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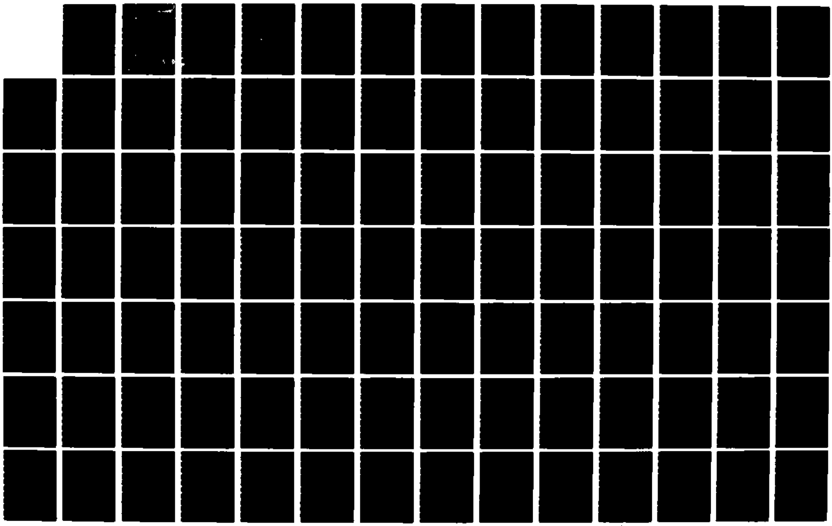

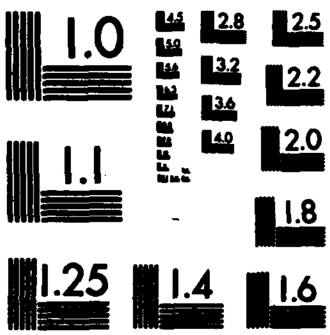
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A Systems Definition and Evaluation of Technology Alternatives for ACES

by

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ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objectives of this report were to: define the ACES system in terms of its objectives, major components, data requirements, major processes, information flow, and organizational components; identify the major deficiences inherent in the ACES; identify current technology and R&D initiatives and the degree to which they do and/or will impact identified deficiences; present recommendations and guidelines for the acquisition of additional technology necessary to overcome ACES deficiencies that will not be eliminated by current technology and or R&D initiatives.

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BACKGROUND

PURPOSE OF REPORT

The Army Continuing Education System (ACES) is responsible for providing educational opportunities that meet the needs of soldiers, wherever they are stationed around the world. In order to meet this responsibility, a variety of programs have been established, such as the Basic Skills Education Program (BSEP), the Servicemen's Opportunity Colleges Associate Degree (SOCAD), Educational Counseling Services, and others.

For these programs to be administered and conducted as effectively and efficiently as possible, accurate records must be kept of individual soldier educational achievements and of the enrollments and costs of the various ACES educational programs. Such a large volume of information with its requirements for frequent updating, security of confidential records, etc., dictate the use of the latest technology. In addition, the best instructional techniques available, including computer-based or computer-assisted instruction, must be incorporated into the ACES system.

Current data management capabilities within the ACES system are severely limited by a lack of automated support. For example, Soldier Educational Development Records (DA Form 669) are kept in paper form at installations, and no central data base exists to permit extraction of data from these records. In many cases, data submitted by installations are incomplete, inaccurate, or arrive so late as to have limited usefulness.

No automated instructional software (courseware) is available for Army-wide use. Where automated systems do exist, they have been developed to serve specific program, installation, or major Army command (MACOM) needs, and they do not appear to permit integration into a system to serve the entire Army.

The aforementioned deficiencies are not recent revelations within the ACES organization. TAGO, MACOMs and AECs have embarked on many technology and R&D initiatives to overcome, to the degree possible, these deficiencies. Their individual efforts in this regard are noteworthy for their resourcefulness, imagination, technical knowledge, professionalism and abilities to overcome seemingly impassible obstacles. Although no single system could likely meet the varied needs of all ACES organizations, each initiative or system's output should be compatible with products resulting from other systems, a situation which currently does not exist.

To ensure an orderly growth process, an accurate assessment of what currently exists is required as is a set of recommendations to guide the development of an integrated information and instructional system to meet future ACES needs. This analytical effort was initiated to satisfy this requirement. Specifically, its objectives are to:

- Define the ACES system in terms of its objectives, major components, data requirements, major processes, information flow, and organizational components.

- Identify the major deficiencies inherent in the ACES.
- Identify current technology and R&D initiatives and the degree to which they do and/or will impact identified deficiencies.
- Present recommendations and guidelines for the acquisition of additional technology necessary to overcome ACES deficiencies that will not be eliminated by current technology and/or R&D initiatives.

It should be noted that this report is targeted for an audience comprised of both technical and non-technical personnel. Therefore, to the degree possible, technical references and terminology have been carefully avoided.

METHODOLOGY

This section describes the approach taken to develop the ACES system definition, conduct an evaluation of the current ACES environment and make system level recommendatioms.

In the beginning of the project, we met with principals from DAAG-ED and OPM to define the scope and objectives of the project. As a result of the meeting, we prepared an action plan which specified an approach based on document reviews and field interviews. The plan was approved and we proceeded with the next phase of the project. The outcome of this phase was a model of the flow of information (an IFM) in ACES, and the technological support for transferring the information between organizational components. To obtain baseline data on the current ACES requirements, we conducted interviews at TAGO with personnel from DAAG-PLS, Micrographic Technology and DAAG-ED (programs, evaluation, and budget). Program managers at DAAG-ED provided the information flows and requirements for specific ACES programs. Concurrently, we reviewed AR 621-5 and 18-1 (and referenced Technical Bulletins 100, 101 and 109), reports on ACES by the Discover Foundation, Defense Audit Agency and Government Audit Office, various proposals (e.g., AREIS) and RFPs (e.g., AARTS) dealing with technology initiatives, and a selection of forms (e.g., DA 1821-R) used within ACES to glean further data on how information is transferred, reported and could be supported by technological innovations. Analysis of these data resulted in the development of information flow models for overall ACES (at the DAAG-ED level) and specific programs within the ACES. We also designed IFM-related data collection instruments to be used at local AEC and MACOM interviews. In-house review and revision of the IFM resulted in a refined model of the information flow and preparation and delivery of an interim working paper and IFM data collection instruments, i.e., "An Approach Towards an Integrated Information and Instructional System for the ACES," in August 1981.

At this point, we assessed the project's status and goals in terms of the characteristics of the final product. Based upon the work plan, we identified (1) ACES data element requirements, (2) a requirement for a functional description, and (3) ACES program Information Flow Models as elements of the final report.

In evaluating the need for data element requirements, we found that they should result from a detailed systems design as specified in a Data Requirements Document (DRD). The DRD, per paragraph 3.1.2.a, DoD standard 7935.1-S (The Automated Data System Documentation Standard), is prepared following completion of the Functional Description (FD). Given that an ACES FD has yet to be developed, the requirement for a DRD, at this juncture, was regarded as being premature. However, the final report should (and does) define and categorize ACES data requirements as well as provide the purposes and applications of the data.

DoD Standard 7935.1-S (paragraph 3.2.1) states that a Functional Description (FD) can range from a few to several hundred pages in length depending on the magnitude/complexity of the system, the system's operating environment, and the opinion of the project manager. The first problem facing participants in this effort was the fact that neither the magnitude/complexity nor the operating environment of the ACES had been defined in a comprehensible manner. As a result of the evaluation, it was decided that rather than an extremely detailed FD, the final product of this effort would be a document delineating the magnitude/complexity and operating environment of the ACES, as well as the near/long term deficiencies inherent in the system and recommendations for their amelioration.

Because the content of a FD is left to the discretion of project management, this report could have been titled an "ACES Functional Description" and serious consideration was given to doing so. However, realizing an ACES FD is the next logical and necessary step towards an integrated instructional and informational ACES, the title, "A Systems Definition and Evaluation of Technology Alternatives for ACES," was considered not only appropriate but a required first step towards a detailed ACES FD.

In evaluating the IFMs, we found that the flow of information, just focusing on the DAAG-ED level, was extensive and oftentimes program specific. The IFMs that had been developed, though accurate for specific ACES organizations, were not necessarily representative of all ACES organizations. To render the ACES program IFMs truly representative would have necessitated extensive field data collection activities requiring directing large portions of our assets in that direction.

Rather than do that, we used the initial IFMs as a starting point for the remainder of our study as they revealed the mass of information and communication required to keep ACES operational. Based on these

IFMs, ACES-related documents, our initial interviews, and a detailed analysis of AR 621-5, we arrived at a comprehensive systems definition of ACES. This definition included the specification of ACES' subsystems, processes, and data requirements, as they should be according to current doctrine.

The next set of activities involved verifying the definitions of system/subsystem components in the field, as well as determining what portion of the subsystem components are supported by technology. The definitions were expanded to include processes and data requirements for each subsystem. A critical review of this expanded system definition by project personnel and the ARI technical advisor was then conducted, and a preliminary set of system deficiencies was derived.

With these materials available to us, we developed a "Systems Definition Data Collection Instrument" (Appendix A) to structure our interviews in the field. We then conducted field visits with three MACOM level Education Directors and their staffs (MDW, FORSCOM and TRADOC) and the ESO and MILPO at Ft. Polk, LA., to review the systems definitions and find out about technology initiatives currently underway which might resolve some of the deficiencies postulated previously. The interviews resulted in an expansion of the system definition and highlighted operational difficulties with technology proliferation. In addition, to assist us in projecting long-term technology solutions, we examined current Army-sponsored research and development initiatives. We focused on those which could relate to ACES subsystems and processes.

We then analyzed all data collected to: identify a comprehensive set of deficiencies in the system; describe current technology and R&D initiatives and their impact; and project near- and long-term technological approaches to meeting ACES needs.

This report is designed to serve as the basis for an ACES project request, i.e., initialization stage of an automated systems development effort specified in DoD Standard 7935.1-S. It will afford the eventual developers of an ACES FD a concrete starting point in its comprehensive description of the magnitude and complexity of the ACES' operating environment, and in its proposed alternatives for achieving technology support for ACES.

ACES SYSTEM DEFINITION

INTRODUCTION

The primary purpose of this report is twofold, i.e., identify deficiencies inherent in the ACES and develop recommendations for a systematic technological solution for alleviating these deficiencies. To accomplish this, a necessary first step is to define ACES. Systems can be defined in a variety of ways. Given the purposes of this report, it was decided that the ACES system would be defined from several perspectives (i.e., objectives, subsystems, processes, data requirements, organizational structure, and information flow). System definitions cannot be developed without first making certain assumptions about the system and defining constraints which directly impact the parameters of the system. Therefore, ACES assumptions and constraints will also be addressed in this section and serve to further define the system as a whole.

The remainder of this section consists of seven parts. The first four of these together comprise the system definition of ACES:

- ACES Objectives: the specific purposes for which ACES was established
- ACES Subsystems: the major functional subsystems of ACES
- ACES Processes: specific processes involved in each of the ACES subsystems
- ACES Data Requirements: data required by each major functional subsystem of ACES

The fifth part of this section will present an organizational definition of the ACES. Here, the major organizational components of the system will be shown and the number of key organizational components involved in the system will be estimated.

