6.	"...there were no significant differences in achievement between students using only videodisc and students using videotape-based units."
1991 Phelps, R., et al. Effectiveness and Costs of Distance Education Using Computer-Mediated Communication. American Journal of Distance Education, 5(3), 7-19.	"Test scores, completion rates, student perceptions, and costs were compared to resident training, and results of instruction by CMC were found to be no different from that of resident instruction."
1991 Simpson, H., Pugh, H., and Parchman, S. Empirical Comparison of Alternative Video Training Technologies. Technical Report-92-3. San Diego, CA: Navy Personnel R&D Center.	"...student achievement was higher and comparable to live instruction with fully-interactive VTT...Student achievement was not higher in the two-way video class when compared to the one-way video class..."
1991 Thomas, R., and Hooper, E. Simulations: An Opportunity We Are Missing. Journal of Research on Computing in Education, Vol. 13, No. 4, pp. 497-513.	"...no difference in knowledge gained when compared to other methods of instruction."
1990 Cennamo, K. S. Squenye, and Smith, P. L. Can Interactive Video Overcome the "Couch Potato" Syndrome? AECT National Conversion Research and Theory Proceedings.	"...although it was predicted that learners would perceive that they invested more mental effort in processing the IV lesson than in processing the ITV lessons and TV lesson, and that learners would perceive that they invested more mental effort in processing an ITV lesson than in processing a TV lesson, there was no significant difference between the three groups."
1990 Hahn, H. Distributed Training for the Reserve Component: Remote Delivery Using Asynchronous Computer Conferencing. Report No. 2Q263743A794. Boise, ID: Army Research Institute.	"The evaluation found that...there were no differences between resident and ACC students on objective performance measures."

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Date, Author, Study Title	Finding
1990 Huffington, D. D., and Young, R. C. Integrating Video Technology into Independent Study: The Missouri Experience. The American Journal of Distance Education, Vol. 4, No. 2.	"...research continues to indicate there is no significant difference in what students learn whether they are in large or small classes, participating in telephone or video conferences, or studying alone in an independent study course."
1990 Kabat, E. J., and Friedel, J. N. The Eastern Iowa Community College Districts Televised Interactive Education Evaluation Report. Eastern Iowa Community College.	"The students at the remote sites received grades an average of .01 lower on a 4.0 scale than students at the origination sites. This was not a significant difference."
1990 Moore, M. G., and Thompson, M. M. The Effects of Distance Learning: A Summary of Literature. American Center for the Study of Distance Education.	"...good teaching by teleconferencing and other distance education techniques has results no better or worse than good teaching by any other method, including good face-to-face instruction."
1990 Rupinski, T. and Stoloff, P. An Evaluation of Navy Video Teletraining (VTT). CRM 90-36. Alexandria, VA: Center for Naval Analyses.	"There were very small, nonsignificant differences in course outcomes between the two groups, and there were no differences between the two groups in the number of course failures."
1990 Simpson, H., Pugh, H., and Parchman, S. A Two-Point Video-Teletraining System: Design, Development, and Evaluation. Navy Personnel R&D Center. Technical Report-90-5.	"Student performance on examinations was comparable in originating and remote classrooms, and student attitudes were similar at both sites."
1990 Stone, H. R. Candid Classroom ITV: An Evaluation of its Effectiveness. University of Delaware.	"Color seems not to increase learning...Students like a talk-back system but seem to learn no more with it than without it...No learning advantage has been demonstrated for 'professional' or 'artistic' production techniques...Eye contact seems not to contribute to learning...adding humor adds not to learning effect."
1990 Stone, H. R. Does Interactivity Matter in Video-Based Off-Campus Graduate Engineering Education? University of Delaware.	"...students do not suffer from the inability to talk back to faculty in real time...distance students perform better where they control not only where but when learning occurs."
1989 Barker, B. O., Frisbie, G., and Patrick, K. R. Broadening the Definition of Distance Education in Light of the New Telecommunications Technologies. The American Journal of Distance Education, Vol. 3, No. 1	"The research base, though scant at present, suggests the students who study via telecommunicated distance education approaches perform as well as their counterparts in traditional classroom settings..."
1989 Barker, B. O. and Platten, M. R. Student Perceptions on the Effectiveness of College Credit Courses Taught via Satellite. Readings in Distance Learning and Instruction No. 2, 104-110, Pennsylvania State University.	"Most students (53.8 percent) felt that televised instruction via satellite maintained their interest as well as did regular classroom instruction."
1989 Beare, P. L. The Comparative Effectiveness of Videotape, Audiotape, and Telelectures in Delivering Continuing Teacher Education. Moorhead State University.	"...individual instructional formats had little effect on student achievement or course evaluation...the lack of individual opportunity to interact on a daily basis with the instructor did not reduce student learning..."
1989 Chute, A. G., Balthazar, and Poston, C. O. Learning from Teletraining. Readings in Distance Learning and Instruction No. 2, 87-96, Pennsylvania State University.	"Students appeared to learn from the teletraining mode as well, if not better, than they did from the face-to-face mode."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1989 Gibbons, M. The Effectiveness of Technology Applied to Instruction: A Summary of the Research Literature. San Diego State University.	"...listed a half-dozen studies from [the 1930's and 1940's] which demonstrated no difference in student performance between those who listened to radio lectures and those who attended live classes."
1989 Grimes, P. W., Nielsen, J. E., and Niss, J. F. The Performance of Nonresident Students in the "Economics U$A" Telecourse. Readings in Distance Learning. Pennsylvania State University.	"...no significant differences were uncovered between either of the distant learner groups exposed to 'Economics U$A' and the control group."
1989 Ritchie, H., and Newby, J. Classroom Lecture/Discussion vs. Live Televised Instruction: A Comparison of Effects on Student Performance, Attitudes, and Interaction. American Journal of Distance Education.	"Studies completed during the past three decades indicate performances by students on achievement-type tests are similar regardless of instruction proximity...comparable performance can be expected from students."
1989 Russell, T. L. A Study of Foreign Language Instruction Via TOTE. Research in Distance Education, Vol. 1, No. 2, pp. 2-4.	"The students who saw the lessons on tape felt they did not learn the material as well as they would have in a traditional classroom setting. However, their test scores were not significantly different from those of the traditionally taught group."
1989 Seigel, A. E., and Davis, C. Delivering Undergraduate Engineering Courses on Television: How Do Grades Compare? University of Maryland.	"...the grade performance of the on-campus student is statistically indistinguishable from that of the off-campus TV student."
1989 Silvernail, D. L., and Johnson, J. L. Evaluative Research Studies of the University of Southern Maine Instructional Television System. University of Maine.	"...no significant differences in the achievement or attitudes of students receiving live classroom instruction and those receiving some type of televised instruction. Overall, no significant differences were found in the achievement levels...no significant differences in end of course grades between ITV and non-ITV classes...no significant differences in grades between the origination site and remote sites...students do equally well in courses taught over the ITV system as they do in a traditional classroom setting. Students learned course content generally well...Students receiving their course instruction by means of interactive television learned as well as students in a traditional classroom."
1989 Timmons, K. Educational Effectiveness of Various Adjuncts to Printed Study Material in Distance Education. Research in Distance Education, Vol. 1, No. 3, pp. 12-13.	"...an examination of the students' grades indicates no apparent advantage at all..."
1989 Whittington, N. Is Instructional Television Educationally Effective? A Research Review. Readings in Principles of Distance Education. Pennsylvania State University.	"...students taking courses via television achieve, in most cases, as well as students taking courses via traditional methods...Television is a technological device for transmitting communication and has no intrinsic effect, for good or ill, on student achievement. Effective instructional design and techniques are the crucial elements in student achievement whether instruction is delivered by television or by traditional means."
1988 Annenberg/CPB Project. Teaching Telecourses: Opportunities and Options: How Do Telecourses Compare to Other Types of Courses? PBS Adult Learning Service.	"...television-delivered instruction is equivalent to traditional, classroom-based instruction in its learning effectiveness... outcomes of the television courses are roughly equivalent to the outcomes of the comparable traditional courses...telecourse students performed better than or as well as non-telecourse students...a third of the faculty studied reported that Annenberg/CPB courses retained more students than traditionally taught courses. Another third said that retention was equal to traditionally taught courses."
1988 Atherton, J., and Buriak, P. Video Simulation as a Computer Applications Instructional Technique for Professionals and Students. Journal of Vocational Education Research, Vol. 13, No. 3, pp. 59-71.	"...video can be just as effective or more effective than other forms of instruction."

