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ABSTRACT

Because the Department of Defense spends more than $7 billion annually on training and educational opportunities, new instructional technologies are constantly explored in an attempt to make education and training more cost effective. Technologies which have been tried include: (1) instructional systems based on behavioral objectives; (2) instructional systems augmented by computer and audiovisual technology; (3) learner centered instructional research; (4) instructional television; (5) cable television; (6) miniature computers/microprocessors; (7) holography; (8) rapid transmission and storage system; (9) satellite communication; (10) computer-assisted instruction; (11) computer-managed instruction; (12) simulations; and (13) wired garrison concept. By combining these technologies in proportions which most effectively meet the educational needs of the armed services, and by pooling available instructional resources and delivery systems to avoid redundancy, the military can enhance the quality of the personnel while reducing unit costs for education. This report briefly describes each of these technologies, and suggests applications in military training programs. (EMH)

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# INSTRUCTIONAL TECHNOLOGY IN THE DEPARTMENT OF DEFENSE

## *now and in the future**

DR. M. RICHARD ROSE

THE Department of Defense faces a monumental task in the area of training and education. Between 15 and 20 percent of its 3 million military and civilian personnel are normally involved in the training process, either as trainers or trainees.

As the military budget has decreased, weapon systems have become more complex. To research, develop, acquire, maintain, and operate these systems require that more resources be devoted to producing qualified personnel. The answer is increased efficiency in the training and educational process. (For this discussion, the distinction between training and education will be unexpressed, and the teaching means used in both, by adoption from various technologies, will be referred to as "instructional technology.")

The Department of Defense keeps training and education under constant review, and additional innovative and cost-effective measures should result from the FY 76 funding of $32.4 million for research and development of instructional technology.

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One indicated change is the relocation of training from the large central training centers to field, ship, and submarine locations for almost continuous upgrading of a highly specialized nature for smaller numbers of individuals, so as to maintain the required high state of readiness in the complicated weaponry employed by today's armed forces.

Secondary, but still important, is the general education provided to members on active duty and former members under the GI Bill. The combination of educational and training opportunities is the cornerstone of the all-volunteer force in attracting high-quality men and women.

More than 85 percent of all service-learned skills have a direct and immediate civilian application. Department of Labor studies indicate that one out of every six civilian craftsmen acquired his or her skill in the military.

In a broad sense, then, the $7 billion annually expended by the Department of Defense in education and training can be viewed as a national social investment. The challenge is to find more efficient ways for continuing and improving this investment in our nation's most valuable resource, manpower.

## Technology in the Instructional Process

In the recent past, instructional technology has seemed to reach a temporary plateau. This is not to say that significant developments have not emerged. They have. The experience of high hopes for educational TV and computers, accompanied by significant investment in the private sector and the subsequent failure of these media to effect the expected revolutionization of educational processes, has induced an air of caution as to future heavy investment in the private sector. The present plateau, however, can only be viewed as a launching pad for what must inevitably follow. Unprecedented forces are at work in the form of aggregating and synergistic technological advances, accompanied by the continued knowledge explosion and attendant knowledge obsolescence cycle—all of this overlaid with the reality of increasing paucity of resources. It is well to examine briefly the present state of the individual technological ingredients as a prelude to a look beyond the present horizon.

### *instructional approaches*

Instructional approaches within the Department of Defense (DOD) are undergoing significant changes in response to the new fiscal environment. An example is the Instructional System Development concept pioneered by the Air Force and subsequently pursued by the other services. The system involves the development of behavioral criteria that state what the student will be able to do as a result of instruction; develop criterion tests that indicate whether the student achieves the objectives; plan, develop, and validate instruction; and, finally, conduct and evaluate the training. By keying the training to specific job requirements, both overtraining and undertraining are avoided. The second aspect of such an approach is to make courses self-pacing, using such strategies as individualized instruction, modular scheduling and a wide variety of audiovisual/computer-linked techniques.

### *Advanced Instructional System*

The Air Training Command is moving rapidly toward a totally integrated system utilizing the most advanced instructional

technologies under the "umbrella" of the Advanced Instructional System (AIS). The primary ingredients of such a system included preliminary analyses of human factors, facilities, reliability, and system maintainability. Long-range plans envision the possible centralizing of the existing five major Technical Training Centers, with the potential for creation of a network not unlike the ARPANET, wherein many major universities and industrial complexes are linked together for the purpose of sharing information.