The sixth part of this section addresses the general information flow of the ACES. In this part, the categories of data involved in the ACES will be identified, general organizational responsibilities will be defined, and general characteristics of the information flow discussed.

It should be noted, all information presented on the ACES system component definition was derived primarily from AR 621-5, Army Continuing Education System (ACES). Thus, the system definitions represent what should be throughout ACES. It is impossible to identify system deficiencies without first knowing how the system was originally intended to function. Asking an individual, "What is wrong with the system?" will always result in a multitude of responses. Some of these responses are relevant, some are not. To identify which are relevant, an understanding of what the system was intended to do is required. Therefore, the system definitions contained in this section, coupled with our review of relevant documents (e.g., GAO, DISCOVER Report, and DAA report), and interviews with ACES personnel made it possible to identify relevant system deficiencies and develop recommendations for alleviating these deficiencies.

ARMY CONTINUING EDUCATION SYSTEM (ACES) OBJECTIVES

The U.S. Army is responsible for recruiting, developing and conserving its human resources. To enhance recruitment activities, the Army must offer educational incentives that develop soldiers' skills in such a manner as to provide a link between the soldiers' military experiences and subsequent reentry into the civilian community. To develop human resources, the Army must: increase each soldier's personal educational growth; increase each soldier's career potential; enhance the soldier's professional development, military effectiveness and leadership abilities; prepare soldiers for positions of greater responsibility; and, ensure that the expertise required to operate/ maintain sophisticated technology is maintained. To conserve human resources, the Army must enhance individual job satisfaction, motivate soldiers to continue learning and offer individual retention incentives. To satisfy these human resources requirements, the ACES was established to provide an integrated system of on-duty job-related educational programs and off-duty educational opportunities for active duty, reserve and National Guard Army personnel. The specific objectives of the ACES are to:

- Provide on-duty and off-duty education that complements and supplements military training.
- Provide a means whereby military experience and training is recognized by civilian industry and accredited by traditional educational institutions.
- During initial entry training, provide all soldiers with the on-duty education necessary to ensure every soldier's ability to communicate effectively in English.
- During all post-entry-training assignments, provide all soldiers with on-duty education required to ensure every

soldier has basic proficiencies in reading, writing, speaking, listening and computing skills.

- Provide all NCOs with on-duty education required to assure that they can satisfactorily carry out their responsibilities as trainers, supervisors, managers and administrators.

- Provide all soldiers with in-service, off-duty, as well as post-service opportunities and financial assistance to pursue post-secondary educational opportunities.

- Respond to any and all soldier inquiries pertaining to what in-service/post-service educational opportunities are available and the procedures they must follow to avail themselves of these opportunities.

- Provide the ability to identify individual soldier educational requirements, i.e., skill/knowledge (S/K) requirements minus S/K already held.

- Ensure that all Army personnel (active duty, reserve, National Guard) are aware of the ACES programs. These would include MACOMs, installation and unit commanders; ESOs and counselors; and, most importantly, individual soldiers during pre-enlistment processing, entry training, post-entry training assignments, as well as ETS processing.

- Ensure that all educational technologies and initiatives are fully exploited.

- Support educational program evaluation (internal and external) to ensure that programs are of high quality and accomplish overall ACES objectives.

- Ensure that all ACES programs are cost-effective.

- Ensure that ACES programs operate in accordance with regulatory guidance.

- Interface with other DOD education-related initiatives, i.e., DANTES, VEAP and the educational opportunities encompassed by the GI Bill.

- Interface with government agencies and processes that, although external to the ACES itself, are vital to accomplishment of its objectives. (These would include the DOL and legislative processes/agencies.)

ACES SUBSYSTEMS

The ACES can be categorized as being comprised of five major subsystems: Counseling, Instruction, Executive, Evaluation and Fiscal, as illustrated in Figure 1. These subsystems, which can also be viewed as major ACES functions, are necessary to satisfy the objectives for which ACES was established. These subsystems are not necessarily unique to any single ACES organization (e.g., DAAG-ED, MACOMs, AECs) but are inherent, to varying degrees, in each of the ACES organizations.

Counseling

Provides each service member with information, assistance and guidance regarding programs and opportunities subsumed by ACES. Contact between the service member and ACES is provided at prescribed times within the service member's Army career, as well as on an "as needed" basis. Counseling encompasses services such as providing advice about in-service educational opportunities and their relationship to career progression, both within the Army and after separation; reviewing within-program progress as required with each service member; assisting service members in following required ACES and related procedures; and encouraging service members to avail themselves of the opportunities represented by ACES.

Instruction

Instruction involves delivering and managing instructional/ educational services and programs necessary to meet ACES educational requirements. Instructional delivery includes acquiring, developing, and

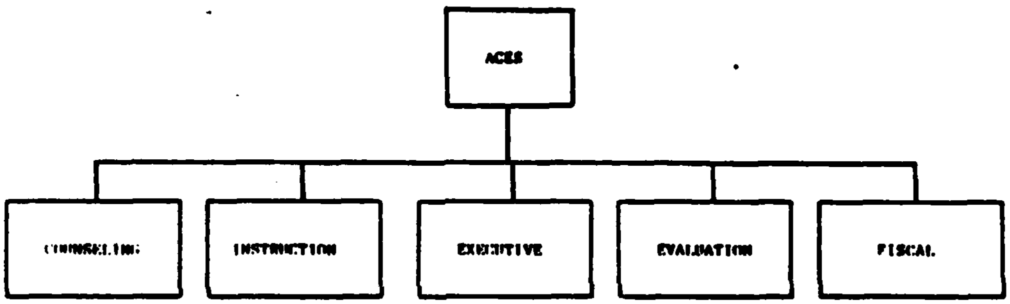


Figure 1. ACES SUBSYSTEMS

conducting instructional programs. Acquisition and development of instruction is accomplished as needs are defined. Instruction is conducted on a continuing on-duty/off-duty basis. Acquisition/ development/conduct of instructional programs is accomplished using military and/or civilian resources. Where an ACES educational requirement can be satisfied in whole or in part by an existing instructional program(s), such programs are acquired (i.e., procured and/or adopted) to satisfy the requirement. Where an ACES educational requirement cannot be satisfied by an existing instructional program(s), the instruction will be designed and developed to satisfy the requirement. Conduct of ACES instruction is accomplished in a variety of ways including the use of accredited institutions, learning/education centers, and individualized/self-contained instructional materials.

Instructional management entails supervising educational services/programs and maintaining relevant operational records for purposes of optimizing resource utilization and resolving operational problems associated with appropriateness of procedures, schedules and priorities. These activities are performed on a continuing, scheduled and as-required basis. Educational service/program supervision includes arranging for and scheduling instructional resources (e.g., materials, equipment, facilities) and scheduling service members' participation in ACES. Maintenance of operational records includes the preparation, collection, filing and referencing of these records.

Executive

Systems management, liaison, and information dissemination are involved in this subsystem. Systems management entails the development of ACES plans, policies and procedures. These activities are performed on a continuing basis. Plans, policies, and procedures are developed as a result of interpreting DoD/Army/other government agencies' policies operationalizing ACES objectives, and obtaining inter- and intra- organizational agreements.

Liaison assures appropriate communications between ACES personnel/organizations and other military organizations, and civilian agencies or institutions for purposes of creating/maintaining mutual understanding and cooperation. This is accomplished on a continuing basis. Assurance is achieved through activities such as negotiating with civilian agencies/organizations/institutions, participation in educational planning with local/state/federal agencies, and maintaining close contact with and being sensitive to military commander needs.

Information is disseminated about ACES programs, opportunities and/or operations, from ACES component organizations (AEC, MACOM, HQDA, etc.) to other organizational components both within and outside the ACES. This is accomplished on a scheduled and as-required basis. Information may be transmitted for purposes of publicity and promotion, documentation of events, requesting approvals, certification, providing guidance, improving and/or operating specific programs, or maintaining communications between organizational components or agencies. The information may be transmitted via prescribed formats and control procedures (e.g., reporting on specific DA forms) or through informal means.

Evaluation

Develops and implements methodologies and sets standards for: determining the degree to which ACES objectives are being satisfied, conducting needs assessments, and making programmatic decisions. These activities are conducted on a scheduled and as-required basis.

Methodologies include systematic procedures for gathering, recording, maintaining and analyzing information. Implementation of these methodologies include activities such as distributing, monitoring, administering, analyzing and publishing procedures for various standard and other tests and measurements. Standards are set for use in identifying educational requirements, for selecting appropriate means to meet these needs, for judging the effectiveness/efficiency of ACES activities (e.g., program to improve service members' job-related educational competencies), and for assuring that these activities comply with ACES and other Army policies.

Fiscal

Projects, authorizes, sets priorities, allocates, monitors and proscribes funds required for the implementation/maintenance of ACES policies, programs and operations. This is accomplished on a scheduled and as-required basis. Funds are provided for ACES staffing, staff development, facilities, equipment, and other operational and programmatic activities.

ACES PROCESSES

To further define the ACES, it is necessary not only to define its relevant subsystems but the processes involved in each subsystem. Accomplishing this furthers one's understanding of the ACES subsystems and their relationship to the ACES data requirements discussed in the following section. The ACES processes and their relationship to each ACES subsystem are illustrated in Figure 2.

Counseling Subsystem Processes

- Informs soldiers about ACES programs and career opportunities
- Provides guidance to soldiers about their participation in ACES programs and career opportunities
- Reviews individual soldier's progress within individual ACES programs

When counselors inform service members about ACES programs, the counselors require access to current ACES and ACES related (e.g., VEAP) program information. The service member has to be informed about eligibility, relevance, duration, schedule and benefits of the programs. Counselors usually provide this information when the service member first arrives at the installation. Programmatic information is often provided in the context of enhancing career opportunities. Career progression information is likely to include such things as relationships between in-service duties and MOS, and civilian careers and explanations of Army systems related to careers like EDMS, MOS structure promotion point structures, SQT, NCOES, OCS, WO procurement, reserve commissions, etc.