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Date, Author, Study Title	Finding
1988 Chute, A. G., Balthazar, L. B., and Posten, C. O. Learning from Teletraining. The American Journal of Distance Education: Vol. 2,. No. 3.	"Students appeared to learn from the teletraining mode as well as, if not better than, they did from the face-to-face mode."
1988 Gibbons, J. F. Tutored Videotape Instruction: An Approach to Educational Productivity. Stanford University.	"...the combined data show that the ITV method was at least as good as live instruction."
1988 Grimes, P. W., Neilsen, J. E., and Niss, J. F. The Performance of Nonresident Students in the "Economics U$A" Telecourse. The American Journal of Distance Education, Vol. 2, No. 2, pp. 36-41.	"...neither distant learner group experienced a significant change in their attitudes towards economics. No significant difference is found between the off-campus and long distance groups...no significant differences were uncovered between either of the distance learner groups exposed to 'Economics U$A' and the control group."
1988 Stone, H. R. Variations in Characteristics and Performance Between On-campus and Video-Based Off-Campus Engineering Graduate Students. University of Massachusetts.	"...no significant differences between on-campus and off-campus degree students regarding performance."
1988 Woodward, D. B. Teaching Instructional Media Utilization: Video Tape Package vs. Classroom Instruction. Illinois State University.	"...there was no statistically significant difference between the mean score achieved by students who received instruction from the Instructional Media Utilization Package and...by students who received only classroom instruction..."
1987 Grimes, P., Niss, J., and Nielsen, J. An Evaluation of Learning and Attitudinal Changes of Students in Economics U$A. The Annenberg/CPB Project.	"...for the spring semester, no significant differences in learning are found between the groups..."
1987 Kataoka, H. C. Long Distance Language Learning: The Second Year of Televised Japanese. North Carolina State University.	"...no statistically significant differences... students can learn Japanese as well as students in regular classes...performance is not lower."
1987 Kitchen, W. Education and Telecommunications: Partners in-Progress. Testimony before the U.S. Senate Committee on Labor and Human Services.	"...in a wide range of elective programming provided from 1983 to 1986, no statistically significant differences in achievement were found between students taking courses traditionally or by..."
1987 Murray, J. and Heil, M. Project Evaluation: 1986-87 Pennsylvania Teleteaching Project. Mansfield University, Pennsylvania.	"...the pattern of scores across seven courses justifies the conclusion that receiving (distant) students do at least as well and perhaps better than their sending-site counterparts and nonteleteaching control students."
1987 Valore, L., and Diehl, G. The Effectiveness and Acceptance of Home Study. National Home Study Council, Washington, DC.	"All of the research published since 1920 has indicated that correspondence students perform just as well as, and in most cases better than, their classroom counterparts."
1987 Whittington, N. Is Instructional Television Educationally Effective? A Research Review. The American Journal of Distance Education, 1, 47-57.	"...a three-year study...which compared the performance of full-time Stanford students and students obtaining instruction via the live, interactive ITFS system...16,652 students taking traditional, on-campus instruction scored a mean GPA of 3.40, while 1,771 students taking live, interactive video instruction have a mean GPA of 3.39. In addition...Stanford is using tutored video instruction...Research indicates that this method...also promoted equivalent student achievement..."
1986 Bates, A. W. Learning From Television. Open Learning for Adults, Longmans.	"...students can learn just as well, if not better from television...There is a good deal of research which suggests that content may be learned just as well through television as through print."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1986 Bates, A., and Couell, R. N. Distance Education: An Overview. Northwest Regional Educational Laboratory	"...students learn as well in distance education programs as they do in regular programs..."
1986 Bergin, V. Letter to Nil Whittingham. June 5 (unpublished).	"Television instruction is neither superior nor inferior to traditional classroom presentation. The question is not which medium works best, but what is effective instruction?"
1986 Carvalho, G. F., Graham, G. H., and Gray, M. A. An Evaluation of Telecourse Delivery of a Basic Management Class: A Comparison of Performance and Attitudes With Day and Evening Sections. Wichita State University and Beech Aircraft Corporation.	"The study concluded that while telecourse students might not have liked some aspects of the telecourse as well as the more traditional delivery modes, they performed as well as day and evening students on traditional tests."
1986 Chute, A., Hulick, M., Messmer, C., and Hancock, P. Teletraining in the Corporate Environment. Tele-conferencing and Electronic Communications. University of Wisconsin-Madison.	"...research conducted by Sales and Marketing Education Division has shown teletraining was as effective and in some cases more effective than face-to-face instruction. In general, there were no significant differences between the amount of information students learned in classes that were teletrained and the amount they learned in face-to-face instruction."
1986 Creswell, K. W. Does Instructional TV Make the Grade? Journal of Educational Television, Vol. 12, No. 1.	"Were the 'live' and 'TV' groups different in course performance or attitudes? The data...indicate that they were not; statistical tests (t-tests, Chi-square) applied to all...items showed no significant differences (at the p is less than or equal to .05 level) between the responses in 'live' sections and 'TV' sections...When we conduct telephone surveys in several courses and statistical tests on the data and find no significant difference between 'TV' and 'live' groups, we conclude that students can learn as well as they learn with professors present."
1986 Kataoka, H. C. Televised Japanese Language Program: The First Year. Foreign Language Annuals, Vol.19, No. 6.	"...students taught under TJaLP can learn as well as those taught in the regular classroom...no statistical significance emerged between the two groups..."
1986 LaRose, R. Adoption of Telecourses: The Adoption and Utilization of Annenberg/CPB Project Telecourses. The ELRA Group, Incorporated.	"...faculty reported that telecourse students performed better than or as well as non-telecourse students..."
1986 Pease, P. The Evaluation of the TIIN Network's Satellite-Based Education Network: A Preliminary Report. TI-IN Network. 3 June.	"...student achievement has been consistent with that experienced in traditional classes."
1986 Stone, H. Non-Tutored Video Instruction in Graduate Engineering Education. University of Massachusetts.	"There are no significant differences in graduate performance between traditional and video-based degree students..."
1985 Ellis, L., and Mathis, D. College Students Learning From Televised versus Conventional Classroom Lectures: A Controlled Experiment.	"Learning under the two lectures modes was statistically equivalent and class attendance was unaffected by the mode of instruction."
1985 Kirkhorn, J. A Teletraining Study: Student Learning Preferences. University of Wisconsin-Madison.	"...no significant difference in student satisfaction between a telephone-based course and a face-to-face course."
1985 Michael, W. B., and Knapp-Lee, L. Evaluating Learning in Telecourses. Coastline Community College.	"In some instances students recorded gains larger than the on-campus students; however, in general the results indicated no significant differences."

Date, Author, Study Title	Finding
1985 Nelson, R. N. Two-Way Microwave Transmission Consolidates, Improves Education. NASSP Bulletin.	"Teachers and administrators in Iowa's two-way interactive television (TWIT) project found no significant differences between TWIT classes and other sections of the same class taught face-to-face by the same teacher."
1985 Research Communications, Ltd. Research on Student Uses of the Annenberg/CPB Telecourses for the Fall of 1984. Annenberg/CPB Project.	"...performance level equaled that experienced in other on-campus courses. This finding held true for students in both two-year and four-year institutions."
1985 Robinson, R. An Investigation of Technical Innovation: Interactive T.V. AECT.	"...students in remote interactive television classes achieved as well on post-tests as did students in traditional classrooms."
1985 Robinson, R. S., Collins, K. M., and West, P. C. Share Advanced [Secondary] Courses With Other Schools via Interactive Cable Television. Northern Illinois University.	"Students in interactive-television classes achieved as well on the post-test as did students in 'live' classrooms."
1984 Denton, J. J., et al. An Examination of Instructional Strategies Used With Two-Way Television. Texas A and M University.	"...achievement scores were at least as high on materials presented over two-way television as they were on materials presented with the professor present in the classroom."
1984 Kuramoto, A. Teleconferencing for Nurses: Evaluating Its Effectiveness. Teleconferencing and Electronic Communications III. University of Wisconsin-Madison.	"Nurses had comparable achievement regardless of the medium."
1984 Partin, G., and Atkins, E. Teaching Via the Electronic Blackboard. Teleconferencing and Electronic Communications IV 68-73.	"...student achievement was comparable to achievement resulting from resident instruction."
1984 Weingand, D. E. Telecommunications and the Traditional Classroom: A Study of the Delivery of Education. University of Wisconsin.	"...1) there is no evidence to support the idea that face-to-face instruction is the optimum delivery method, 2) Instruction by teleconferencing can facilitate learning as well as or better than can classroom instruction, and 3) the absence of face-to-face contact is not detrimental to the learning process."
1984 Winn, W. Why Media? Instructional Innovator.	"Media are primarily for the delivery and storage of information. Media do not directly determine the type or amount of learning. It is the messages themselves, which are carried by media, that are critical factors for producing achievement or changing attitudes."
1984 Zigerell, J. Distance Education: An Information Age Approach to Adult Education. ERIC Clearinghouse on Adult, Career, and Vocational Education. Columbus, Ohio.	"...performance does not significantly differ between telecourse and classroom students taking equivalent courses."
1983 Allen, M. L. Paper Presented to ASEE at the Arizona State Interactive Video Experience. Arizona State University.	"...overall [24 years], there was no statistically significant difference in the academic performance of the two groups..."
1983 Clark, R. E. Reconsidering Research on Learning from Media. University of Southern California.	"...there are no learning benefits to be gained from employing any specific medium to deliver instruction...The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievements any more than the truck that delivers our groceries causes changes in our nutrition."
1983 Holdampf, B. A. Innovative Associate Degree Nursing Program-Remote Area. Department of Occupational Education and Technology, Texas Education Agency.	"...audioconferencing with an existing nursing school...and videotapes of...classes were combined...there were also no significant differences in course grades or scores on national nursing tests..."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1983 Kurh, J. Student Evaluation of Instructional Teleconferencing. University of Wisconsin.	"...academic achievement and student satisfaction in teleconferencing classes is equal to that of students in resident classes."
1983 Smith, J. Evaluation of the Telecourse Program at Saddleback College: Student Retention and Academic Achievement. Nova University.	"In each instance no difference was found in the amount of learning that occurred between telecourse students and on-campus students."
1982 Christopher, G. R. The Air Force Institute of Technology–the Air Force Reaches Out Through Media: An Update. University of Wisconsin.	"...students learned at least as well as resident students..."
1982 Montgomerie, T. C. Telidon Distance Education Field Trial. Telidon Project Evaluation, Alberta, Canada, Department of Education, Planning and Research Branch, November. 207pp	"Telidon instruction was as effective as the traditional correspondence and conventional in-school instruction."
1981 Cohen, P., Ebeling, B., and Kulik, J. A Meta-Analysis of Outcome Studies of Visual-Based Instruction. Educational Communications and Technology Journal.	"...students learned slightly more from visual-based instruction than from traditional teaching, but there was typically no difference between the two groups in regard to course completion, student attitudes, or the correlation between attitudes and achievement."
1981 Sakamoto, T. Innovations in Higher Education. Research Institute for Higher Education, Hiroshima University.	"...conducted a series of televised lectures on identical subject matter in a similar situation...(1) with the professor's face on one TV monitor and two types of instructional material on the other two...(2) with any two TV images frozen...and any single moving image...(3) with no professor's face but two types of instructional material on two TV monitors...There were no significant differences in academic achievement among the three groups."
1980 Wilkenson, G. L. Media in Instruction: 60 Years of Research. AECT and NAVA.	"The results of several decades of research...can be summed up as "no significant difference."
1979 Orlansky, S., and String, J. Cost-Effectiveness of Computer-Based Education in Military Training. IDA Paper, Science, and Technical Division, Institute for Defense Analysis, Arlington, VA.	"...overall difference in achievement had no practical significance because no significant difference in achievement was found in thirty-two studies."
1979 Sakamoto, T. Utilization of Educational Technology in Higher Education of Japan. The Pursuit of Excellence in Higher Education, Keinyong University, Korea.	"In terms of academic achievement there were no significant differences between the groups."
1978 Kelly, J. T., and Anadam, K. Nationwide Prime-Time Television in Higher Education. International Journal of Instructional Media.	"...remote mediated learning combined with appropriate contact with live instructors and peers, can be at least as effective and significantly less costly per unit than traditional lecture modes."
1978 Miller, G. R., and Fontes, N. E. Video Technology and the Legal Powers. Beverly Hills, CA, Sage.	"...no significant differences between information retention of jurors when television was used to present testimony instead of direct live observation."
1977 Crow, M. L. Teaching on Television. Faculty Development Resource Center, University of Texas.	"...participants may favor a 'live' teacher in their classroom, although research studies point out that both the televised image and live presentation are equally effective."