Central to the planning of an advanced system is the essentiality of increased responsiveness to validated requirements. Components include the Time-Share, Interactive, Computer-Controlled Information Television (TICCIT) and the Lincoln Terminal System as well as PLATO IV, all of which will be discussed. The planners and programmers of the system contemplate increased pooling of training items at a central or regional site offering the greatest potential for forward efficiencies. Automated and self-paced technologies are envisioned, possibly even allowing the trainee freedom of action in selection of the best delivery system for the individual's needs. Possible technologies could also include voice-sensitive terminals, three-dimensional manipulative visual displays, touch-sensitive terminals, and keyboard devices integrated into master computer systems of combined training and training management.

The planners also contemplate the future potential for virtual memory units using magnetic bubbles that could permit a smaller mainframe than is currently possible but one possessing significantly more capacity. Use of virtual capacity, due to the dynamic buffer zones, would significantly improve communication relays, either by telephone lines or microwave lengths.

The forward potential of multiplexing at a single, central site or through geographic regions opens even wider vistas for efficient sharing of training technologies and capacities, either intra- or interservice.

*learner-centered instructional research*

A widely held contemporary educational philosophy views the student as a relatively passive individual. Curricular materials are organized and delivered in such a way as to make learning possible. This whole philosophy and approach is being reexamined by the Advanced Research Projects Agency (ARPA). In an admittedly high-risk but high-gain area, the ARPA study postulates that alternative technological approaches to learning are possible, centered in learning strategies. The thrust would be directed toward making people smarter, rather than contents smarter, using such devices as methods of improving memory and reasoning ability. Having done this, it is postulated that in subsequent courses of instruction the trainees could utilize the newly learned skills in improving their own learning. An analogous concept is found in present undertakings in which computer science techniques are utilized to make machines smarter in the whole area of artificial intelligence.

*instructional television*

Within the Department of Defense, there continues to be a recognized role for educational television. This medium is used in each of the service academies, in the Naval Postgraduate School, the Air Force Institute of Technology, the professional military educational schools such as the command and staff colleges and war colleges, and in the service training commands. The

Air Force finds educational television especially valuable at Air University in the Academic Instructor course. In training all Air Force instructors, including those who will assume duties as professors of aerospace science at colleges and universities throughout the country, this institution offers a 20-hour elective course in educational television. In addition, television is used extensively in critiquing platform presentations (self-confrontation).

At other military teaching institutions, educational television is used to bring field experiences into the classroom. In naval operations as well as flying operations, television introduces a valuable cost-effective dimension by permitting students to view an environment without the high cost of equipment operation.

An exception to the declining use of instructional television throughout the Department of Defense is found in the Academy of Health Sciences of the United States Army located at Fort Sam Houston, Texas. This organization has a vital outreach program in the medical and health sciences field, including an extensive loan library of videotape cassettes. Included are programs designed primarily for continuing education of professional medical personnel, in addition to lesson plans for training and instruction in paramedical fields. The library of video cassettes exceeds 1000 different programs. In addition, the Academy operates a 12-channel closed-circuit playback system in support of the Academy of Health Sciences' academic curriculum, medical teaching programs of the medical center, and patient rehabilitation and educational programs. A wide range of both studio and mobile production equipment is utilized in conjunction with modern, up-to-date techniques and procedures. Given some of the technological advances in communications, to be discussed later, there is obvious potential for expanded application and transmission of educational material through satellite or other advanced means.

In general, however, each of the services is moving to consolidate and otherwise reduce costs attendant to television operations. A primary reason is a general disenchantment with black-and-white television, coupled with the high cost of color television. In the Air Force the number of television production centers in use has been reduced from six to one. The other services have similarly reorganized, with single centers servicing much wider geographical areas. The price paid is lack of immediate responsiveness.

It was previously noted that 20 to 30 percent of the approximately 900,000 hours of "on-call" Department of Defense instruction obsolesces annually. The relative costs of developing and updating such material are revealing:

Development and Updating of Instructional Material

(Cost per student minute—after having developed learning objectives)

| | *Develop* | *Update* |
|---|---|---|
| Sound-on-slide | \$ 13 | \$ 2 |
| Computer-assisted instruction | \$ 38 | \$ 2 |
| Color television | \$248 | \$200 |

The relative developmental and update costs suggest a central reason for the present de-emphasis of educational television as a primary instructional medium.