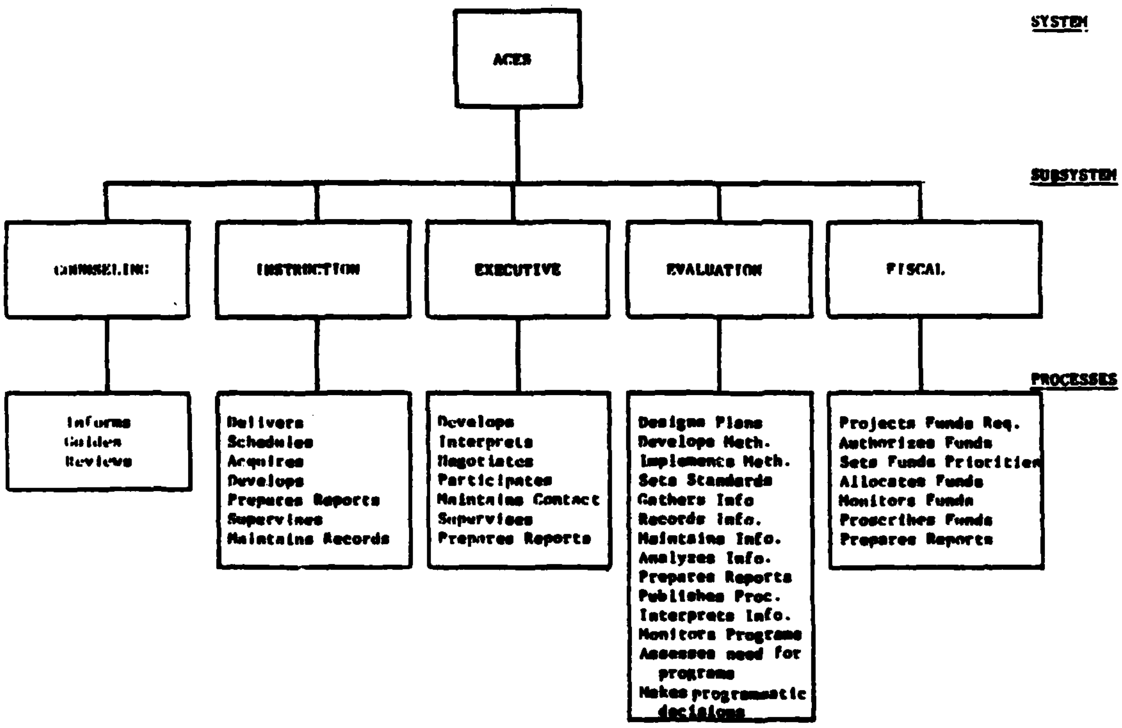


Figure 2. ACES PROCESSES

Once the information is presented to the service member, the counselor has to provide individualized guidance to optimize the service member's use of ACES opportunities. To accomplish this, the counselor needs data from the individual soldier records. The counselor needs to scan all data elements within the record to plan a program with the service member that is consonant with his/her previous education, time remaining in service, training history, general abilities (from test scores), etc. While providing guidance the counselor should use career progression information to explain to the service member various career strategies such as cross-training, changing MOS, shortage MOS, obtaining educational and job-related credits through non-traditional means (e.g., the AAP). The relationship between promotion points and education/training is a critical area which ties the ACES programs to individual career decisions and it is the counselor in the AEC who provides that information to the service member.

Having determined the most appropriate ACES programs for a specific soldier, counselors must then access specific ACES instruction information. This is necessary to enroll soldiers in programs and involves determining the availability of specific instruction, when/where the instruction is provided and the enrollment procedures that must be followed.

The counselor is also required to monitor the service member's progress within individual ACES programs. Data required for performing this activity include additional individual soldier record data, i.e., within-course attendance and test scores, course completion notification, dropout notification and program specific (e.g., number of modules, tapes, self-study packages, etc.) completion information.

Instruction Subsystem Processes

- Delivers instruction
- Schedules students' participation in ACES instruction
- Schedules instructional resources
- Acquires ACES instructional products and services
- Assumes responsibility for developing the ACES instruction
- Prepares appropriate reports relating to instruction
- Supervises instruction
- Maintains required records relevant to all ACES instruction

The delivery of instruction in ACES takes several forms, including contracting for classroom lectures, video tapes, individual carrels, correspondence courses, computer-based instruction, etc. The data required for effective instructional delivery are common across delivery mechanisms. These data are such things as clear relationships between the course(s) being delivered, and the needs of the service member, validated instructional content, and adequate facilities. Facilities within the AECs must be scheduled to meet the needs of the different classes which are offered at any one time. Scheduling of resources includes both on-duty and off-duty hours. Scheduling and operational data must be maintained on classroom facilities, learning resource center and MOS library facilities. Service member participation in ACES programs have to be scheduled both on an individual and group basis. For this, the ESO needs complete information regarding each of the ACES courses being offered, as well as data on the training cycle and individual abilities of the soldiers likely to be enrolled in the ACES courses. In those instances where existing instructional packages do not meet ACES needs, the AEC turns to instructional development information to ascertain which programs must be designed and developed to meet ACES educational requirements.

Although most of the instructional delivery at the AECs is performed under contract, the AEC retains a management, supervision and recording role for all ACES instruction delivered at the installation. Contractors are required to inform the AEC about costs, enrollments, dropouts and academic progression of enrollees, and these data are in turn consolidated by the AEC and reported via various forms to the appropriate authority. In addition, the AEC maintains information on the specific contracts (e.g., length/amount of contract, technical representative, etc.) which are in effect at the installation, to deliver instruction. Additional data, such as inventories of available instructional materials are often maintained at the AECs, either by contract personnel or by ACES personnel.

<u>Executive Subsystem Processes</u>

- Develops plans
- Interprets DA, DoD and other governmental agency policies
- Negotiates with civilian agencies
- Participates in educational planning with civilian agencies
- Maintains close contact with military commanders
- Supervises ACES staff development
- Prepares reports

One of the primary processes performed within the executive sub-system is to develop plans, policies and procedures for ACES programs. These plans build on previous ACES, DA, DoD and other agency (primarily Congressional) plans, policies, and procedures. External direction and legal requirements are interpreted and used to formulate ACES policies. The operational implementation of these policies results in detailed ACES program information. Such a formulation of ACES policies, plans and procedures, can be found in AR 621-5.

Executive subsystem processes are both internal to, and extend beyond, ACES and, oftentimes, DA. They include negotiations with civilian agencies and institutions for accreditation and other purposes. To a large extent, the success of ACES is predicated on the award of civilian credits for military experiences. So the negotiation process is a critical one for the on-going success of ACES programs. To that end, ACES cooperates and contributes to educational planning with civilian agencies at all levels. At the DAAG-ED level, this is represented by consulting with other federal agencies who are involved with civilian education. At the local AEC level, it involves participating with local school and educational boards in providing a total educational environment in that geographical area.

The installation is an educational microcosm, where the ESO must maintain close contact with installation commanders, so that the programs offered by ACES complement the training and MOS-related activities of a the personnel at that particular installation. To that end, individual soldier data, as well as installation-specific information, are required by the ESO for planning the programs which meet the installation needs. At the installation level and beyond, ACES staff development is an on-going concern of the total system and necessary information includes the availability of staff development courses and seminars. Documenting participation in staff development activities, as well as documentation of ACES plans and policies, constitute the reporting process of this subsystem.

Evaluation Subsystem Processes

- Designs evaluation plans
- Develops evaluation methodologies
- Implements evaluation methodologies
- Sets program standards
- Collects, records, maintains and analyzes evaluation data
- Prepares evaluation reports
- Publishes evaluation procedures
- Interprets information
- Monitors programs
- Assesses needs for programs
- Makes programmatic decisions

Evaluation processes can be found at all organizational levels within ACES. Evaluation plans are made on a programmatic basis at the DAAG-ED level using a data base of ACES plans, policies and procedures. While at the installation level, evaluation plans are often on a program-by-program basis, based upon test and performance measures and ACES instruction information. Where possible, standards against which to judge the success or failure of a program are established based upon ACES policies (e.g., AR 621-5). In other instances, the standards may be set as a result of a review of non-ACES policies (e.g., apprenticeship training certification), or in the instructional setting by examining the course objectives and/or job requirements of the graduate.

Evaluation methodologies are developed and implemented, based upon the evaluation plans and the need for specific data to decide whether or not programs meet the stated standards. To accomplish this, data are collected, recorded, maintained and analyzed primarily in the form of test and performance measures. Within course/program test and performance results are also examined in light of the specified standards. In those instances where conventional tests are not part of the program (e.g., AAAP), the installation monitors the service member's participation very closely and records his/her progress in the program. Some standards of programmatic evaluation are based on such variables as enrollment, participation, etc. The standards for these types of evaluation are derived from the needs assessment data collected at the installation level before programmatic decisions are made. Based upon the needs assessment data, the ESO and his/her staff decide which programs are needed at the installation. Then these programs are evaluated in the light of the goals to see how well they met the stated needs.

Evaluation processes are generally applied down to the program and end-of-course level. Within course evaluation is usually performed by the contractor who is supplying the course. The update of the individual soldier record which occurs at the end of course primarily consists of end-of-course grades and other course completion information. Other updates to the record would include any tests or performance measures which were taken during the soldier's participation in the ACES program, such as achievement, attitude, job performance and related data.

Fiscal Subsystem Processes

- Projects ACES program requirements and budgets
- Authorizes all funding
- Prioritizes funding requirements
- Allocates funds
- Monitors ACES expenditures
- Proscribes use of funds
- Prepares relevant fiscal reports

The processes in the fiscal subsystem revolve around the expenditure and projection of dollars within the ACES. Projected budget expenditures are calculated based upon past usage of equipment, materials and manpower costs, as well as the Educational Service Plans (ESP) provided by each installation. The ESP projects manpower, materiel and programmatic costs, as well as expected enrollments and participation for each installation. Based upon the ESP, the budget on an installation-by-installation basis is authorized. Projected ACES expenditures in terms of personnel and logistical costs are specified. Both the projected and actual ACES expenditures are keyed to such data items as specific ACES subprogram, cost, personnel time, enrollment information, numbers of personnel, TDY, PCS, supplies, services and equipment costs, testing, correspondence courses, etc. Within the subprograms for which data are maintained, priorities are established in terms of the expenditure of funds. Monies are allocated based upon ACES and other policies and requirements.

The actual expenditures of monies during the fiscal year are monitored on a quarterly basis through the use of installation to MACOM and MACOM to DAAG-ED reporting procedures. Based upon the data in these reports, ACES-wide fiscal reports and future projections are prepared.

One of the major ACES programs is providing tuition assistance to service members. A process within the fiscal subsystem is defining the eligibility requirements for tuition assistance. As a policy matter (AR 621-5) there are proscriptions on which service members can benefit from the aid provided by the tuition assistance program. In addition, data from non-Army sources (e.g., educational institutions) are required to determine whether or not the tuition assistance money was spent legitimately. In those instances where it was not, it is the obligation of the AEC to recover those monies from the individual service member. The standards by which the AEC decides whether or not the monies are to be recovered are found in the ACES Plans, Policies and Procedures (AR 621-5).

ACES DATA REQUIREMENTS

Given the ACES objectives and related subsystems, this section will address the data required by each subsystem to perform their intended processes. Data will be discussed in categorical terms and, within each category, by the specific type of data involved. For example, Individual Student Records (Category) contain individual test score data (Type). In the previous section, the ACES processes using these data were listed. For example, the Counseling Subsystem's guidance process uses ISR (Individual Soldier Record) data to determine appropriateness of ACES programs for individual soldiers.

The dependency of various ACES subsystems on common data becomes apparent in Figure 3, which illustrates ACES Subsystems and Data Requirements. Each of the categorical ACES data requirements identified in Figure 3 will be discussed individually.