ATTACHMENT A: EFFECTIVENESS OF DISTANCE LEARNING

Date, Author, Study Title	Finding
1977 Saloman, G., and Clark, R. E. Reexamining the Methodology of Research on Media and Technology in Education. Review of Educational Research.	"Studies have consistently reported achievement on performance tests was similar regardless of the medium used...media (face-to-face versus television) were not significant factors on achievement..."
1977 Schramm, W. Big Media Little Media. Sage.	"...media are mere vehicles that deliver instruction but do not influence student achievement..."
1977 Wood, D. M., and Wylie, D. G. Educational Telecommunications. Belmont, CA, Wadsworth.	"...there is no statistical basis to conclude that TV itself affects learning situations or grades positively or negatively..."
1977 Dambrot, F. General Psychology Over Closed-Circuit Television. Audio-Visual Communication Review, Vol. 20, No. 2.	A pilot study compared 18 control students enrolled in a regular closed-circuit television class of General Psychology with 18 experimental students who were assigned to an independent study section of General Psychology. Students in independent study viewed the TV lectures at the tape stations at their discretion and took course examinations when they felt prepared. The results indicated no significant difference in course achievement or attitude between the two methods of course preparation. Interaction effects between independent study vs. closed-circuit TV and three levels of scholastic ability were also nonsignificant.
1976 Gordon, G. N. Classroom Television: New Frontiers in ITV-Research and the Wonder Drug: NSD. Communication Arts Books, Hastings House.	"The kind of research that characterizes most of the documents purporting to examine ITV...show no significant difference between courses taught over television and equivalent courses given to live matched groups."
1976 Macken, E. Home-Based Education. U. S. Department of Health, Education, and Welfare. Washington, DC.	"...sixty-seven American studies of the effectiveness of correspondence education at the college, technical, and high school level...there was no significant difference in learning outcomes between correspondence and conventional study."
1975 Chu, G., and Schramm, W. Learning From Television: What the Research Says. ERIC ED 109 985.	"...an experimental study with 80 college students to test the effect of feedback on learning. No difference was found in learning and retention among four treatments...There can no longer be any real doubt that adults learn a great amount from instructional television...The effectiveness of television has now been demonstrated...in many parts of the world, in developing as well as industrialized countries...and with a great variety of subject matter and methods...No difference was found in learning and retention..."
1974 Thorman, J. H., and Amb, T. The Video Tape Presentation versus the "Live" Presentation: Better, Worse or the Same? Moorhead State College.	"...the students learned the same amount, as measured by test performance, whether they were taught by the videotape-discussion method or by the lecture-discussion method..."
1973 Childs, G. B. Correspondence Study: Concepts and Comments. University of Nebraska.	"...it is clear that students who receive instruction by correspondence study achieve at least as well as students who study by other means including classroom instruction, programmed instruction, and television or by use of kinescopes or videotape...students in correspondence courses either matched or slightly exceeded the achievement of students taking the same courses via different formats. Instructional methodology seemed to make no significant difference."
1972 Anderson, C. M. In Search of a Visual Rhetoric for Instructional Television. Audio-Visual Communication Review, Vol. 10, No. 1.	"Administration decisions on the use of television seem to have assigned a positive evaluation to the same no significant differences, deducing that, if television can perform as well as conventional instruction, it holds great potential for solving some of the logistical and personnel problems in education."
1972 Schram, W. Quality in Instructional Television: What Research Says About ITV. University Press of Hawaii.	"Students like a 'talkback' system, but seem to learn no more with it than without it...No learning advantage has been demonstrated for 'professional' or 'artistic' production techniques..."

Date, Author, Study Title	Finding
1971 Johnson, L. Cable Television and Higher Education: Two Contrasting Experiences. ERIC	"...students can learn about as well from television as from classroom instruction..."
1970 Forsythe, R. Instructional Radio. An Evaluation of Instructional Technology.	"Experimental studies comparing radio teaching with other means or media have found radio as effective as the so-called 'conventional methods. Even though radio has been criticized for being only an audio medium, studies have shown that visual elements in learning are not uniformly important."
1970 Gordon, G. N. Classroom Television: New Frontiers in ITV. New York: Hastings House.	"...participants may favor a 'live' teacher in their classroom, although research studies point out that both the televised image and live presentation are equally effective."
1969 Davis, R., Johnson, C., and Dietrich, J. Students Attitudes, Motivations Shown to Influence Reception to Televised Lectures. College and University Business, Vol. 46, No. 5, pp. 59-63.	"The overall distribution of grades for students who saw lectures live was not significantly different from students who saw lectures on TV."
1969 Dubin, R., and Hedley, R. A. The Medium May Be Related to the Message: University of Oregon, pp. 2 and 16.	"We started with some promising results that led us to the conclusion that face-to-face instruction is better than televised instruction. However, when we turned attention to variations in the television medium we discovered that the apparent reason for the face-to-face instructional superiority lay in the distinct inferiority of two-way television instruction. When we limited attention only to one-way television instruction it was not demonstrably inferior to face-to-face teaching. We found nothing in our analysis by teaching methods and subject matter taught that led us to a conclusion other than there was no measurable difference between the two media."
1969 Kittross, J. M. The Farther Vision-Educational Television Today: Chapter 14 Meaningful Research in ETV. University of Wisconsin.	"To our initial surprise and later disappointment we found over and over again that there were 'no significant differences' (NSD) between television and conventional instruction."
1969 Madson, M. L. Methods, Including CCTV, of Presenting Introductory Biology: Their "Affect" on College Freshmen. Minnesota University.	"There was no difference in achievement between groups."
1969 Twyford, L. C. Educational Communications Media. Encyclopedia of Educational Research, p. 370.	"...in almost 90 percent of the comparisons there were no substantial differences in achievement or information gain [with media] over conventional instruction...Students learn about as well irrespective of the methods employed."
1968 Boswell, J. J., Mocker, D. W., and Hamlin, W. C. Telelecture: An Experiment in Remote Teaching. Adult Leadership.	"Pre- and post-test results showed no significant differences in mastery of content; student course evaluations showed no difference in student attitudes."
1968 Chu, G. C., and Schramm, W. Learning from Television: What the Research Says. National Association of Educational Broadcasters.	"...there is no statistical basis to conclude that TV itself affects learning situations or grades positively or negatively..."
1968 Mielke, K. Questioning the Questions of ETV Research. Educational Broadcasting Review.	"Media comparison studies, regardless of media employed, tend to result in no significant differences..."
1968 Thornton, J. W., and Brown, J. W. New Media and College Teaching: Instructional Television. NEA: Department of Audiovisual Instruction.	"There is no longer any question as to the efficacy of television in extending and improving instruction in higher education. In nearly every situation where it has been tried and carefully evaluated, results show that it permits learning equal to and not rarely superior to that achieved under traditional classroom practices."

SECTION 4: SYSTEMS INFRASTRUCTURE

PURPOSE

The purpose of this section is to document existing technology-based education and training resources available to DAU, evaluate and quantify additional systems required to deliver future courses, and describe a high-level implementation approach.

The curriculum analysis section of this plan indicates a requirement to utilize a variety of media to meet the mix of Level One, Two, and Three courses. These media include video teletraining and a hybrid combination of desktop multimedia and online Web-based training. Therefore, system resources are defined as those resources required to develop, deliver, and maintain the courses and to provide learner tracking and support.

OVERALL STRATEGY

DAU will centrally manage a single, integrated systems infrastructure to support technology-based education and training requirements. Education and training requirements will drive the design of the systems infrastructure.