Another reason for the present decrease in the use of educational television is its inherent lack of flexibility in some modes and high cost in others. In the case of videotape, there is no potential for feedback or question-and-answer session. Video disk technology, as presently being developed by Philips, RCA, and Thompson CSF, addresses to a large degree the problems of flexibility and offers great promise. The disk permits random access, as well as branching and switching to other modes,

such as computers, for mediation. The drawback lies in the cost of producing the video disks. While it is estimated that video disk viewing equipment may soon be available for $500 each, significant investment is essential for the equipment required for production. Production runs of approximately 2000 disks are required to bring costs within the reach of most users. In view of the unfortunate marketplace experiences of those who lost after making significant investments in educational technology in the past, heavy investment will not be soon forthcoming without a proven market.

Militating against extensive use of video disks in DOD training establishments is the low intensity of requirements in terms of numbers of disks required and the wide variety of courses needing constant updating. Scalar economies would not be reached in the majority of DOD requirements, which range from runs of two to two hundred items. There is, however, a great potential for such technology in Defense overseas schools, educational programs, and other high-intensity instructional applications.

*cable television*

An aspect of cable television as a communications mode of particular interest to policy-makers, planners, and educators is its low cost. In one investigation conducted by the MITRE Corporation, the cost of cable to bring mediated instruction into a series of homes in one community was less than $2000.

*miniature computers/microprocessors*

Continuing breakthroughs in micro technology present tremendous potential for computer miniaturization at very low cost. Five years ago computer time cost $20 per student hour. Presently computer time in many cases can be obtained for less than $1 an hour. There is a real possibility that, in the intermediate term, miniature computers or microprocessors can be sold for less than $100 each.

*holography*

This recently emerged technology of combined reflected light waves and laser optics permits the introduction of highly realistic imagery in three dimensions unmatched by any other photographic method. This whole area of laser technology appears to be on the threshold of making truly major contributions to educational technology.

The hologram produced by laser technology is totally descriptive of the medium. It comes from the Greek roots "holos" and "gram," meaning *message*, and those who have viewed such holograms would agree that in fact the medium does truly convey the *whole* message.

Far from being a simple three-dimensional image, the holographic projection is visually indeterminable from the real object. The image preserves all of the visual information about an object, including spatial depth. The unique contribution of laser light in the process, in addition to encoding and transmitting the information, is that it stores all of the information in the hologram in a totally unique way, permitting retrieval. Laser light directed on the hologram unlocks the stored visual information, permitting the viewer to see the original object reconstructed in space in full dimensionality.

The applications to instructional technology are legion. It has been said that we think in holograms. What, then, could be a better medium for conveying information than one consistent and in tune with perceptual and cognitive patterns!

The awe inspired by one's first view of Michelangelo's "Pieta" could be shared by all. Similarly, brain surgeons around the world could simultaneously study a master surgeon's art in unprecedented proximity. At leisure, with full dimensionality, individuals located in a submerged submarine could be instructed in the intricacies of a complex piece of equipment that defies description in plano. The compatibility of holography with video cassette and video disk technology opens vistas that defy description.

The potential of holography for raising training effectiveness while realizing large economies is suggested in a 1972 study that estimated the value of operational equipment used for training to be in excess of $4.5 billion. With nuclear propulsion systems and jet aircraft, as well as a wide variety of other equipment costing millions of dollars each, a large part of these costs could be avoided. Up-to-date and extensive holographic libraries of the pertinent high-cost equipment could be maintained, for example, at training sites around the world on video disk for immediate call-up and study as required. Trainees could become intimately familiar with the equipment, lacking only the hands-on phase, which could be easily attained on the job.

Holography will certainly have a profound impact on instructional methodology, perhaps on our world and our lives.

*rapid transmission and storage system (RTS)*

A unique system pioneered by Goldmark Communications Corporation is especially pertinent in view of present fiscal constraints as well as increasing update training needs. By use of a unique process that is pedagogically as well as psychologically sound, pictures and graphic material are produced and overlaid with sound as the main medium.