Individual Soldier Records

Five types of individual soldier record data are required, i.e., identification, test score data, educational history, training history, and counseling record. Identification data include unique soldier identifiers to include name, rank, SSAN, current unit, Military Occupation Specialty (MOS), Date of Rank (DOR), Date of Birth (DOB) and Estimated Time of Separation (ETS). Individual test score data include scores obtained on standard Army tests (ASVAB), educational test scores (GED, college equivalencies, etc.), SQTs, as well as any scores from Army/civilian educational and/or training activities. Educational history data include a history of all educational activities

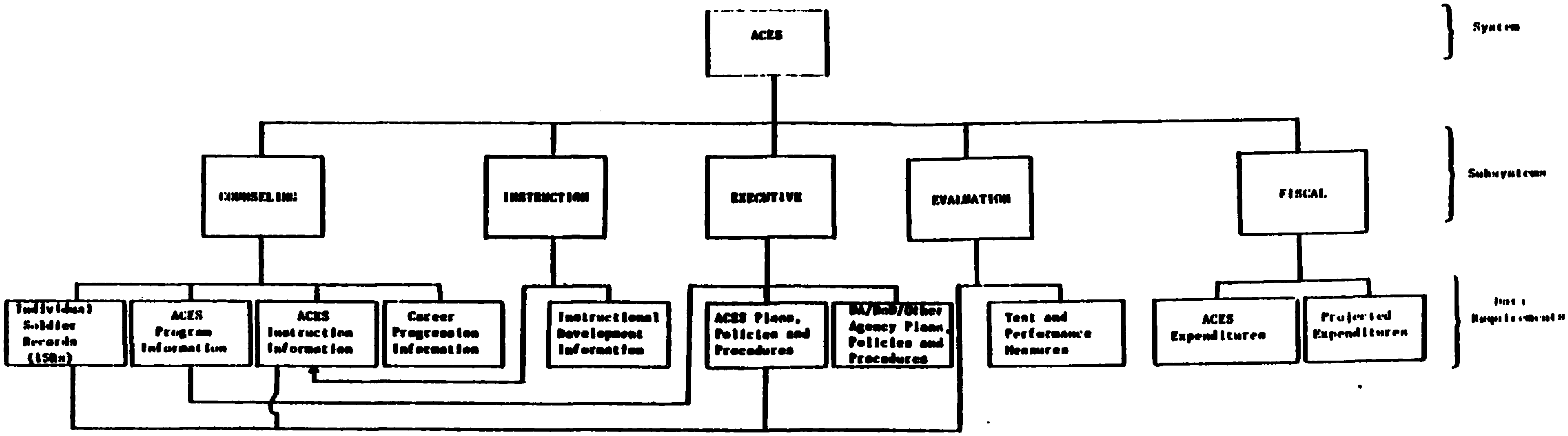


Figure 3. ACES Data Requirements

(pre-Army enlistment, as well as during enlistment) to include course titles, dates, where education was obtained, grades, equivalencies, and whether or not education was obtained through an ACES program (if so, what specific program, e.g., tuition assistance, SOCAD). Training history data include a complete, comprehensive record of all military training received by the soldier containing formal title(s) of training program(s), dates, location and final grades/test scores. Counseling record data represent a complete record of all counseling received by each individual soldier to include dates, subjects discussed, amount of counseling received (i.e., time), type of counseling received (e.g., informative, guidance or review) and name/location of counselor providing the counseling.

ACES Program Information

Complete, concise information regarding each of the ACES and ACES-related (e.g., VEAP) programs. Keyed to specific programs, this information would include program objective(s), eligibility requirements, enrollment procedures, applicable AR's, current enrollment benefits to be derived from participation in individual programs, as well as applicable instructional programs available at, or through, the local installation. The latter should be regarded as a link between these data and ACES instructional information.

Career Progression Information

Keyed to MOS, skill level and pay grade, this information would detail the prerequisites for promotion to the next higher pay grade.

Prerequisites would be defined in terms of time in grade, time in service, SQT scores, educational/training requirements and the correlation of each to promotion points.

ACES Instruction Information

This set of information could be viewed as a catalogue of all ACES on/off duty military, as well as civilian instruction available at each installation. Keyed to individual ACES programs, information about each instructional program would include title, objectives, dates, time, and location where instruction is offered, duration of instruction, instructional mode (e.g., classroom, self-paced, correspondence course) and completion requirements. A subset of information related to this data category would be instructional materials. For each instructional program, the materials used in that instruction would be identified in terms of related literature (e.g., instructor guides, programmed instructional texts), films, videodiscs, tests or student self-study materials. Where instruction is being accomplished via a contract with a local educational institution or individual, the instructional program will be noted as such and include information such as length/amount of contract, technical representative (COR).

Instructional Development Information

Data pertaining to instructional program(s) being designed and developed for ACES educational requirements which cannot be satisfied by existing program(s). This information includes all pertinent data regarding instructional development activities to include applicable ACES program, Army/DoD/civilian agency responsible for development,

development costs, title of program being developed, objectives to be taught, identification of all associated training materials under development (e.g., student aids, films, videodiscs, tests), projected/ actual development milestones and current status of any given development activity.

ACES Plans, Policies and Procedures

A necessary and sufficient set of short- and long-term ACES plans which affect the operation and maintenance of ACES programs at any management level, i.e., AECs, MACOMs or DA. A current set of descriptive, comprehensible ACES policies governing the operation/maintenance of ACES programs. A description of responsibilities and step-by-step procedures involved in specific ACES programs for all personnel including individual soldiers, counselors, ESOs, MACOM staffs and DA personnel.

DoD/Army/Other Agency Plans, Policies and Procedures

Any data generated by organizations/agencies considered outside of those organizations directly involved with ACES (e.g., Department of Labor) which may affect ACES plans, policies or procedures. Such data would include accreditation requirements, congressional actions, procurement regulations, personnel policies, eligibility criteria, and other organizational/agency specific links with ACES operations.

Test and Performance Measures

Information regarding evaluation standards and criteria; test and measurement materials; procedures for gathering, recording, maintaining and analyzing data by program, installation and MACOM. In addition, the data obtained from applying test and measurement instruments (e.g., achievement scores, attitude ratings/rankings, frequencies, times, enrollments, etc.) are included.

ACES Expenditures

A complete record of all ACES-related actual expenditures in terms of personnel and logistical costs. This information may be keyed to specific ACES subprograms, and includes cost, personnel time, and enrollment information, as well as data on numbers of personnel, TDY, PCS, supplies, services and equipment costs; testing; correspondence courses; counseling sessions; and the amount of participation in ACES-sponsored courses. These data include both operational and research and development costs.

Projected Expenditures

Out year estimated equipment/materials and manpower costs by ACES program and agency/organization (e.g., DAAG-ED, MACOM, AEC).

ACES ORGANIZATION

The Army Continuing Education System is shown in Figure 4. It is a complex mix of civilian and military components with information moving in both directions between all levels. We have concentrated on the levels which incorporate DAAG-ED, MACOMs and the Army Education Centers (AECs). ACES is a hierarchical structure with policy and guidance formulated by DAAG-ED, and promulgated by the MACOMs to the AECs. There is, however, independent contact with civilian institutions and/or agencies at each level (e.g., local AEC contacts local boards of education). The agencies, organizations, institutions and staff components shown in the key are referenced at the DAAG-ED level of the chart. Beneath each functional area are indicators (e.g., A, 1, a, etc.) which show the different organizations, etc., with which DAAG-ED must interact to administer the ACES programs. The key is as follows: DA/DoD staff are indicated by capital letters, government agencies by arabic numerals, and civilian agencies by lower case letters.

DAAG-ED (Education Directorate) is a central office located in TAGO. There are 12 MACOMs reporting directly to DAAG-ED, and there are 369 AECs at Army installations throughout the world. In CONUS, AECs may consist of a single Education Center or, on larger installations, a main Education Center with several sub-centers (usually co-located with troop concentrations). In USAREUR the AECs are organized into "communities" under the MACOM. Education Directors are in charge of MACOM ACES activities. Each AEC is under the direction of an Education Service Officer (ESO) or Education Specialist.

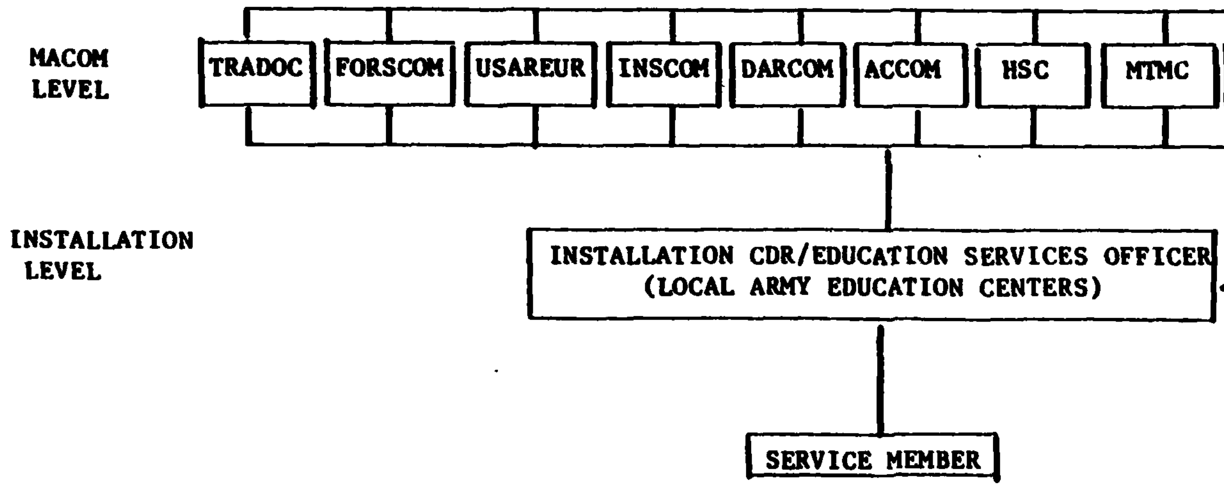
DA STAFF LEVEL

TAG

DAAG-ED LEVEL

FUNCTIONS OF THE EDUCATION DIRECTORATE, TAGCEN

COORDINATING AGENCIES	SKILL RECOGNITION	ACADEMIC	BASIC SKILLS	Non-Resident LANG TRAINING	COUNSELING	BUDGET
DOD/DA Staff	A B C D E F G I M N O R	A B C D E F G H I J K L M N	D E J K L E M N R G	A B C D N G I R	B D E F G M R	B E G
GOVT Agencies	2 3 8 10 11	1 2 6 8 9 10 12	2 8 11 9 3 4 7	7	8 9 10	
Civilian Agencies	a d e i j k n o	a b d f g h k l o	a e	e	c d m e	



SUPPORTING ACTIVITIES
- Installation
- DANTES
- DLI FLC/DLI ELC.
- 660 Supporting High Schools, Colleges & Universities
- Servicemen Opportunity College (SOC)
- State Departments of Educ
  - Departments of Accreditation.
  - Adult Educ. Counseling
- Directors of State Certification and Licensing
- Directors of General Educ Development Testing and Equivalency Programs (GED)
- State Approving Agencies for V.A. Certification of Post-Secondary Programs
- Local Boards of Educ
- Direct Liaison and Cooperative Action with Recruiting Pers
- Direct Contact with Project AHEAD and SOC Institutions

KEY

DoD/DA Staff

A OCE
B OCA
C ODCSLOG
D MILPERCEN
E ODCSPER
F RECRUITING COMMAND
G TAGO/TAGCEN
H ASA M&RA
I ASA FM
J OCLL
K OCAR
L NGB
M OTJAG
N ODCSOPS
O UTSC
R UTIC

GOVERNMENT AGENCIES
1. Veterans Administration
2. Dept. of Health, Educ & Welfare: (several divisions)
3. Dept of Labor
4. U.S. Office of Educ
5. Dept of Agriculture
6. Federal Republic of Germany
7. Defense Language Institutes (DLI FLC & DLI ELC)
8. Defense Activity for Non-traditional Educ Support (DANTES)
9. Army Research Institute
10. Federal Advisory Committee on Apprenticeship (Depts of Air Force, Navy and Marine Corps.)
11. Fifty State Depts of Educ
12. Federal Interagency Comm on Educ.