CONTENTS

This section includes the following topics:

- Applicable Policy and Guidance
- Current State Systems
  - ◊ Connectivity
  - ◊ Consortium Capabilities
- Future State Systems
- Implementation Strategy

This section includes the following three attachments:

- Attachment 4-1: Summary of Current DAU VTT Resources
- Attachment 4-2: Federal Government Video Teletraining Database
- Attachment 4-3: Industry Trends

Applicable Policy and Guidance

SYSTEM ARCHITECTURE CONCEPTS

The proposed DAU systems architecture will be developed and implemented in accordance with DoD and industry standards for open systems, interoperability, and reuse. The architecture described in this section emphasizes the following key system development concepts:

- Tailoring of DoD and industry standards related to information systems acquisition to support commercial acquisition of Information Technology (IT).
- Emphasis on interoperability through compliance with DoD Technical Architecture for Information Management (TAFIM) and Joint Technical Architecture (JTA) strategies.
- Maximization of the use of commercial-off-the-shelf (COTS) and nondevelopmental items (NDI), as required by the DoD 5000 series directives and instructions.
- Development of software reuse strategies and repositories.
- Compliance with common data environment (CDE) initiatives.
- Application of disciplined systems development and rapid prototyping development methodologies.

STANDARDS AND GUIDANCE

Where applicable, the following standards and guidance will guide DAU infrastructure implementation:

- Information Technology Reform Act of 1996
- Technical Architecture for Information Management (TAFIM)
- DoD Joint Technical Architecture (JTA)
- DoD Information Infrastructure Common Operating Environment (COE)
- DoD 5000.2R—Mandatory Procedures for Major Defense Acquisition Program and Major Automated Information System (MAIS) programs
- MIL-STD 498—Software Engineering
- Federal Information Processing Standards
- Aviation Industry Computer-Based Training (CBT) Committee Interoperability Standards

SECTION 4: SYSTEMS INFRASTRUCTURE

Current State Systems—Connectivity

INTRODUCTION

This section documents the existing infrastructure available to support technology-based education and training. It is divided into DAU and Consortium school resources. Currently, there is a variety of distributed training resources within the DoD and DAU's Consortium schools. These include correspondence, limited multimedia, and video teletraining.

DAU concluded an infrastructure study in July 1996 that assessed the resources available to the Consortium schools. The data in this section are drawn from the infrastructure study and interviews with DAU personnel. The intent of this section is to provide a high-level picture of existing resources rather than reiterating significant portions of the infrastructure study.

DAU TO CONSORTIUM SCHOOL CONNECTIVITY

E-mail is the primary resource utilized between DAU and the Consortium schools. There is a Consortium-wide e-mail system that allows DAU personnel to communicate with the various Consortium schools. DAU uses Digital Equipment Corporation's "Teamlinks Information Manager" e-mail software. The Consortium schools use a diverse range of e-mail packages. However, text messaging and data file attachments can be sent between the Consortium schools and DAU.

DIGITAL CONNECTIVITY

Currently, there is no large-scale wide area network (WAN) connecting DAU to the Consortium schools. To support technology-based education and training, future requirements may evolve for a high-bandwidth network between DAU and the Consortium schools. Specific systems requirements will be developed after course development, distribution, and maintenance scenarios are clearly defined.

Current State Systems—Consortium Capabilities

CONSORTIUM FUNCTIONAL CAPABILITIES

The ability of the existing Consortium school systems to support technology-based education and training will be a function of their system infrastructure, planned course media mix, and course design.

Table 4-1 documents the functional capabilities reported by each of the Consortium schools in the July 1996 Infrastructure Report. The capabilities reported are stand-alone multimedia, Web via Internet, and VTT. (Note: The gray cells indicate that the data were not available for the infrastructure study.)

FUNCTIONAL CAPABILITIES MATRIX

Table 4-1. Technology-Based Education and Training Functional Capabilities Matrix

Consortium Member School	Stand-Alone Multimedia Systems	Web Delivery	VTT (1V/2A) Delivery	VTT (1V/2A) Receive	VTT (2V/2A)
AFIT	88	Yes	Yes	Yes	Yes
ALMC	10	Yes	Yes	Yes	Yes
AMEC	24	No	No	No	No
DCAI	0	No	No	No	No
DSMC		Yes	Yes	Yes	Yes
IRMC	121	No	No	No	No
LTF	20	No	No	No	No
NCAT					
NFCTC	23	Yes	No	Yes	No
NPS	0	Yes	No	No	No
OASN	0				

Current State Systems—Consortium Capabilities

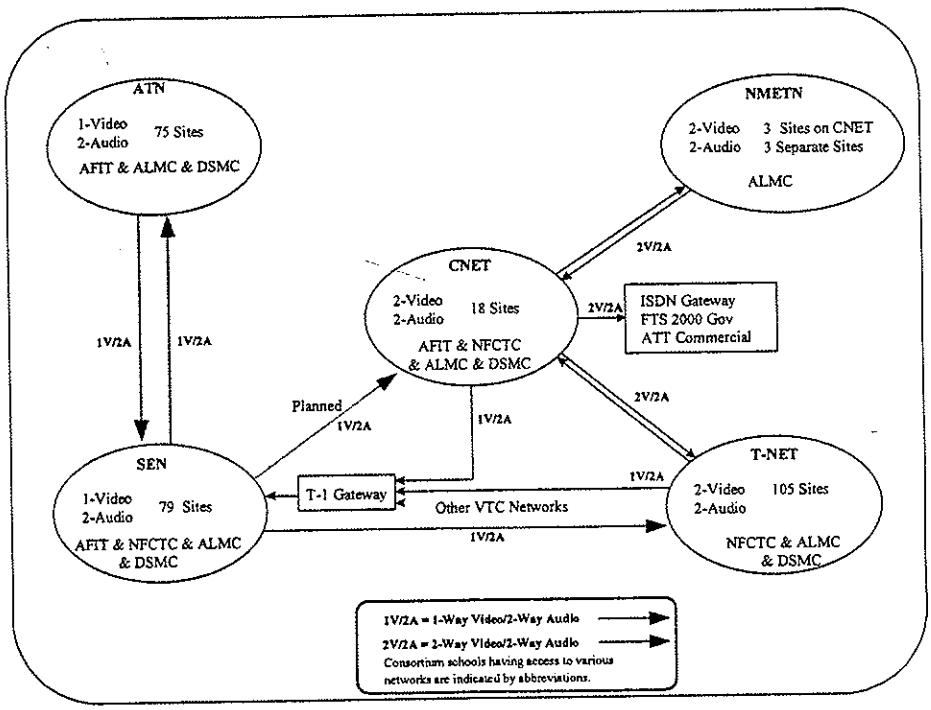
VIDEO TELETRAINING RESOURCES

There are multiple VTT networks within DAU. Attachment 4-1 documents some of DAU's major VTT networks and their individual capabilities.

VTT GATEWAYS

Figure 4-1 graphically depicts the system gateways between the DoD VTT networks.

Figure 4-1. DoD Video Teletraining Connectivity Diagram



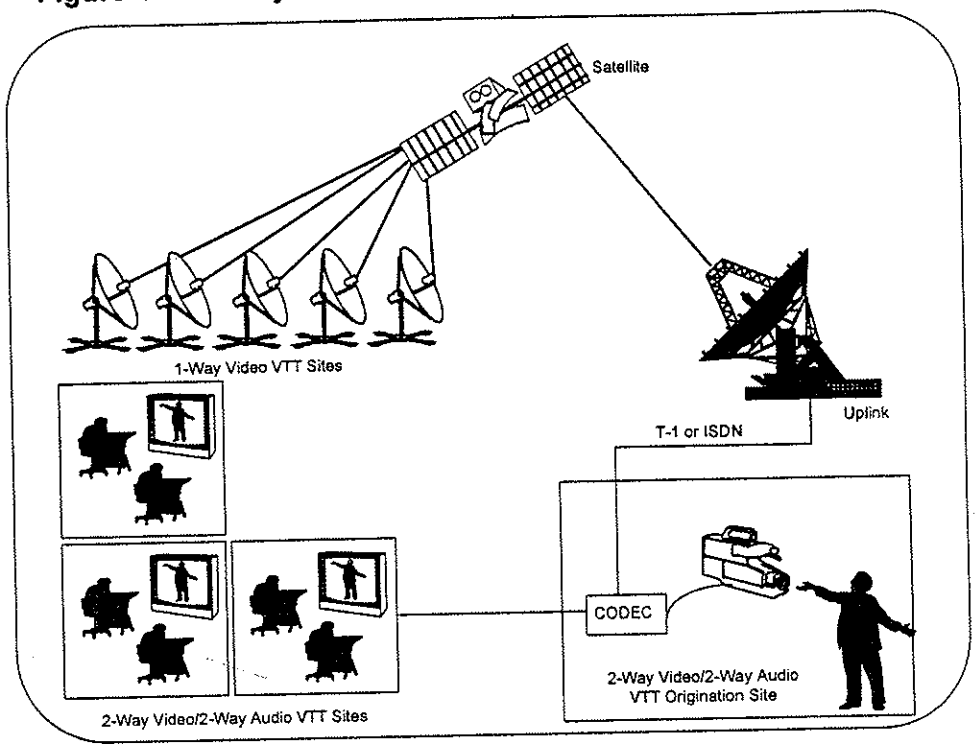
It is important to note that there can never be full interoperability between a 1-way video VTT system and a 2-way video VTT system because the 1-way video VTT supports video in only one direction. The video connectivity provided by the system gateways depicted in Figures 4-2 and 4-3 on the following pages can expand the reach and flexibility of a VTT but never allow for full interoperability between 1-way video and 2-way video systems. These considerations will have to be factored into the course design process.

Current State Systems—Consortium Capabilities

EXTENDING THE REACH OF VTT VIA GATEWAYS

Figure 4-2 depicts a scenario in which 2-way video/2-way audio VTT courses could be sent to numerous 1-way video/2-way audio Government receive sites. There are approximately 750 Government 1-way video/2-way audio VTT receive sites nationwide.