In addition to being highly successful as a teaching/learning device, the system, known as Mark I, has the additional advantages of low production cost coupled with low update cost—a significant item. A variety of sound tracks to the same video presentation makes the system multilingual. The outstanding feature is the transmission and storage capacity. A standard one-hour, one-inch videotape will contain 30 times the capacity of existing systems, or the equivalent of 30 one-hour programs. From within any of the groups of 30 segments, any number of programs can be reproduced simultaneously on different television sets. An individual user would have access to all programs on the tape, with the capability of selecting, stopping, and repeating at will.

The RTS programs can be transmitted over standard television station cables, microwave, or satellites. The high-density storage capability of the system is paralleled by extremely high transmission efficiency by compression of data at a 15-to-1 ratio. During a hypothetical eight-hour period, when a television station or satellite might normally be off the air, approximately 240 different half-hour lessons could be transmitted, received, and stored. This system, with its high efficiency not only in rapid transmission and low-bulk storage but in low cost of updating, should find widespread application in the Department of Defense as one of the primary components of alternative instructional delivery systems in the future.

*satellite communications*

The roundness of the world introduces certain constraints on the typical line-of-sight communications systems. Whereas the "High Antenna" project conducted by Pur-

due University, using an airplane as a broadcasting station, was able to broadcast television programs to hundreds of Midwest schools, a satellite independent of atmospheric interference and weather phenomena offers unparalleled opportunity for maximum coverage.

Such a potential was demonstrated in May 1965 when a high school class in West Bend, Wisconsin, and a class at the Lycée Henri IV of Paris, France, linked up via Early Bird satellite for a joint one-hour class. Since that time numerous experimental and prototype programs have been conducted. Under the present leadership of the National Institute of Education, the goal of a national educational network is fast approaching realization.

Applications Technological Satellite ATS-6 experiments initiated in 1971, jointly by the Department of Health, Education and Welfare and the National Aeronautics and Space Administration, pioneered the widespread applicability of satellite communications as an instructional and informational medium. The premise underlying the experiment of direct and immediate application to the Department of Defense was "that satellites could provide information to people who cannot easily, quickly, or economically be reached by other means and that, given its capability to reach large geographic areas, a satellite could convey special information needed by comparatively small, isolated groups."

A series of interrelated experiments involved separate activities occurring in Appalachia, the Rocky Mountain region, and Alaska and were referred to by the National Institute of Education as the "Education Satellite Communications Demonstration." The demonstration constituted the largest and most complex application of technology to education ever attempted.

By use of available time on the ATS-6, multiple-voice signals as well as color television were transmitted to small, inexpensive antenna-receivers from its geosynchronous orbit above the equator. From this position, television beams on the ATS-6 transmitted signals to provide double footprints approximately 1000 miles north to south and 300 miles east to west on the Rocky Mountain and Appalachian sites.

In addition to "receive-only" terminals, which cost approximately $4000 each, "intensive terminals" were utilized; these latter had the ability to receive both audio and video signals and to transmit audio signals, permitting interactive participation. Programs transmitted included the "Time-Out" series on career education, directed toward junior high school students and including information on decision-making, self-assessment, and career education. Additional series include "Careers in the Classroom," for in-service training of teachers and staff members at the junior high school level, and "Footprints," designed for adults in rural, isolated communities. Such topics as health care, land use and environment, problems of the aging, and consumer education were included.

The National Institute of Education experiments appeared to have preliminarily answered the question regarding the effectiveness of satellites as alternative delivery methods of education to rural and highly isolated populations. This pioneering work has led the way to presently emerging consortiums for the expanded use of satellite communications.

The international aspect of satellite communication, aside from the Alaskan experiment, was demonstrated by the same ATS-6 satellite. In August of 1975 India began the Satellite Instructional Television Experiment. For one year the Indian Space Research Organization (ISRO) will use the NASA satellite to beam TV direct into 2400

isolated villages. Clearly demonstrated will be the ability of satellites to operate on call to all parts of the globe, delivering a wide variety of informational and instructional programs utilizing various technologies.

It remains for the Department of Defense to realize the full potential of this satellite technology, which is so immediately and directly applicable to a defense organization dispersed in nearly 100 countries, on more than 600 ships, and operating locations throughout the world. Toward this end, research is presently being contracted by the Advanced Research Projects Agency that will study the feasibility of using this technology in shipboard training.