CIVILIAN AGENCIES
a American Council on Educ
b American Assoc of State Colleges & Universities
c American Assoc of Collegiate Reg & Admission Ofcs
d Commission on Post Secondary Accreditation
e Natl Alliance of Businessmen
f Adult Education Assoc
g American Assoc of School Administration
h Educ Commissions of the States
i American Vocational Assoc.
j National Assoc of Trade and Tech Schools
k Educ Media and Technology Conferences
l Carnegie Corp of New York
m National Assoc of College Admin Counselors
n Civilian Industrial Community (Mgt & Labor)
o Other Educ Assoc Councils and Commissions

There are 172 ESOs and 178 Education Specialists in ACES. Counselors are assigned to the AEC (the number is proportional to the number of troops being serviced). There are 470 counselors in ACES. The AEC has direct control and responsibility for operating the MOS library and some of the learning centers on post. In addition, the AECs contract for the delivery of instruction at the installation.

DAAG-ED INFORMATION FLOW MODEL (IFM)

In developing an information flow model (IFM) which focuses on DAAG-ED, an input, process and output approach was adopted. This approach resulted in two IFMs, i.e., a general IFM illustrated in Figure 5, and a detailed IFM illustrated in Figure 6. The general IFM (Figure 5) illustrates the organizational input/output interfaces between DAAG-ED and organizations in higher/lower echelons, as well as organizations/individuals outside of DoD. Specifics regarding these interfaces/relationships are required to fully understand this IFM. Therefore, a more detailed IFM was developed.

Figure 6 illustrates a more detailed DAAG-ED IFM for ACES. As the figure illustrates, DAAG-ED inputs can come from three sources, i.e., MACOMs, TRADOC (which is a MACOM, but provides inputs to DAAG-ED that come only from TRADOC and not other MACOMs), and AECs. There are primarily three ACES subsystems within DAAG-ED involved with these inputs (i.e., Fiscal, Executive and Evaluation) as illustrated in Figure 6. On the output side of the IFM, four primary outputs have been identified, two of which are specific (DD Form 2136s and Policies/ARs), and two that are less specific (information papers and information). The less specific outputs are indicative of the functional nature of the DAAG-ED, i.e., they are primarily a policy-making and query-response organization. All of the DAAG-ED outputs result from processes inherent in the Executive Subsystem, as noted in the figure.

It should be noted that this is a DAAG-ED IFM only. Therefore, only the ACES subsystems and processes of DAAG-ED are specified.

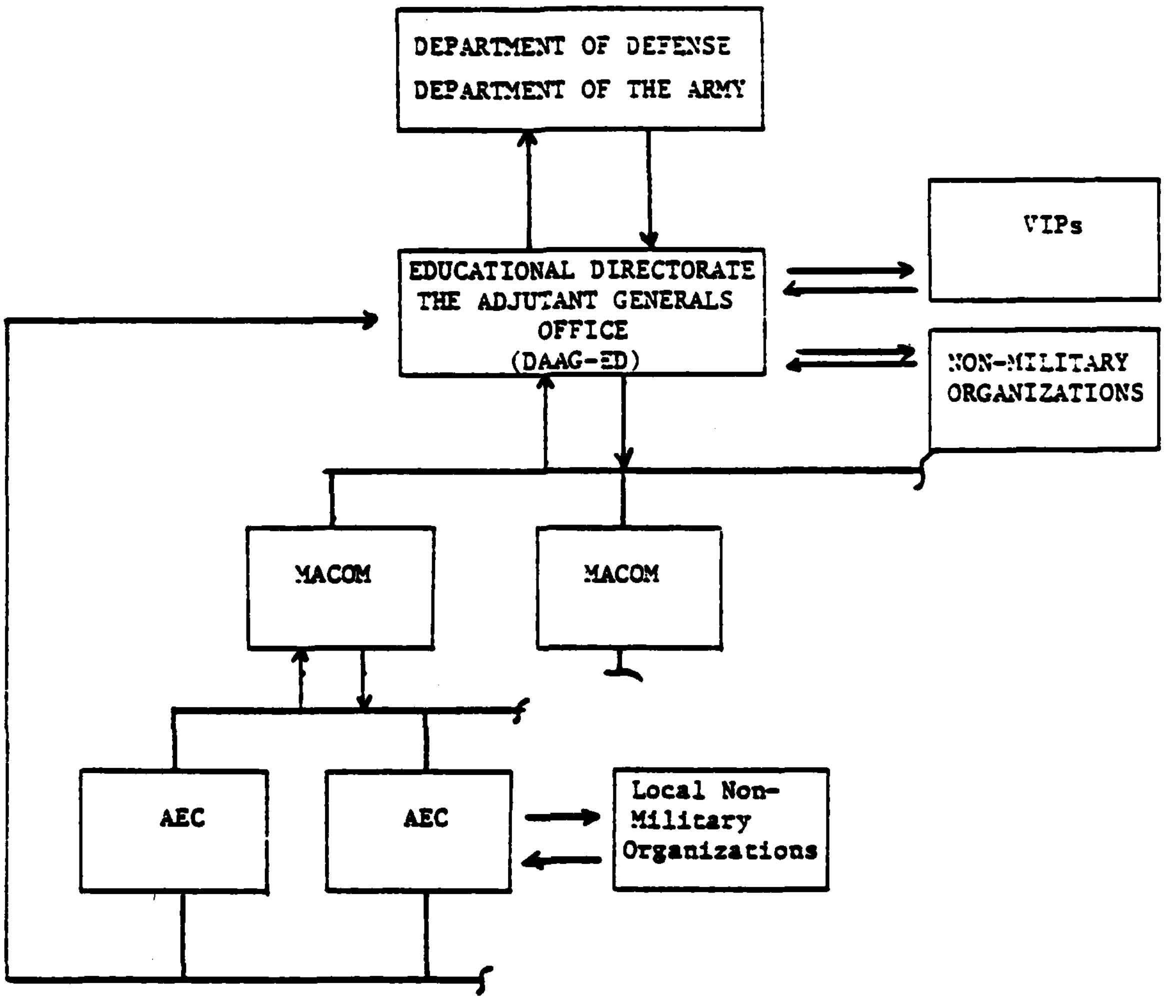


Figure 5. DAAG-ED GENERAL INFORMATION FLOW MODEL (IFM)

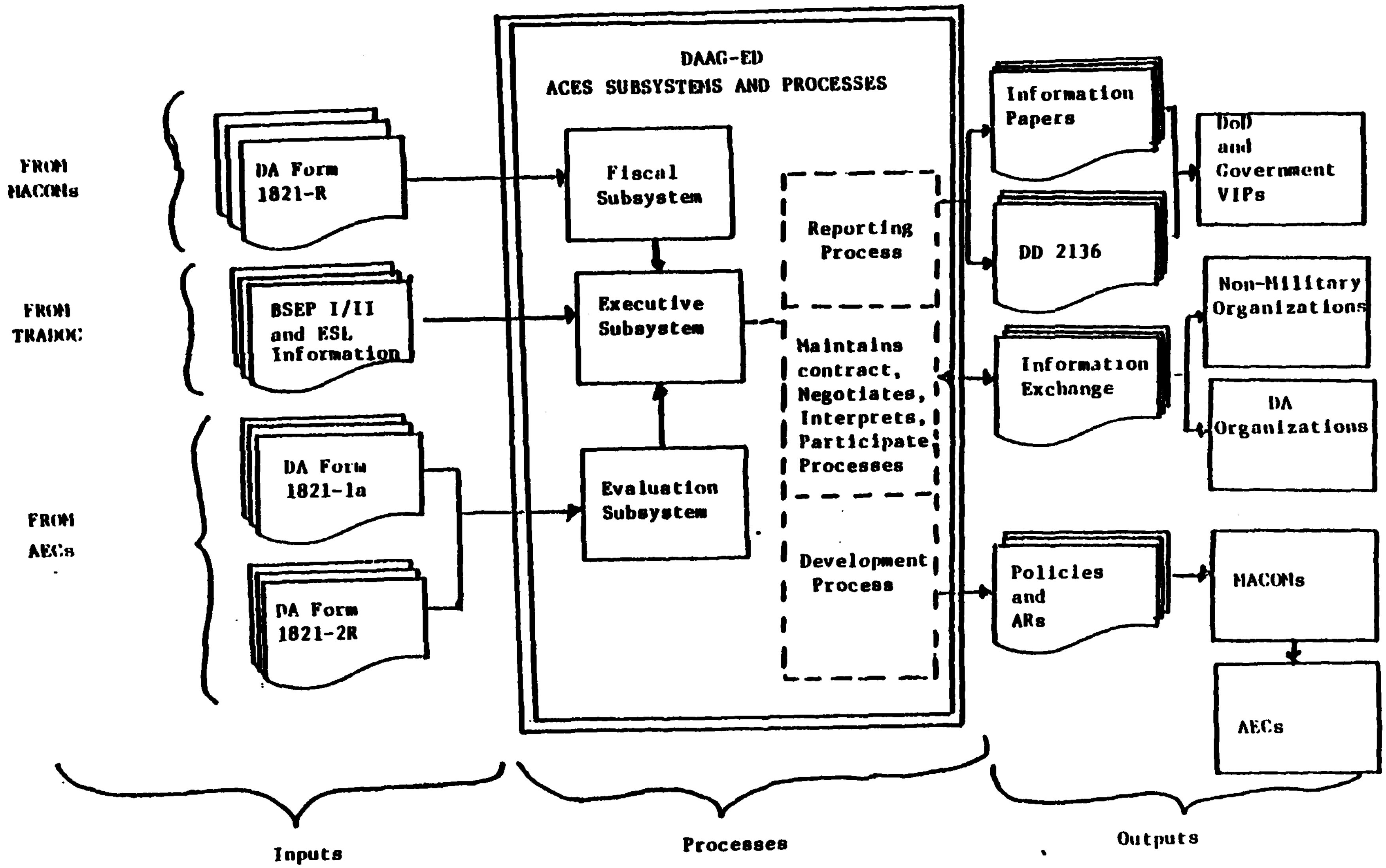


Figure 6. DAAG-ED Detailed Information Flow Model (IFM)

This does not mean that these subsystems and processes are unique to DAAG-ED. To the contrary, they are inherent in each of the ACES organizations, but to varying degrees.