Figure 4-2. 1-Way Video Gateway to 2-Way Video Receive Sites



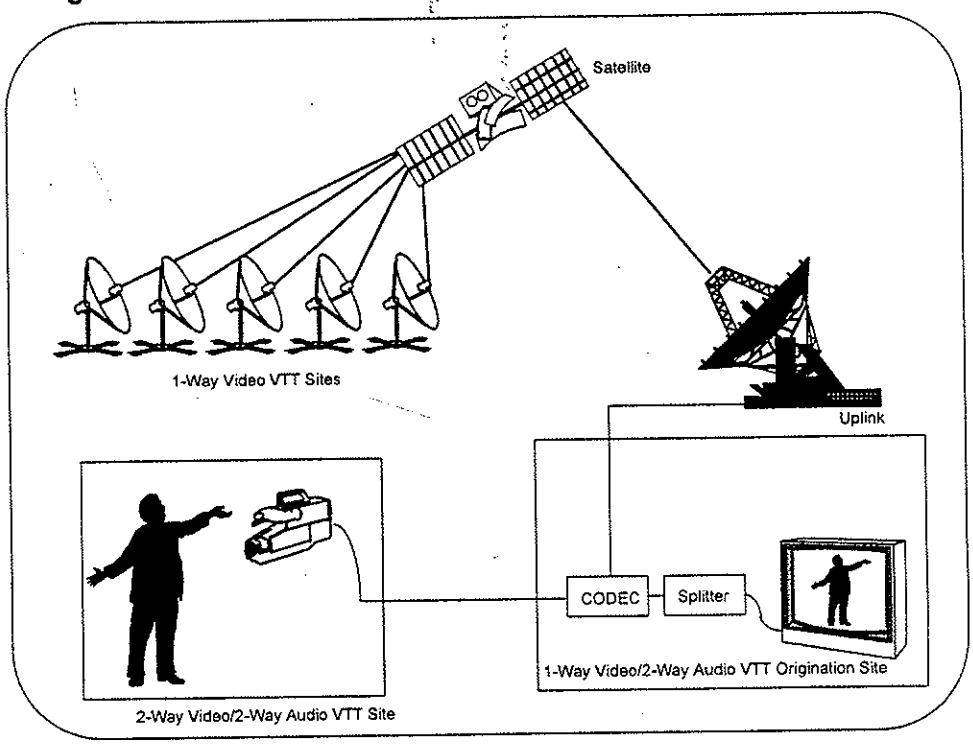
2-way video/2-way audio VTT networks such as CNET and TNET can send courses to over 750 (1-way video) receive sites nationwide.

Current State Systems—Consortium Capabilities

ACCESSING REMOTE INSTRUCTORS VIA VTT GATEWAYS

Figure 4-3 depicts a scenario in which a 1-way video/2-way audio teletraining network can patch in remote instructors from any CNET, TNET, or other Government VTT site. These configuration options increase flexibility in VTT course design.

Figure 4-3. Remote Instructor Access via 2-Way Video Gateway



MULTIMEDIA AND WEB-BASED COMPUTER RESOURCES

The curriculum analysis in Section 2 documents a requirement to deliver hybrid Web-based/multimedia courses. For the purpose of this plan, multimedia is defined as text, graphics, audio, animation, and video.

Digital video can be integrated into course materials via hardware or software encoding and decoding. DoD policy does not support the procurement of hardware (e.g., MPEG) encoding equipment for multimedia purposes. Additionally, software-based digital video puts a significant strain on the personal computer (PC) and typically requires a minimum configuration of Pentium 133 MHz with 6X CD-ROM. Course design techniques will have to minimize the use of digital video unless off-line download techniques are used.

Current State Systems—Consortium Capabilities

EXISTING PCS SUPPORT ONLY LOW-END MULTIMEDIA

Table 4-2 summarizes the IBM-compatible PCs reported by the Consortium schools. (Note: The gray cells indicate that data were not available for the infrastructure study.)

Table 4-2. Consortium School Computer Resources

Member	# of PCs	# With CD-ROM	% With CD-ROM	# With Audio	% With Audio	# Multimedia Enabled	% Multimedia Enabled
AFIT	273	168	61.5	88	32.2	88	32.2
ALMC	614	349	56.8	10	1.6	10	1.6
AMEC	125	24	19.2	24	19.2	24	19.2
DCAI	50	0	0.0	0	0.0	0	0.0
DSMC	537	537	100.0				
NCAT*	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IRMC	121	121	100.0	121	100.0	121	100.0
LTF	50	35	70.0	20	40.0	20	40.0
NFCTC	58	22	37.9	23	39.7	23	39.7
NPS	54	0	0.0	0	0.0	0	0.0
OASN	12	0	0.0	0	0.0	0	0.0

* NCAT leases computer resources to support individual course offerings.

Only 15 percent of the 1,894 PCs reported by the Consortium schools are capable of playing CD-ROM-based multimedia courses with audio files. In light of the existing Consortium computer resources, the following guidance is provided for computer systems accessing future DAU on-line courses.

Minimum Recommended Platform: 486 Class PC, 16 MB RAM, 66 MHz, SVGA Graphics Card with supporting 14" monitor, 14.4 Kbps Modem, Hard Drive (minimum 85 MB free), & Keyboard/Mouse.

Recommended Future Platform: New platforms should be capable of supporting desktop audio and video conferencing through MMX-enable technology and include audio input device, video input device, speakers/headset jack, and T-1 line access to the Internet.

Current State Systems—Consortium Capabilities

Additional investment in VTT resources is not required at this time. Calculations of learner accessibility must be made on a course-by-course basis to ensure that DAU end users have access to VTT receive sites within local driving range of their work sites. The accessibility study can begin after a careful load projection for VTT courses has been completed.

- The curriculum analysis provided in Section 2 outlines a mix of technology-based education and training delivery to meet DAU's Level One, Two, and Three courses. In particular, Section 2 documents a projection for significant Web-based/CD-ROM training.
- The next topic, Future State Systems, discusses the functional requirements and systems considerations involved in supporting technology-based education and training.

Current State Systems—Consortium Capabilities

EXISTING CONSORTIUM NETWORK CONNECTIVITY

The infrastructure study indicated that all Consortium schools have their computers networked on a local area network (LAN). In addition, e-mail support is available across the 12 Consortium schools and at DAU. Currently, 9 of the 12 schools report access to the Web/Internet; however, the availability on an individual PC level was unreported.

Table 4-3. Consortium School Network Connectivity

Member	Network Available	E-Mail	Operate BBS	Web Access
AFIT	Yes	Yes	Yes	Yes
ALMC	Yes	Yes		Yes
AMEC	Yes	Yes		Yes
DCAI	Yes	Yes	Yes	
DSMC	Yes	Yes	Yes	Yes
IRMC	Yes	Yes		Yes
LTF	Yes	Yes		
NCAT	Yes	Yes		Yes
NFCTC	Yes	Yes		Yes
NPS	Yes	Yes		Yes
OASN				

CURRENT STATE SUMMARY

- As outlined previously, significant VTT resources are available to the DAU that can be configured to support 1-way video/2-way audio and 2-way video/2-way audio requirements. There are currently 126 2-way video/2-way audio compatible VTT sites. Additionally, both CNET and TNET have gateways to other Government 2-way video VTT sites.
- In addition to the 154 1-way video/2-way audio downlinks reported as part of ATN and SEN, there are over 750 compatible 1-way video/2-way audio downlinks Government-wide. (Note: A copy of the Government-wide video teletraining database is included in Attachment 4-2.) With proper logistical planning and coordination, these VTT resources are available to support DAU's Technology-Based Education and Training Program.

Future State Systems

INTRODUCTION

Given the VTT resources available to DAU and the requirement for significant Web-based/CD-ROM training, this subsection discusses how DAU can take advantage of Web technology to construct a *distributed, seamlessly integrated, virtual schoolhouse* that provides *production, delivery, maintenance,* and *accounting* functionality to *appropriate authorized users*. In order to ensure a common point of reference, it is necessary to provide background information regarding possible uses of Web technology.

DISTRIBUTED WEB TECHNOLOGY

- Distributed: Web technology provides a mechanism for constructing networks of interconnected components that are scalable from the LAN to the Internet. Through the use of existing safeguards, these components may be deployed locally (that is, completely behind a firewall) as a separate physical Intranet, as a virtual Intranet to an authorized subset of the Web community, or globally on the Internet.

SEAMLESSLY INTEGRATED WEB TECHNOLOGY

- Seamlessly Integrated: The Web was designed on open standards in order to maximize compatibility and interoperability. While most Web tool manufacturers do offer unique system extensions in order to differentiate their products from the pack, nearly all are realistic enough to support a lowest common denominator that provides significant functionality. Careful component selection and well-thought-out course design specifications can ensure that all system users—from the learner to the course developer to the system administrator—can operate in an environment that, from their point of view, provides the richest possible experience.

VIRTUAL SCHOOLHOUSE

- Virtual Schoolhouse: This is the collective name for the process of delivering formal instruction via the Internet using text posted on-line, e-mail, newsgroups, chat, and like mechanisms. The virtual schoolhouse concept is being exercised successfully around the world, and its popularity is growing exponentially.

Future State Systems

PRODUCTION

- Production: Two different production issues will be addressed: The conversion of existing courses to a format that is suitable for delivery in the virtual classroom and the development of new courses in the future.

MAINTENANCE

- Maintenance: Courses change. While Web-based courses are easier to update and enhance than traditional training media, the mechanisms through which these updates and enhancements are applied must be determined.