*computer-assisted instruction*

A report prepared by the MITRE Corporation, dated 1972, contains the blunt assertion that computer-assisted instruction (CAI) has been a commercial failure. After tracing and properly identifying the root causes of the commercial failure, the National Science Foundation funded MITRE to "catalyze the mass dissemination of CAI"—this goal to be realized through the achievement of a major market success for computer-assisted instruction. Time-Share, Interactive, Computer-Controlled Information Television (TICCIT) is presently being used in two demonstration systems at the community college level with great success.

Despite the commercial failure of computer-assisted instruction, which was largely due to environmental factors and marketing problems rather than the inability of the system to do the job, computer-assisted instruction has found a broad constituency in the Department of Defense. All four services are finding extensive applications for the system, which has been proven to reduce training time by as much as 35 percent and failure rates frequently in excess of 20 percent.

Examples of on-line advanced technology systems include PLATO IV, currently being used throughout the country in technical training. It consists of a keyboard, a high-speed individual image selector, a random-access audio device, and a plasma display panel with variable numbers of terminals. Computer support is supplied by the University of Illinois and is possibly the most advanced computer-assisted instruction system using a large central main frame. Presently the system will accommodate 700 students on-line at any one time.

The Navy uses PLATO IV (Programmed Logic for Automatic Teaching Operations) in at least three advanced developments, including role-playing techniques. One program is directed toward understanding and improving interpersonal behavior in basic training between recruit and trainer. The second program involves a study concerning the value systems and attitudes of company commanders. A parallel undertaking is in the form of developing criteria for predicting successful performance in the role of recruit company commander.

A three-year effort using PLATO IV has just been completed at Aberdeen Proving Ground, Maryland. The evaluation results indicated that, in general, students who receive their instruction through CAI perform significantly better than students who receive their instruction in other ways. In addition, both student and instructor attitudes were positive. Time savings ranging from 15 to 45 percent were consistently realized, compared to traditional group-paced instruction. However, the costs of computer-assisted instruction in this particular form in the near term may be too high to provide a viable instructional system for the Department of Defense. Ex-

panded potential applications and the continued escalation of personnel costs continue to interact. In the intermediate term, scalar economies *may* be reached, and cost/benefit analyses suggest the feasibility of implementation.

The Lincoln Terminal System, developed by the Lincoln Laboratories of Massachusetts Institute of Technology, employs a terminal with a viewing screen and audio speaker. With a keyboard for student responses, terminals are connected to a central minicomputer, programmed to monitor student progress and facilitate branching. The random-access audio fiche feature replaces the computer memory. The system has proven highly cost effective in reducing training times and associated personnel costs, in some cases by as much as 37 percent. A follow-on version is programmed for remote sites and field training detachments not requiring the minicomputer hookup.

### *computer-managed instruction*

In computer-managed instruction, the computer may not play a direct instructional role as it does in computer-assisted instruction; rather, it manages the instructional process, i.e., the testing, diagnosis, and prescription. Students may receive all their instructional materials in some sort of off-line mode, usually programmed instruction text, audiovisual materials, or any other instructional method. The computer, in this mode, also manages instructors and deals with the resource allocation problem. Potentials for combination are apparent.

The Navy has made significant use of this computer management. In one study, documented savings—through the reduction of training time and attendant personnel costs—possibly exceeded $10 million in one year. In addition, the number of instructors needed to teach this course was reduced by 20 percent. Student performance rates were slightly better than under the old system. Both student and instructor attitudes were positive toward computer-managed instruction.

As a result of these studies, the Navy has bought the computer hardware and software to implement an expanded program. Currently 2000 students per week are employing the system. Within the next five years it is estimated that 15,000 students will utilize the system weekly. In order to provide the curriculum materials for this level of effort, the Department of the Navy is allocating between 2 and 3 million dollars for the next three years to replace group-paced materials with self-paced instruments utilizing advanced instructional technology.

### *simulation*

The whole field of simulation, including synthetic flight training systems, has received unprecedented interest. Recent advances in high-fidelity simulation and 360-degree visual systems promise greatly to transform flight training as well as the specialized training associated with all high energy-consumption equipment.