ACES SYSTEM EVALUATION

INTRODUCTION

As noted in the Methodology section, information has been gathered from a number of sources. Reviews of the reports from the Discover Foundation, the GAO findings, and the Defense Audit Agency Report were accomplished. Interviews with various MACOM representatives were conducted, as well as interviews with personnel at DAAG-ED. In addition, visits were made to a sample of AECs in order to gain additional information from those ESOs who have had experience in attempting to acquire or use technology to support their functions.

These sources of information provided a focus for the overall evaluation of the ACES system. First, we identified 14 major deficiencies in the ACES system. These items were then organized into one of three primary areas of emphasis, i.e., policy, technology, or data. Next, we identified the subsystems principally affected by these deficiencies (Figure 7).

The remainder of this chapter describes how current technology initiatives may ameliorate or alleviate some of these deficiencies and how each subsystem is affected by the initiatives. R&D initiatives are also presented to show how deficiencies could be impacted in the future. Lastly, this chapter describes the impact on ACES deficiencies by combining the current technology acquisitions and longer term R&D initiatives.

ACES DEFICIENCIES

In this section we present a list of 14 deficiencies indicated from an analysis of the information analyzed in this study. They are categorized as relevant to policy, technology, and data. (See Table 1)

Table 1. ACES DEFICIENCIES

Policy

1. Inconsistent program evaluation data
2. Lack of acceptable course mastery criteria
3. Non-standardized curricula
4. Insufficient counseling time
5. Lack of priority scheme for information needs

Data

6. Inaccessibility of individual soldier longitudinal data
7. Inadequate counseling capabilities (data)
8. Inaccessibility of accurate up-to-date individual soldier data
9. Incompatibility of data bases
10. Inability to continuously monitor soldier's progress in ACES program
11. Lack of current/accurate, accessible cost data

Technology

12. Incompatibility of technology acquisitions
13. Unsystematic use of technology
14. Insufficient automation support for the ACES subsystems

The list of deficiencies was completed from analysis of interviews and available documents. Interviews were conducted with ESOs at TRADOC, FORSCOM, and MDW, and with DAAG-ED personnel at TAGO. The document sources were noted in the Methodology section on page 4.

	DEFICIENCIES	COUNSELING	INSTRUCTION	EXECUTIVE	EVALUATION	FISCAL
		ACES Subsystems				
POLICY	1. Inconsistent Program Evaluation Data	x	x	x	x	
	2. Lack of Acceptable Course Mastery Criteria	x	x		x	
	3. Nonstandard Curricula		x		x	
	4. Insufficient Counseling Time	x			x	
	5. Lack of Priority Scheme for Information Needs	x	x	x	x	x
DATA	6. Inaccessibility of Individual Soldier Longitudinal Data	x			x	
	7. Inadequate Counseling Capabilities (Data)	x	x			
	8. Inaccessibility of Accurate, Up-to-Date Individual Soldier Data	x	x		x	
	9. Incompatibility of Data Bases	x	x	x	x	x
	10. Inability to Monitor Soldier's Progress in ACES Programs	x	x		x	
	11. Lack of Current/Accurate, Accessible Cost Data	x	x	x	x	x
TECHNOLOGY	12. Incompatibility of Technology Acquisitions			x		x
	13. Unsystematic Use of Technology	x	x	x	x	x
	14. Insufficient Automation Support for ACES Subsystems	x	x	x	x	x

Figure 7. ACES DEFICIENCIES AND SUBSYSTEMS AFFECTED

Policy Deficiencies

• Inconsistent program evaluation data. It was reported during interviews both at TAGO and in the field that program data are maintained manually at the AECs. Although data required for the 1821-R are always maintained, these data primarily describe the fiscal status of each program. A comprehensive evaluation should also look at effectiveness, and these measures are most directly tied to field performance. There is currently no mechanism available for field feedback and retesting (DAS Report, 1981) to pass information back to the AECs to know what effect their programs are having on the performance of the soldier after graduation. Any feedback now given on effectiveness is anecdotal.

• Lack of acceptable course mastery criteria. According to AR 621-5, with the exception of ASEP, there are no requirements for contractors to teach to specific instructional objectives. Without the specification of objectives, the definition of course mastery criteria is left to the discretion of the teaching institutions. The "objectives" that the institutions across the country use vary in specificity and interpretation from installation to installation. Furthermore, from interviews, ESOs report that they receive primarily course completion data by soldiers; e.g., this soldier completed a given course on this date. As detailed course descriptions in the form of instructional objectives are missing, the ESOs are not sure of exactly what that soldier has completed. DAS (1981) also pointed out the need for standardized tests so that one can determine exactly what graduates do and do not know.

• Non-standardized curriculum. Even though the Army as a whole has adopted the ISD process whereby training programs relate to specific tasks and objectives which are to be achieved in training, the ACES system does not require adherence to ISD by its contractors. Moreover, most courses delivered within the ACES are delivered by a traditional delivery mechanism and developed in the traditional fashion. Each instructor works on his own lesson plan and delivers a course according to his own preferences. Thus, although courses may have similar names at different installations, the contents will vary according to what the instructors choose to put into them. This holds true both for BSEP courses, as well as for some of the advanced courses offered within the AECs (DAS Report of 1981, Review of Installation-Sponsored Education Programs for DoD Personnel).

• Insufficient counseling time. The amount of counseling time available is a direct function of the number of personnel in the AECs and the size of the installation on which they serve. In some of the larger posts where the AECs are commonly staffed with 3 to 4 counselors, available counseling time is not as critical as it is on the smaller posts or substations where it is likely that a single ESO has to perform all administrative functions, as well as take a portion of the counseling functions required by AR 621-5. The ACES Needs Assessment Survey (Discover Foundation, 1979) found that counselors can only spend 35% of their time on one-to-one counseling activities resulting in not seeing 36% of their potential clients.

• Lack of priority scheme for information needs. It became apparent during the interviews that personnel at all levels within ACES felt they should have immediate on-line access to all information generated within ACES. In addition, it was a common feeling that other parts of the system do not need the kinds of data that they commonly request. The HumRRO analysis of information flow within ACES revealed that most of the data are generated at the AEC level, and that only selected data (in consolidated form) are used at the MACOMs, and in even greater condensed form by DAAG-ED to formulate policy and prepare information papers.

Data Deficiencies

- Inaccessibility of individual soldier longitudinal data. The 1977 GAO report pointed out the need for long-term evaluation data for comprehensive assessment of program effectiveness. In order to adequately evaluate the effectiveness of many ACES Programs, the soldier's career history should be examined. From interviews and documents alike, it seems that these data are only available in data bases with limited access and are not accessible (except by special request) by DAAG-ED personnel. Because DAAG-ED does not have control over the data bases in which longitudinal data can be found, it is difficult for them to request that new applciations programs be written to extract data in the particular forms and formats which would be most useful for their purposes.

- Inadequate counseling capabilities. Counselors need vast amounts of data when they are giving the soldier career and/or academic guidance (Discover Foundation, 1979). Some of these data exist on the soldier's Form 669 and in his/her 201 file. Additional data are required which specify what course offerings are available near the installation. Many installations are located in close proximity to other DoD sites. If adequate communication could be established between these sites, counselors could make soldiers aware of educational opportunities at these other installations.

- Inaccessibility of accurate up-to-date individual soldier data. Individual soldier data are kept in MILPERCEN Files. During interviews, ESOs stated that they could make use of individual soldier data in their needs assessment and planning activities, as well as for evaluating their programs. However, under normal operating conditions, ESOs do not have access to the large MILPERCEN data bases. They can make special requests through the MISO, but often the turnaround time for these requests is such that by the time the ESOs obtain the data, they are no longer useful.

- Incompatibility of data bases. If AECs, MACOMs, and DAAG-ED were given access to the data bases already identified in this report (e.g., MILPERCEN, etc.), they would need a collection of terminals and telephone hookups in order to be connected with all data bases. The incompatibility of data bases is also internal to ACES. Data elements are often not given the same nomenclature from post to post. The 1821 Form is an attempt to standardize the data which are used within ACES, however, 1821 only covers the fiscal subset of the required data.

- Inability to continuously monitor soldiers' progress in ACES programs. The monitoring of within-course progress for each soldier is the job of a contractor who is delivering the course.

Currently, there are no requirements in RFPs or SOWs for the contractor to make available to the ESO within-course performance data. According to the SOWs, only attendance data must be supplied on a regular basis to the ESO. DAS (1981) pointed out that this problem is also critical in the Tuition Assistance Programs, where soldiers may be carried on a school's registry when their status is incomplete in a course, or they are about to fail. The ESO must know the exact status of each soldier to verify that the soldier still qualifies for tuition assistance.

- Lack of current accurate accessible cost data. Cost data are reported on a quarterly basis from the AECs to the MACOM and DAAG-ED on Form 1821-R. Theoretically, these data should be maintained throughout each quarter so that making the entries on the 1821-R are merely a matter of transcription. However, because of the shortfall in personnel and various duties that have to be performed at the AEC, this is not the case. Very often, cost data are entered as a percent of the projected expenditures (e.g., 25% per quarter) as opposed to actual expenditures. These data are unrealistic because expenses are often incurred at different times of the year, rather than spread out evenly. Maintaining the required cost data in a manual system is extremely difficult, since there is this variable expense schedule.

Technology Deficiencies

• Incompatibility of technology acquisitions. According to FORSCOM, TRADOC, and DAAG-PLS, there are several systems which are in use for instructional presentation, data analysis, managment and reporting in ACES. These include PLATO, microcomputers, IBM systems, and DEC systems. Unfortunately, the programs written on one machine, and the way data are stored on a particular machine, are not compatible with application programs and data storage and retrieval requirements on other machines.

• Unsystematic use of technology. The uses of technology within ACES are generally predicated on isolated perceptions of need rather than detailed systems analyses which lend to establishing ADP requirements and then procurement. As no systematic analysis of ACES was ever performed, the resulting technologies are varied and idiosyncratic (e.g., they cannot be replicated elsewhere). the Army has attempted to standardize the use and procurement of technologies via AR 18-1. However, the timeframe for procurement under 18-1 is so lengthy that many organizations requiring new technology seek to circumvent the process in order to expedite a solution to their immediate needs.

• Insufficient automation support for the ACES Subsystems. The ACES Subsystems, as defined in this document, have extensive data requirements. Each subsystem includes processes which act on and use very specific data elements. The data requirements specified on pages 28 through 33 of this report were derived from AR 621-5 and interviews with ACES personnel (both at headquarters and in the field). If all of these data requirements were fulfilled, it would result in a massive amount of information--too much, in fact, for manual manipulation. The data base would have to be supported by automation in order for the subsystems to use the data efficiently. We could find no coordinated effort within ACES to translate all the data requirements specified in this report into data elements for purposes of automation.