DELIVERY

- Delivery: Quality computer-based training delivery requires leading-edge Web technology, which places the minimal compliance level on the learner's playback environment. The optimal bandwidth for use with computer-based training delivery is 128 Kbps. Currently, high-speed bandwidth connections are not widely available to the general public. Using a lower bandwidth will result in slower response time, causing learners to experience fewer on-line interactions. These potential bandwidth limitations can be mitigated through the use of various strategies. Strategies such as proxy servers, hybrid CD-ROMs, caching techniques, or downloading courses prior to start for slower links can help to overcome bandwidth limitations. Application of these techniques will support the use of bandwidths as low as 28.8 Kbps or 14.4 Kbps.

ACCOUNTING

- Accounting: The ease with which Web-based technology can interface with legacy applications and databases enables automation of the collection and maintenance of all user records, from registration to progress reports to certification.

Future State Systems

APPROPRIATE AUTHORIZED USERS

- Appropriate Authorized Users: Even though it is reasonable for the DAU Web site and virtual schoolhouse to take advantage of the economies and efficiencies of Web technology, many of the components of the site should not be made available to the Web community at large. In fact, most sections of the DAU Web presence should behave as a virtual private network (VPN) that can be accessed only by users who have been granted permission to use the data stored therein.

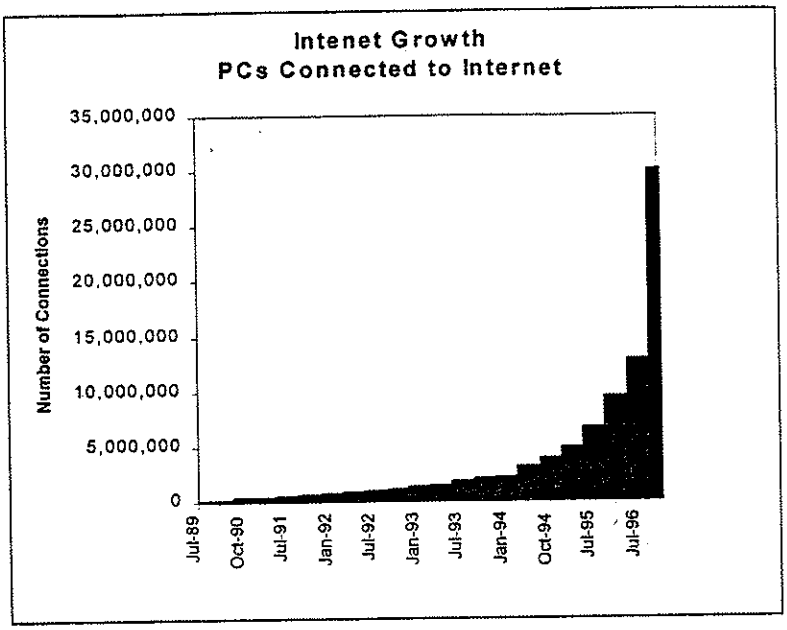
The Web provides the tools and supporting services that DAU needs to produce and maintain a new generation of computer-based education and training, to deliver these courses to authorized users, and to track learner progress through the course of instruction offered by the DAU virtual schoolhouse.

INTERNET GROWTH

The existence of the Internet offers DAU the potential of providing ubiquitous connectivity to the acquisition population anywhere, anytime. The growth of the Internet has been truly phenomenal and continues to exceed experts' projections. Figures 4-4 and 4-5 on the following page document the exponential growth of the Internet over the last 7 years.

PCs CONNECTED TO THE INTERNET

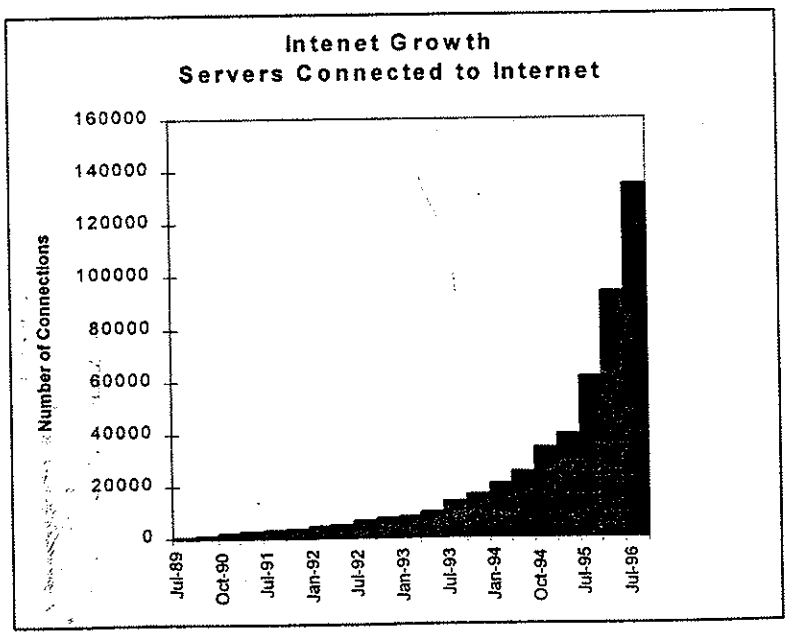
Figure 4-4. PCs Connected to Internet



INTERNET SERVERS

The growth of servers, which host the content that makes the Internet a rich source of information, has also increased dramatically.

Figure 4-5. Servers Supporting the Internet



Future State Systems

WEB-BASED TRAINING

Web-based training is an innovative approach to technology-based education and training, in which computer-based training is transformed by the capabilities of the World Wide Web, the Internet, and Intranets. Web-based training presents course content in a structure allowing self-directed, self-paced instruction on any topic.

> Web-based training is an ideal vehicle for delivering training to learners anywhere in the world at anytime. Advances in computer network technology and improvements in bandwidth will continuously increase multimedia capabilities and access.

With today's tools, instructional designers can produce highly effective courses to meet the training needs of a diverse population. Web browsers now support animation, chat and conferencing, and real-time audio and video.

ADVANTAGES OF WEB-BASED TRAINING

The advantages of Web-based training are numerous:

- Easy delivery of training to students via the existing Internet.
- Multiplatform capabilities (Windows, Mac, UNIX).
- Easy updating of content.
- Controllable access: By user ID, number of accesses, date/time of access.
- Options for installations on private networks for security or greater bandwidth.
- Options to link with other training systems.

DISADVANTAGES OF WEB-BASED TRAINING

There are, however, some disadvantages of Web-based training:

- Formatting of content in current browsers is limited.
- Bandwidth/browser limitations may restrict media design options.
- Limited bandwidth means slower performance for sound, video, and intense graphics.

To address these limitations, DAU is pioneering the use of lesson downloading and hybrid Web-based/CD-ROM course formats.

NETWORK CONNECTIVITY TO THE LEARNERS

Network connectivity between DAU and the learner population is a key requirement to support the Technology-Based Education and Training Program. The demographics of DAU's learner population make the network connection issue a major systems infrastructure consideration. The ability of DAU's learners to connect to the Internet at home or work via standard phone lines has a dramatic effect on the feasibility and cost of this initiative.

A number of network connection technologies are currently available, and new technologies are evolving daily. Table 4-4 provides an overview of selected transmission technologies and their availability.

NETWORKING TECHNOLOGIES

Table 4-4. Networking Technologies and Availability

Network Connection	Bandwidth	Geographic Availability
Standard Modem	14.4 or 28.8 Kbps	100% (standard phone lines)
ISDN (Integrated Switched Digital Network)	64 Kbps per channel bidirectional 24 channels = 1.54 MBps	100% metropolitan 35-50% rural
ADSL (Asynchronous Digital Subscriber Line)	1.5 MBps send 64 Kbps return	0% (available 2nd quarter, 1997)
Cable Modems	4 MBps Send	0% only R&D test beds (Only 10% of cable networks in America will support cable modems)

ADSL COULD DRASTICALLY CHANGE INTERNET ACCESS

The Asynchronous Digital Subscriber Line (ADSL) is a very promising emerging technology that could drastically change the face of the entire Internet Service Provider (ISP) industry. ADSL promises to provide Integrated Switched Digital Network (ISDN) speeds over standard phone lines. Utilizing standard phone lines is extremely attractive because the wiring infrastructure already exists nationwide.

Current product specification projections for ADSL are between 128 Kbps and 1.54 MBps outbound and 64 Kbps return between the ISP and the end user.

BANDWIDTH EFFECTS ON FILE TRANSFER TIMES

Table 4-5 illustrates the effect of network bandwidth on file transfer times for a 220 Kb file. Note that these data are representative of system performance with no additional load beyond a single user on the network. Although this is not a realistic scenario, it demonstrates the relative speeds of various network connections. These data are the result of tests at Bell Labs.

Table 4-5. Unloaded Network File Transfer Times

Network Connection	Bandwidth	Download Time (sec)	Times as Fast as a 28.8 Modem
Standard Modem	28.8 Kbps	60	1
ISDN	128 Kbps	8.8	6.8
ADSL	1.5 MBps	.7	85.7
Cable Modems	4 MBps	.4	150

EFFECTIVE BANDWIDTH REALITIES

There is significant confusion about the differences between effective bandwidth and component bandwidth. Effective bandwidth is the final bandwidth that the network provides the end user after all loading and bottlenecks are taken into account. This is in contrast to component bandwidth, which is the maximum bandwidth of an individual system such as a modem or a network card. When an individual uses a 28.8 modem to connect to the Internet, the modem is dedicated for the individual PC; thus there is no effective loading. But if a LAN with hundreds of users is connected to the Internet with a T1 circuit (1.54 MBps), an individual on the network will have an effective bandwidth connection to the Internet that is highly dependent on the load (i.e., the number of users).

Effective bandwidth drops dramatically when normal network loading is present. Table 4-6 compares file transfer times for a 5.4 MB file with both a nonloaded and a loaded network. These data are the result of tests at Bell Labs.