The reasons for such an increasing role are obvious. It has been variously estimated that, while the cost of a simulator could be ten times that of an aircraft, it is possible that the annual training hours generated by a simulator could exceed those of an aircraft by ten to one. Other studies project a potential reduction of up to 50 percent of present flying time in undergraduate flight training through increased use of flight simulation. It is further estimated by some that up to 25 percent of all flying might be replaced by simulation.

There remain as many questions as answers in the field of mechanical and

flight simulation in such areas as the proper mix of actual versus simulated training, certain interactive effects with other sensory modalities, and a variety of similar complex relationships. As the answers to these vexing questions emerge, simulation will play an increasingly key and central role in the instructional equation.

*wired garrison concept*

Recognizing the continued sophistication of communications electronics systems on Army posts and the piecemeal, sometimes incompatible, nature of the various systems, the United States Army joined with MITRE Corporation in examining the concept of a wired garrison. The present complex of separately designed, procured, installed, operated, and maintained systems tends toward increased cost and decreased efficiency. In the light of recent technological advances in the field of communications and computers, it was postulated that interrelation of existing systems could result in an integrated multimode information transfer system with greatly increased capacity as well as efficiency, perhaps at lower cost.

Implicit in the planning for this undertaking were the vast needs in the field of training and education within the Army. The Department of the Army has clearly stated realistic educational and training goals for each member, which are spelled out in a master plan. The *Army Educational Services Plan* is soundly based on the principles that each Army member should be permitted the opportunity to develop his maximum career potential, that the process of learning is continuous and lifelong, and that educational opportunities both attract highly qualified, highly motivated people and retain them for a more productive average period of service. This, coupled with the technical training requirements engendered by continued and accelerating knowledge obsolescence, creates a prevailing requirement for educational and training delivery systems.

In addition to proposed mission-related training programs, the educational components of the wired garrison concept are intended to extend from basic literacy instruction through the postgraduate level. The MITRE Corporation, upon completion of a "need assessment" coupled with an inventory of available systems and technologies, proposed an action program at Fort Bliss, Texas, to meet the validated needs. Included are a wide variety of computer-assisted, self-paced combinations, including two-way interactive video systems. Also being examined is an array of programs using computers for simulations and gaming purposes in logistical as well as complex technical and administrative fields. Remote access is a primary consideration in all applications. Using low-cost cable TV with currently available hardware, it would be possible to bring to the post hundreds of individual courses offered through The Association for Graduate Education and Research. A consortium of seven private educational institutions, located in north Texas, pools their physical and academic resources to enhance graduate education in the Dallas–Fort Worth region. A wide variety of other courses is available, either off-the-shelf or from other adjacent institutions of higher learning. This imaginative joint undertaking by the Department of the Army and MITRE represents a model and potential to be carefully examined by others, both in the Department of Defense and elsewhere. The implications and ramifications of such a system are legion.

## Beyond the Horizon

The Department of Defense is probably the largest instructional institution in the

world, with a span of courses ranging from prekindergarten to the most sophisticated postdoctoral studies and including a full range of specialized training. At any given time, more than one-half million individuals are participating in the DOD training and educational process. Given these realities, it was to be expected that the Department of Defense would assume a lead role in the advancement of instructional technology toward increasing efficiency and reducing costs. This has truly been the case.

Recognizing the potential for redundancy when each of the services has requirements to train individuals, frequently in the same skills, the Army, Navy, Marine Corps, and Air Force joined together in creating the Inter-Service Training Review Organization. This organization, headed by the training chiefs of each of the four services and working through a structure of committees with representatives from each service, has been in operation since September 1972. The purpose of the organization was not to create a new super training agency, with attendant bureaucratic inertia, but rather within present resources to organize a small group of experts and users to examine existing training processes, practices, technologies, and needs and thus to realize any economies possible through cooperation, consolidation, exchanges, or changed training patterns and practices.

From an early start in 1972, 27 enlisted occupational specialty subgroups, seemingly indicating the greatest potential for consolidation, were examined, and ten of these subgroups later consolidated. The organization has continued its efforts with great success. Aggregate recurring savings now exceed $2,850,000 in cost reductions; and annual cost avoidance is in excess of $1,200,000 as a result of actions to date.

One committee within the organization—the Training Technology Committee—is committed to the increased coordination and exchange of all facets of instructional technology. The committee's charter states:

> To review existing and new training technology with the objective of utilizing advancements by all Services, thereby effecting significant cost savings and avoiding unnecessary duplications.