The effects of these deficiencies are analyzed in a number of ways as indicated in the accompanying charts. Our first analysis indicates which of the subsystems are affected by each of the deficiencies (see Figure 7.) For example, the first deficiency listed "inconsistent program evaluation data" affects primarily the counseling, instruction, executive and evaluation subsystems. The impact is most immediately felt by the ESO and the counselor in attempting to help the individual soldier make plans for career development. On a larger scale, it also affects the entire planning function of ACES and DAAG-ED, thereby affecting the executive subsystem as well.

The following sections of this chapter deal with the impact of current technology initiatives and R&D initiatives on alleviating these deficiencies. We prepared a system deficiency audit relating deficiencies to technology acquisitions, R&D initiatives, and, lastly, a combination of both sets of initiatives (see Figure 7).

CURRENT TECHNOLOGY INITIATIVES AND THEIR IMPACT ON SYSTEM DEFICIENCIES

Introduction

The major MACOM technological initiatives to be described are: (1) the purchase of AIDS by FORSCOM with distribution to the various FORSCOM sites; (2) the planned TRADOC implementation of PLATO IV with a central computer at Ft. Leavenworth (CDC 6500) and distribution of PLATO terminals to support ACES programs throughout TRADOC. The TAGO technology initiative to be discussed is the TAGO Administrative Support System (TASS). Other technology initiatives seem likely to occur at the local AEC level rather than through MACOM purchases. This is exemplified by activities of the AEC at Ft. Polk (to be described later in this section).

Although each initiative was intended to improve some aspect of the ACES system, the overriding problem with all of these attempts is that they constitute a fragmented approach to data base development and management. It does not give the ACES program managers an easily accessible, unified data base for all of The Adjutant General's ACES programs. As long as technology initiatives are driven by local parochial interests, without any integrated guidance concerning the way in which information is to be organized and submitted, then program and policy level deficiencies will continue.

TAGO Technology Initiatives

The objective of the TAGO Administrative Support System (TASS) is to provide improved administrative capabilities to managers and administrators within TAGO. It has been operational since October 1979 and provides for integrated capabilities in the following application areas:

a. Electronic Mail. The ability to communicate electronically via computerized systems. It is designed to replace informal notes and memos and facilitate the distribution of information.

b. Document Management. The ability to manage documents throughout their life cycles from creation to disposition.

c. Data Research. The ability to gain convenient access to computerized information locators and directories of documents and files.

d. Executive Aids. The ability to have executive level personnel access various capabilities which improve personal time management.

e. Management Aids. The ability to access computerized problem-solving software in support of management functions.

The TASS equipment components are a central timesharing computer, terminals, distributed processors and specialized equipment. Applications requiring central storage of data or that need mainframe support are run on Digital Equipment Computer systems, with an operating system and associated telecommunications equipment. Access to the central computer is by a general-purpose remote terminal consisting normally of a cathode ray tube, keyboard and printer. In special instances, word processing machines are configured as remote terminals to interact with the central computer. Applications which do not require data sharinag or use of the central computer are locally executed through use of the word processing machines. Special input/output devices, such as optical character readers (OCR) and plotters can also be used. Also included are document image readers, and terminals for facsimile transmission.

TASS is available to DAAG-ED for use by program managers to both store and analyze program-specific data and communicate with the field via the electronic mail feature. This is the only initiative specifically designed within the TAGO organization that has the potential to help overcome the deficiency of insufficient automation support for all the ACES subsystems (#14). However, it does so only at the headquarters level.

FORSCOM Technology Initiatives

FORSCOM's primary ACES-related automation initiative is the procurement of 73 Bell & Howell AIDS teaching machines for distribution to six FORSCOM AECs. The device includes a supercontroller (APPLE II microprocessor adapted for educational uses), a 13" color monitor, a disc drive and controller, and a Centronics printer. Software for AIDS includes both APPLESOFT (a version of BASIC) and GENIS (an authoring software package). AIDS is to be used for instructional delivery in AECs at Forts McPherson, Lewis, Campbell, Devens, Bragg and Ord. It is intended that both off-the-shelf courseware be used (AIDS uses software which runs on the APPLE II microcomputer) and that in-house authoring of needed materials be done.

The procurement of the AIDS by FORSCOM will primarily affect the Instruction subsystem at the local levels. According to the FORSCOM representatives interviewed, they are to be used primarily for adjunctive or supplemental computer-based instruction. Orientation on the use of the AIDS is planned for ESOs and counselors; however, local determination at the AECs will be made concerning how to use the AIDS instructionally. Thus, it is not likely that this technology acquisition will provide an integrated solution to overcome the system deficiencies cited earlier other than alleviating, to some degree, deficiencies #8, #10, and #14.

A second initiative by FORSCOM involves connection to the ATARRS system with an IBM 3278 terminal and a printer. The 3278 also interfaces with the System V Level II WANG word processor, so that data can be entered into ATARRS via FORSCOM's word processing functions. The ATARRS, which is an acronym for A TrA ining Resource and Requirements System, runs off the USSAMSA computer in the Pentagon. One of the subsystems which runs under ATARRS is QMS (the Quota Management System). ATARRS and QMS are used to determine recruiting requirements for the Army which then translates them into training requirements. Seats are reserved on a by-name basis in service schools for soldiers as they are recruited. ATARRS updates the enlisted master file with this information. ATARRS will contain data for all of the Army's formal schools.

When completed (FY 85), ATARRS will also be helpful to ESOs insofar as they will be able to determine, by querying ATARRS, when soldiers with specific characteristics (e.g., MOS) are assigned to different bases. ACES programs can then be tailored in advance to these characteristics. From a management perspective, ATARRS could provide FORSCOM with more timely, up-to-date information about an individual soldier's status. While it may be a partial solution to overcoming that deficiency (#6) as well as #14, within the Executive Subsystem, this technology is different from the PLATO system planned to be acquired by TRADOC and is also different from the current software and hardware which has been purchased to be distributed at the other FORSCOM sites (e.g., AIDS) Thus, this added difference exacerbates the incompatibility among technologies.

TRADOC Technology Initiatives (PLATO)

Plans are underway to establish a networked system with a large mainframe computer and numerous users (up to 600 are possible now). The system is called PLATO (Program Logic for Automated Teaching Operations) and involves a large CDC central computer (CDC 6500) linked to PLATO terminals by telephone lines.

There are numerous PLATO terminals in AECs within CONUS (e.g., Ft. Campbell and Ft. Ritchie, etc.), and overseas (e.g., Brussels, Korea). Ft. Eustis is using PLATO V to deliver BSEP instruction under a PLATO CMI approach. Current TRADOC plans call for a proliferation of PLATO for purposes of aiding instructional delivery, improved management, and electronic mail. The PLATO terminals will run on the CDC 6500 mainframe at Ft. Leavenworth.

It is quite possible that the PLATO system could impact many of the existing ACES deficiencies (#'s 6, 7, 8, 10, 14). For example, the Instruction subsystem could be clearly improved by providing standardized testing, instruction, and management information for the AEC, the MACOM, and the DAAG-ED. However, a good deal of courseware and software development remains to be accomplished if the existing course materials on PLATO are to be integrated for satisfaction of Army needs and if the management information is to be available for all levels of ACES personnel. It is too easy to slide over from what could be to what is in our interpretation of the capabilities of the current PLATO system. For example, the mainframe CDC 6500 located at Ft. Leavenworth could provide much of the answers to the deficiencies cited above. However, its capabilities are to be shared not only by ESOs at various TRADOC schools, but with other DoD elements and agencies outside the Army, such as Air Training Command, FAA, etc. Experience dictates that wherever there is a sharing of network capabilities, priorities must be clearly established, and there is a tremendous contention that develops over which needs will be served first. This difficulty will be great enough within the Army and its various commands, but even more difficult dealing with agencies outside the developing network.

Local AEC Initiative (Ft. Polk System)

Fort Polk has had portions of their administrative activities automated for several years. Most of their activities have focused on Form DA 669. There are 15,000 active 669's at Ft. Polk at any given time with a turnover of 400-600 per week. The current system calls for maintenance of off-line records with the AECs inputting data onto a diskette which is picked up by an on-post messenger and delivered to the MILPO where it is put in a special DA 669 data base. Ft. Polk is developing an interactive system where each counselor and the main learning center will have terminals which are connected, through dedicated telephone lines, to the main computer. DA 669's can then be updated and initiated at any time on an interactive basis. The software assistance to set the system up is being provided by MISO (Management Information Systems Office). They have developed a special separate data base for the AEC to which the AEC is supposed to have constant access (the exception is Monday morning when the system is on maintenance).

In addition to the 669 data, contractors supply the AEC with their monthly billings and they break up the billings according to the breakdowns on the 1821-R form. These data are then input to the system and compiled 1821-R data can be requested at any time. Ft. Polk envisions that eventually the 1821-R can be transmitted to FORSCOM directly on the terminal (electronic mail), with no paper being transmitted.

Ft. Polk has two IBM 4331's (one is a Group II) that run in CINCOM (CINCOM Systems Inc.) Environment (similar to CICS) and use VM on the system. They are currently running a data base management system called TOTAL, which is put out by CINCOM that can also run on WANG computers. They use a language package put out by CINCOM called MANTIS.

The point of this description is that Ft. Polk's local initiatives, while an admirable attempt to deal with their data base management requirements, may be incompatible with the Army-wide, DA level effort, VIABLE (see page 64 for discussion of this R&D initiative) designed to accomplish the same purposes and more by 1983.

Ft. Polk's solution is analogous to that taken by TRADOC in that both are piggyback approaches, except that this is at the local level. There has been a good deal of groundwork laid for the sharing of resources avilable through the local post computer. Even on-post, this effort is a high risk. The computer is currently used primarily for operations. To date, the specific, dedicated individuals involved seem to have compatible interest and have provided mutual support for one another. However, this solution is the epitome of what could be characterized as an electronic cottage industry approach. Their achievements and their capabilities are based upon single-mindedness, dedication, and a unique local constellation of events and resources. It is not something that can readily be replicated at other AECS. It is likely that the information from this approach; i.e., the data base, cannot be easily made available in a standardized way through the chain of command up to the DAAG-ED. Thus, the Executive subsystem is not aided by this timesharing approach in any integrated way, but only on a fragmented basis. Even though deficiencies #6, 10 and 14 are ameliorated locally, this would be a difficult as a model to implement at all the AECs world-wide unless mandated from higher headquarters.

<u>Summary</u>

This discussion of technology acquisition indicates that there are a number of significant ways to augment existing subsystems that could attempt to overcome a number of management and instructional deficiencies. However, because of the limited perspective necessarily held by each part of the organization (i.e., DAAG-ED, local AEC), satisfaction of an integrated requirement for both management and instructional information will not be achieved in this manner.