Table 4-6. Network Loading Effect on File Transfer Times

Network Connection Technology	Unloaded Download Time (min)	Loaded Download Time (min)	Performance Decrease
28.8 Modem	24.54	24.5	None
ADSL	.29	1.8	6.2 times slower
Cable Modems	.13	4.05	29.3 times slower

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EFFECTIVE BANDWIDTH REALITIES (CONTINUED)

Beyond Internet connection alternatives available to the general public, DAU may also pursue a DoD-based solution. Currently, initial requirements for a DoD-wide Global Combat Support System (GCSS) are under development. Based on early projections, this system might connect DAU with much of the learner population at their DoD work sites. The GCSS will be a high-bandwidth backbone comprising a combination of terrestrial and satellite transmission methods. Although this system may provide the learner connectivity that DAU requires, it will have to be evaluated against the flexibility that a non-site-specific solution (i.e., available via standard phone lines) provides.

COURSE DELIVERY OPTIONS AND CONSIDERATIONS

Interactive training can be created and delivered in a variety of different formats and technologies, each with its own strengths and limitations. Over the past few years, Internet and private Intranet-related technologies have taken center stage for training delivery as a result of the rapid expansion of network infrastructures. While these technologies have enabled huge advances in the remote delivery of education and training, there are complexities and constraints that must be taken into account during course deployment.

In general, there are four basic methods for the delivery of courses: Internet, private Intranet, local networks, and stand-alone media (sometimes described as packaged media such as diskette, CD-ROM, or other portable media). Depending on the requirements of a particular DAU course, a hybrid Web-based/CD-ROM approach may be used.

INTERNET DELIVERY

Internet delivery of courses is achieved by placing the course software on a server that is connected to the Internet so that anyone with an Internet connection can access the application. Such a connection could be through a private dial-up Internet account, an organization's internal LAN that is in turn connected to the Internet, or services such as America Online or CompuServe.

INTRANET DELIVERY

Intranet delivery uses the exact same software tools, browsers, and protocols that are used for Internet applications, but the server on which the courseware resides is connected only to specific private networks. These networks are usually configured to serve the needs of a particular organization in terms of speed, security, and access. Intranet users must connect to, or already be a part of, an existing private network. Access to outside networks (e.g., the Internet) may or may not be available in these cases.

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LOCAL NETWORK DELIVERY

Local networks consist of client systems connected to one or more central file servers. The main difference between local networks and Intranets is that local networks may or may not rely on Internet protocols (TCP/IP) and tools for the delivery of data from the server to the client. In these situations, client-server applications can exist in which portions of a course are executed by the server and portions by the client. Or, the server might simply be a data repository for courses that are fully executed by the client.

STAND-ALONE MEDIA DELIVERY

Stand-alone media include any portable storage media that can contain course content. These include diskette, CD-ROM, and very soon, DVD-ROM. Courses delivered by stand-alone media may consist of any type of software that will execute on the local system or can be the same as those delivered via the Internet, the Intranet, or LANs. Usually, stand-alone media provide a great deal more speed (bandwidth) than networks can provide; therefore, multimedia-rich applications are usually based on local stand-alone media.

CD-ROM DISTRIBUTION

Initially, some of the Web-based courses will be delivered in a Web-enabled/CD-ROM hybrid environment. This is due to current Internet limitations regarding bandwidth and network response time. To this end, packaged and/or stand-alone multimedia in the form of CD-ROMs will be required for courses that are multimedia intensive (e.g., extensive video), and/or for users who do not have Internet access. The CD-ROM may also "house" interface tools like the "branded" browsers discussed earlier.

As required, each learner will be supplied with CD-ROM packages prior to course initiation, in a fashion similar to receiving learner guides for VTT courses. Distribution of these CD-ROMs would be from the central registration facility. For learners with Internet access, changes in course content and/or annual course updates will be delivered via the Web-based course component. Configuration management (CM) of these course packages will be accomplished by the DAU Program Director.

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WEB-BASED COURSE PRODUCTION

Much of the existing body of DAU training materials has been shown to be appropriate for hybrid Web-based/CD-ROM delivery of training. Moreover, as the acquisition regulations that form the basis for the DAU curriculum are revised, these courses must evolve to keep pace. The relative ease with which Web-based training material can be adapted to meet this continuous need for change is a significant plus.

SHARED COURSE DEVELOPMENT AND MAINTENANCE ENVIRONMENTS

Sophisticated processes for course development, maintenance, and support will be required by the DAU virtual schoolhouse. This process will be a collaborative effort managed by the DAU Program Director and supported by course development contractors and instructors from the Consortium schools and Functional Board experts. Web technology is very well suited to this production and maintenance model.

Each course in the curriculum will be designed and developed in strict accordance with configuration management practices established by the Program Director.

CONSORTIUM-WIDE INTRANET

To support course development and maintenance, Consortium-wide connectivity will be established via an Intranet, a private subset of the Internet. This privacy may be enforced either by installing dedicated circuits among the member institutions or by using a well-thought-out security policy enforced by "firewall" technology. The completed and approved courses will be centrally managed and controlled.

DELIVERY SYSTEMS

A professional course delivery and maintenance capability will support one or more Web servers hosted on one or more NT or UNIX workstations. Server capacity will be scaled to course production schedules and user demand requirements.

INTEGRATED SERVER SUITES

Integrated Web server suites are highly recommended as the environment for developing the DAU virtual university. This architecture provides the highest quality Web server environment, is well integrated and relatively inexpensive, and provides most of the required services (except course and authoring software). It is therefore recommended that DAU work within the integrated Web server environment.

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INTEGRATED SERVER SUITE ENVIRONMENT

There are several software products available under an integrated server suite environment that can be purchased separately or together. These software packages typically include the following:

- Enterprise Server: Manages and publishes content and executes on-line applications to form the foundation of an Intranet.
- Catalog Server: Provides indexing, searching, and browsing of all the content and services on an Intranet.
- Certificate Server: Issues and manages public-key certificates and security keys for users and servers, making possible a highly secure Intranet.
- Directory Server: Provides a universal directory service for enterprise-wide management of user, access control, and server configuration information.
- Proxy Server: A high-performance Web server that replicates and filters content, improving performance, control of content, and network security.
- Messaging Server: Provides administration, scalability, security, performance, and remote connectivity.
- News Server: Facilitates secure groupware-style discussion groups that enable team collaboration and easy information sharing.

COURSE MAINTENANCE

A well-designed course delivery system will also meet the virtual schoolhouse's site maintenance needs. Web-based courses are relatively easy to modify. In the case of server-resident content, the responsible organization need only change the data on the host. In the case of CD-resident data, the responsible organization must place the corrected data on the host and also change all links to that data so that the links point to the host resident data instead of the outdated material on the CD. These changes will be invisible to learners who are completing the course across the Web.

Administering course maintenance activities requires significant planning. To this end, written policies and procedures will be developed by the Program Director.

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WEB-BASED COURSE DELIVERY AND ACCOUNTING

Three components come into play during the distribution of Web-based training materials. Two of these components—the server (host facility) and the client—are under DAU's control. The Internet Service Provider's (ISP's) responsiveness must be specified in contractual arrangements.

HOST FACILITY

The Web server(s) responsible for delivering the Web-based component of the course materials would reside at one or more host facilities. The host facilities are, from the learner's perspective, a single logical site; that is, all learner interaction is processed through a single Uniform Resource Locator (URL).

As currently envisioned, the course component of the virtual schoolhouse will be hosted at a commercial Web Server Provider. The course administrative database will be maintained on a separate DoD-managed server. As a backup, the virtual schoolhouse will be mirrored at a separate facility.

SECURITY AND COST

Security and cost perspectives make housing the production system at a facility designed from the ground up to host such operations the best option, and the volatility of technology makes leasing a better business choice than purchasing over the short term.

SYSTEM ADVANTAGES

Because all of the clients whose content is hosted at the Web Server Provider share infrastructure requirements, the following advantages can be expected:

- Server suites will be in place, current, and stable.
- Learners will enjoy higher speed Internet connectivity.
- A Webmaster and skilled System Administration staff will maintain the facility.
- Mirrored backup will ensure system integrity at all times.
- Twenty-four-hour-a-day, 7-day-a-week up-time can be guaranteed.

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ESTIMATED WEB COURSE PROFILE

A rough profile of DAU's initial Web courses has been developed using the current initiative to develop the Simplified Acquisition Procedures (SAP) Web-based course. Each SAP lesson is approximately 1 hour in length and currently has a compressed file size of approximately .5 MB. To allow for expansion in course design complexity, an estimated file size of 1 MB for a 1-hour lesson is assumed. Additionally, each course will have an HTML shell and course download resources that contain the course link maps. The shell is currently 3-4 MB, so 5 MB is assumed.

A course administration database will be required to maintain learner profiles, learner records, prerequisite information, percent completion, test scores, etc. For the purpose of this estimate, each learner is allocated 10 Kb for tracking files. The total file size of the learner tracking database is a function of the average user load. On average, the user load per course is estimated to be 500 learners. A key objective of technology-based training is to increase training opportunities, so an estimate of 1,000 learners per course will be used. Based on the above assumptions, the course size can be calculated as follows:

- Each Lesson (1 Hour) = **1 MB/Hr**.
- HTML Shell and Download Course Resources = **5 MB**.
- Learner Database Tracking Files = 10 Kb/Learner x 1,000 Learners/Course = **10 MB**.
- Average Course = 40 Hours = 40 x 1 MB of Files/Hr (40 MB) + 5 MB Shell + 10 MB Learner Database = **55 MB/Course**.
- Given the above, assume the average course size will be **70 MB**.