A present initiative of the organization's subpanel on technology is a study contract, funded by the Advanced Research Projects Agency's Training Resource Application Information Data Exchange, under the acronym TRAIDEX. This feasibility study envisions a system that would enable all members of the training community to input to a central bank or repository the various software and hardware elements of training technology and support material required in the development of training courses. The system would be designed to interface with all existing systems, making research and development advances of one group, agency, or service immediately available to all.

Simultaneously, a program is being undertaken to create mutual interservice support areas, geographically bounded, within which there will be a totally free technology exchange between participants. Ten such mutual support areas have been designated, and interchange is already taking place. These initiatives are all designed toward forward effectiveness and avoidance of reinventing the wheel.

In looking beyond the horizon (admittedly a dangerous pursuit), this Inter-Service Training Review Organization will increasingly play a central role in fulfilling the needs created by continued escalation of training costs, quantum technological advances, and the requirement for greater

sharing of existing resources toward realizing even greater efficiencies.

*instructional systems—thrust of the future*

On re-examining the constituent parts of present-day instructional technology, one can readily see that the prior analogy to instructional technology now being poised on a launching pad is probably valid. With the combinations of computer-assisted instruction and computer-managed instruction in the context of advanced holography, video disk, and videotape and minicomputer technologies, the instructional process of the future will change dramatically. Further, communications media advances, in terms of cable television and satellite communications to carry such programs, combined with the Goldmark Rapid Transmission and Storage System, suggest potentials almost defying description. The general nature might well be that of flexible, multipurpose, integrated instructional systems.

The possibility of an interservice-shared satellite communications system with presently redundant time devoted to instructional transmission immediately comes to mind. With such a system, military members located at the most far-flung and isolated posts, including submarines and ships at sea, using stand-alone learning carels including video disk/tape and minicomputers, could be constantly updated in their fields of specialty. In addition, high-quality educational courses ranging the full spectrum, from remedial through graduate study, would be available for off- or on-duty education.

In the future, instructional technology will increasingly play a role early in weapon systems acquisition processes. Cost-benefit analyses of training subsystems to support such weapons will become an implicit part of the acquisition and deployment decision process, in light of the significant impact of instructional demands on the total cost of a weapon system during its life cycle.

Similarly, a significant number of research and development managers within the Department of Defense feel that computer-managed instruction in one form or another will have a predominant role during the next five years. Further utilization of this technology will place in the hands of decision-makers the appropriate information on the optimal mix of technologies to be used in any instructional process, recognizing the individuality of the learning process and the continuing need to reduce time in training and to get individuals on the job faster and better trained.

It is apparent that all of the technological components for advanced instructional systems of unprecedented efficiency and economy are at hand. The pitfalls, however, lie in the attitudes and minds of men. Such technology should be embraced and adopted only within the context of learner-centered systems, not for technology's sake alone. Those senior officers charged with the educational and training responsibilities for members of the Army, Navy, Marine Corps, and Air Force have shown unparalleled vision in what has taken place to date. It remains only for the same individuals, personally and through the aegis of the Inter-Service Training Review Organization and its working committees, to continue to fit together the continually emerging complex existing pieces of the jigsaw puzzles, toward the ideal.

Mr. David Sarnoff's prediction made in 1966 has been more than fulfilled:

> . . . some of the most profound changes wrought by the computer will be in education, . . . the task ahead will be to assign to the machine those things which it can best do and reserve for man those things he must provide and control, . . .

Unparalleled opportunities lie ahead to improve the quality of man's life while increasing the efficiency of the instructional process. Away from the stultifying effect of group-paced learning, the individual, sharpened in abilities to learn, motivated by the instructional process itself, will be free to proceed at an individually selected pace in a mode best fitted to his or her learning pattern and abilities.

The men and women who serve in our armed forces are and must continue to be the best the nation has to offer. The demands placed upon them by ever advancing technology and decreased resources can be met only through such alternate instructional delivery systems. At the same time, these men and women must continue to be afforded those opportunities for educational advancement enjoyed by their peers not serving in the armed forces. Components of instructional technology, in hand or soon to be available, offer an unprecedented opportunity for the creation of a true "learning society" in the Department of Defense.

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