SYSTEM ADMINISTRATOR

Given an outsourced solution to host Web content, there will be a requirement for additional DAU technical personnel. It is envisioned that initially one full-time person will be required as a System Administrator. The System Administrator's responsibilities are described in Section 3.

YEARLY SERVER PROJECTIONS

There will be an increasing need for server capacity as DAU converts courses to Web-based training. Using the course projections provided in Section 2, server capacities are specified in the Action Plan that will be used by the Implementation Team.

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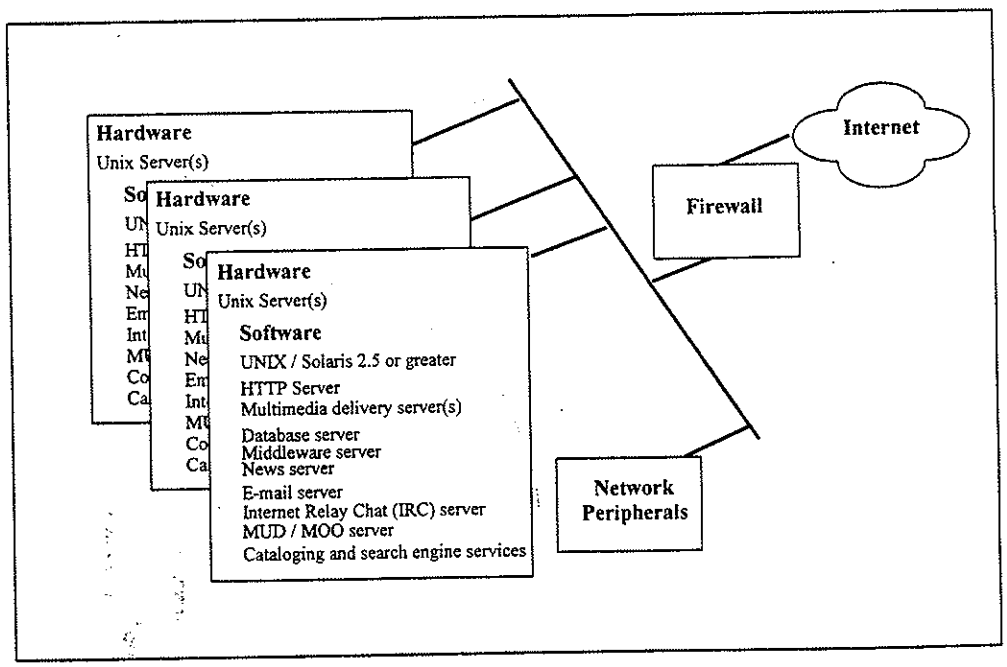
SERVER HARDWARE

A Web site the size and complexity of the DAU virtual schoolhouse typically resides on a distributed system of networked UNIX workstations connected to the Internet via T1 or T3 lines. The site is protected from unauthorized access by a firewall. Table 4-7 specifies minimal requirements for the delivery hardware. Figure 4-6 provides an overview of the optimal delivery environment.

Table 4-7. Minimal Delivery Server Hardware Suite

System	Sun Sparc Ultra Server(s) or equivalent
Operating System	UNIX/Solaris 2.5 or greater
Memory	128 MB
Hard Disk	1 GB hard drive free
Connectivity	LAN and T1 or T3 to Internet
Security Infrastructure	Firewall

Figure 4-6. Optimal Course Delivery Environment



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SERVER SOFTWARE

The DAU Web site(s) will consist of a wide variety of server software packages distributed across one or several hardware platforms, depending on the nature and volume of the content to be delivered. The delivery site(s) will likely require server applications such as:

HTTP SERVER

- HTTP Server: The basic HTML delivery vehicle.

MULTIMEDIA DELIVERY SERVERS

- Multimedia Delivery Servers: Special data formats like streaming audio and streaming video require specialized server software. The use of these formats can significantly enhance courses.

DATABASE SERVERS

- Database Servers: These servers are required to support the interactivity, faculty function automation, records storage, and the remediation functions of the Web-based course environment.

MIDDLEWARE SERVERS

- Middleware Servers: These servers will support enhanced integration of database functions in the course environment.

NEWS SERVER

- News Server: A news server is the underlying system used to support the USENET on the Internet. Fundamentally, these servers set up a series of bulletin-board-style forums sorted by subject and in effect form communities of interest. Functionally, a news group provides a mechanism for a learner to ask a question of a group and potentially get an answer back that is of some interest to others in the group who did not think to ask the question themselves. This process has led to collections of frequently asked questions and answers called FAQs. A news group also provides the means to disseminate news about a particular subject to a broad audience. The system works like an e-mail list server but is more user friendly because the learner logs onto a site and only downloads/views the information (based on subject) of specific potential interest. The system uses standard e-mail as a mechanism for posting, and viewers are easily available and often found as components of Web browsers such as Netscape Navigator.

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SMTP SERVER

- Simple Mail Transport Protocol (SMTP) (e-mail) Server: Providing an e-mail server enables a training center to provide each learner (who may not have an existing account) and instructor with a consistent mailing address for personal exchange of information not appropriate for a group.

IRC SERVER

- Internet Relay Chat (IRC) Server: IRC is useful as an adjunct to e-mail and news by allowing real-time exchange of questions and answers on a subject basis similar to a news server. Functionally, IRC sessions can be set up (e.g., using news) to schedule a time in which an instructor would be available to answer questions.

MUD/MOO SERVER

- Multi-User Dimension (MUD)/MUD Object Oriented (MOO) Server: MUD/MOOs are efforts to create a virtual world and are in essence a sophisticated form of IRC. MUD classrooms and extensions are being developed as a means for computer-based remote learning. MUD servers are generally accessible through Telenet, and freeware clients of all types are available.

CATALOGING AND SEARCH ENGINE SERVICES

- Cataloging and Search Engine Services: In addition to CBT course material, it is important to have reference materials available for learners to conduct unstructured research and collect background information. These on-line documents can be placed into an automated cataloging library using automated tools, and their contents can be searched by sophisticated keyword style search engines.

SERVER SOFTWARE FACTORS

It is important to note that multiple software servers (e.g., SMTP servers, IRC servers) can be hosted on a single hardware server. The performance will vary with the number of simultaneous users and the type of application. A single hardware server would be more than enough to support DAU's learner population for standard textual and graphics Web content. Textual information creates a very low file transfer duty cycle. That is, an end user only downloads files about 5 percent of the time he or she is on-line. Conversely, streaming audio and video have 100-percent duty cycles (i.e., while the files are being heard or viewed by the end user, they must be continuously downloaded).

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CLIENT

The power, flexibility, affordability, and new possibilities presented by Web-based technology have an even greater impact on the learner. Given a well-designed virtual schoolhouse, anyone with Web access can participate in the on-line learning experience. Clearly, the more capable the client machine and Internet connection, the more satisfying the experience.

CLIENT HARDWARE

While it is possible to access the Internet on a 386-based PC through a text-only-based browser, such a configuration is below the minimum that should be required to attend the DAU virtual university. As outlined in Table 4-8, a 486/66 MHz is recommended as the current minimal receive machine.

Table 4-8. Current Minimal Courses Receive/Playback Hardware

Microprocessor	486/66 (Pentium with local bus video recommended) or PowerPC processor
Memory	16 MB RAM
CD-ROM	4-6X Speed (optional)
Monitor	14 inch
Graphics Card	SVGA (640x480)
Hard Disk	Minimum 85 MB free
Sound Card	Sound Blaster-compatible (optional)
Connection	Internet connectivity (14.4 Kbps modem; 28.8 Kbps recommended)
Pointing Device	Mouse or other

Future state client hardware should be capable of supporting desktop audio and video conferencing through MMX-enabled technology and include audio input device, video input device, speakers, headset jack, and T-1 access to the Internet.

CLIENT SOFTWARE

Properly designed courses should not require any custom software on the client side. Properly designed courses imply that the following limits are maintained:

- Small file sizes.
- Minimal image resolutions.
- Appropriate compression techniques.
- Reuse of components (graphic and applets) to leverage caching.
- Consistent data types (e.g., not mixing AVI, QuickTime, and MPEG).
- Freely available, multiplatform, plug-ins.
- JavaScript versus Java should be used if possible.

With respect to Web browsers, it is recommended that DAU courses be designed to function with either Microsoft Explorer or Netscape Navigator.

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ADMINISTRATION AND ACCOUNTING

The adoption of Web technology will allow DAU and the Consortium Schools to develop and deploy virtual schoolhouse applications that:

- Are platform-independent to allow course developers to author once and run anywhere, even across both client and server platforms, rather than force them to port and customize applications repeatedly for different proprietary platforms.
- Run on clients or servers without recompilation to enable universal partitioning of the application.
- Use common technologies and skill sets.
- Use open standards that are flexible enough to cooperate with existing applications from different vendors today and in the future.
- Leverage existing infrastructure investments in desktop computers, servers, mainframes, databases, applications, and networks.
- Scale from the LAN to the Intranet, enabling the exposure of business processes through the corporate firewall to connect applications directly to learners, course developers, and Consortium schools.
- Can be deployed and managed centrally from the server rather than requiring costly updates to static, individual desktops or laptops.
- Support Consortium-wide component reusability, increasing the Consortium's ability to develop new courseware and applications rapidly from existing services.

Because of the security features and the ability of the Web-based components to interface with existing databases, DAU can automatically provide administration and accounting services—a virtual registrar. By leveraging the unique, two-way communications capability of the Internet, it is possible to certify that an individual has received a course, observe a learner's progress, and record test results and other valuable feedback. In this way, DAU will be able to verify each learner's level of understanding and thereby enable certification programs.

INDUSTRY TRENDS

Attachment 4-3 discusses industry trends related to the development and delivery of technology-based education and training.