For example, of the 14 deficiencies listed in Table 1 (page 36). only 5 are in any way addressed by the current technology initiatives. Of these, only the TASS initiative is specifically designed within TAGO to help overcome the need for TAGO automation support, and it does so only at the Headquarters level (DAAG-ED). The inaccessibility of longitudinal data on an individual soldier is impacted only by the FORSCOM use of ATARRS and by the plan for use of PLATO by TRADOC. In addition to these two initiatives, the attempt by Ft. Polk to piggyback onto an on-post IBM 4331 may help to overcome this deficiency at their installation. PLATO provides the opportunity for better data in the Counseling subsystem at the local AEC level, as well as providing some access for accurate and up-to-date individual soldier data as the soldier completes a particular ACES course. The FORSCOM acquisition of AIDS will help the local AEC to obtain more accurate and timely individual soldier data, and to monitor the individual soldier's progress.

Other than these effects, the current technology initiatives do not address the majority of the deficiencies noted. There will continue to be inconsistent program evaluation data and non-standardized curricula. It is quite clear that a PLATO-like technology could provide solutions to a number of other deficiencies we have noted. However, this must be guided by policy decisions which would dictate structured information requirements and controlled standardized curricula. Moreover, policy should also dictate the manner in which the R&D initiatives are to be integrated into ACES as the emerging technologies resulting from these initiatives become available. For example, interactive videodisc projects, the ARIES and AARTS projects, as well as others to be discussed in the next part of thie section should be incorporated into a centralized ACES system through the development of appropriate hardware/software interfaces.

R&D INITIATIVES AND THEIR IMPACT ON ACES DEFICIENCIES

Introduction

For purposes of this report, it is assumed that R&D initiatives could have substantial effects on ACES only in the long term (i.e., 1990) time frame. This takes into account the need to move through various stages of research, testing, budgeting and Army-wide implementation.

There are several DA-sponsored technology-based research or development initiatives which could impact ACES. These projects range from general-purpose, large-scale hardware/software acquisitions, to special function software packages. Many of the ACES-related initiatives highlight deficiencies in the current system. For example, the automation of DA Form 669 is seen as a high priority item at three levels. DAAG-ED is funding AARTS, an automated transcript system, which includes the 669. TRADOC is planning to put 669s on PLATO. Meanwhile, Ft. Polk AEC, using their IBM installation computer, have automated their 669s already with an interim off-line system using floppy discs (to be converted shortly to a completely on-line interactive system). Implications of these efforts and the other initiatives for alleviating ACES deficiencies will be discussed later in this section.

The initiatives to be discussed include:

- 1821-R Automation
- AREIS
- AARTS
- SDMS
- UMD/Videodisc
- ARI R&D
- VIABLE
- JOIN

Automation of 1821-R

The DA 1821-R is the primary form on which fiscal data are entered into the ACES fiscal subsystem. The 1821-R will be on-line at DAAG-ED, in January 1981. The program is intended to:

- Eliminate consolidation of 1821 data by the MACOMs
- Permit entry of Educational Services Plan (ESP) data for projections and comparisons
- Facilitate statistical analysis of 1821-R data using standard software packages (e.g., SPSS)

The automation of 1821-R will replace many time-consuming manual operations, as well as permit new manipulations of 1821 data. Perhaps most importantly, it will allow for quick access to the data in several different output formats. The system currently consists of a custom software package which runs under the System 2000 DBMS on a time-shared (IBM compatible) computer. The system will assist DAAG-ED in the fiscal and programmatic management of ACES.

In addressing the deficiencies (as shown in Figure 8), automation of the 1821-R will allow for more consistent evaluation data by providing current, accurate, and accessible cost data at the DAAG-ED level (#11). Because the software runs on IBM compatible machines, it can be used on several Army systems (e.g., most installations have IBM 360/370's). However, no designated, dedicated ACES hardware has been established for its implementation. Therefore, this automation effort will provide only a small step in overcoming the Technology Deficiencies of the ACES (#12, #14).

The Army Education Information System (AREIS)

AREIS is a hardware/software counseling system which is currently in the development cycle. AREIS will have two distinct parts to it. It will have direct access functions for counselors and ESOs, to be used while the counselors are working with soldiers. Also interactive dialogues for enlisted personnel who want to get information about various ACES programs will be available. AREIS was implemented (on a pilot basis) on two separate systems. The first system, designed for use by soldiers, is composed of three components: an orientation which introduces the user to the content of AREIS, the services of the Education Center and to the various programs which make up ACES; the second helps users to define and access work-related interests, skills and values; and the third sets forth a number of short- and long-term goals which can be met during the period of military service or after separation. The second system, the Counselor Administrator System, is capable of displaying master schedules of courses given through the Education Center, modification of the soldier educational development record (DA Form 669), and data compilation for planning or report purposes. The interactive dialogues are currently being programmed. Operational hardware selection decisions have not been made regarding AREIS. The use of AREIS will alleviate some Data Deficiencies (#7, #8) by assisting counselors in being able to provide relevant and current course information to service members. It will also help overcome Technology Deficiency #14 in counseling by allowing service members to obtain information directly from the automated system.

Army/ACE Registry Transcript System (AARTS)

An Automatic Data Processing (ADP) system called the Army/American Council on Education (ACE) Registry Transcript Service is being developed to provide soldiers with transcripts of Army educational activities completed while on active duty. These may be used for school matriculation purposes or to supplement resumes of prospective employers. They will reflect Army formal service school courses completed, MOS credit recommendations, tests taken carrying ACE credit recommendations, and college courses completed at accredited post-secondary institutions. AARTS will principally affect the Instruction and Counseling Subsystems at the local AEC level.

The development of this service will take about two years and will involve two contracts. One has been awarded to the American Council on Education (ACE). The Council has a threefold role in the system's development:

- To establish a quality control function
- To maintain and update the data base (Army formal service schools and MOS credit recommendations)
- To market the registry

The second contract consists of securing ADP services for systems analysis and design of the transcript, and it is estimated that the analysis and systems development will take two years (until 1983). At the current time (November 1981), a hardware/software system for AARTS has not been selected.

AARTS will enable AECs to maintain accurate enrollment and completion data for their various course and program offerings. As noted in Figure 8, this initiative will help alleviate certain Data and Technology Deficiencies (#7, 8, 14). The AARTS data will allow for more accurate and continuous evaluation of programs, and expeditious reporting of service members' involvement in ACES. AARTS will provide more up-to-date and accurate individual soldier data for use by both counselors and service members.

Evaluation of a Spatial Data Management System (SDMS)

The goal of this project is to develop and evaluate instructional applications of an advanced multimedia technology. The technology is based on the concept of spatial data management, a technique for organizing information spatially and hierarchically.

The vehicle for this evaluation is a Spatial Data Management System (SDMS) which incorporates videodisc, microprocessor, and other devices which have promising features for instructional purposes. The Army's Basic Skills Education Program (BSEP) is serving as the context for the project.

In Phase I, two tasks are being performed. The first involves a comprehensive R&D program in spatial orientation skills; the second concerns the BSEP category of learning strategies. In Phase II, a third task will focus on the attainment of basic skills related to a cluster of Military Occupational Specialties (MOSs). The project, under contract with HumRRO, will be completed in 1984.

SDMS could be used for instructional delivery of standardized curricula (addressing deficiency #3), be used to provide continuous monitoring of individual or grouped student progress (#8, 10), administer standardized tests, and be used by counselors to support their job activities (#14).

University of Maryland System (UMD/Videodisc)

The University of Maryland is currently developing the second version of its prototype microcomputer/videodisc system. In the first version, ten (10) terminals were involved. Six (6) of them are used as stand-alone systems and the other four (4) are multi-user stations. Hardware reliability problems in the multi-user envirionment caused a second prototype to be developed. The current prototype is Z80 based, with one double sided 5¼" floppy disc, one ten megabyte Winchester type disc, a 512 x 512 resolution color graphic monitor with a touch panel and digital sound, and a videodisc player. The new units are meant to be used as stand-alone instructional delivery devices. Three prototype terminals and courseware (i.e., BSEP) will be delivered by the end of FY 81 to be used in USAREUR ACES facilities. This initiative could provide a partial solution to deficiencies #2, 8 and 10, and provide support to the instruction subsystem (#14).

ARI Research and Development

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has had a long history of research and development in the area of technology applications. The various R&D initiatives can be grouped according to the ACES subsystem which they principally affect. Most of the R&D will directly or indirectly impact the Instruction Subsystem. However, the following initiatives have the potential to improve the Evaluation Subsystem.

Third-Party Evaluation of TRADOC Developed Curriculum. In order to insure independent evaluation from the developer (the first party, TRADOC) and its contractor (the second party, to be selected), ARI will serve as the independent evaluator (i.e., the third party) reporting to the DA Staff. ARI plans to develop and conduct evaluations of revised Basic Skills Education Program components (e.g., MOS Baseline Skills and English-as-a-Second-Language). A comprehensive evaluation methodology for both the overall revised BSEP and its components will be designed and applied to determine whether BSEP produces results intended by program goals and objectives. An evaluation system will be developed to permit a continuing evaluation of ongoing BSEP programs by ACES personnel.

Multidisciplinary Evaluation Techniques. This research will support the third party evaluation of TRADOC developed curriculum by extending the state-of-the-art in evaluation techniques. The current state-of-the-art does not permit a quantitative assessment of qualitative improvements in basic skills. The focus of this effort will be multidisciplinary and will integrate the rich descriptive nature of cultural anthropology with the quantitative rigor of psychometrics. These new techniques will be included in a comprehensive evaluation methodology for the Basic Skills Education Program so as to determine whether BSEP produces results intended by its program goals.

Embedded SQT. Computerized Embedded Skills Qualification Test (SQT) is capable of providing detailed immediate performance feedback. In the Embedded Tactical Fire Direction System SQT, a detailed Soldier's SQT Report is provided immediately after the soldier completes all test items. The current embedded SQT work began in July 1979, and the concept has been demonstrated in preliminary versions several times at Ft. Sill. The product from this effort was a PLANIT-based SQT covering 28 tasks and approximately 36 scorable units. Materials in the deliverables included a magnetic tape containing the scorable units to cover the 28 tasks, a computer listing of all units, and supporting instructions and annotations.

The initial effort was so successful that the Field Artillery School requested continued development of the Embedded SQT. Specifically, this additional work expanded the Embedded SQT to higher skill levels and will also develop documentation and procedures for field validation. The validated and fielded SQT will be used by the Directorate of Training Developments at the Field Artillery School for testing TACFIRE operators at the Battalion level. The validated and fielded SQT was finished in September 1981, and will allow the test to be administered in units where TACFIRE is developed, e.g., Ft. Hood and USAREUR in June 1982.

Future considerations include the possibility of 'tailoring' or 'adapting' an SQT to the individual student. Preliminary research results indicate that test length could be reduced from 20 to 50% with no decrease in accuracy, with similar savings in test taking and administration time.

Other initiatives will, if successful, have implications for the ACES Executive and Fiscal Subsystem.

Information and Dissemination Center for Basic Skills. The objective of this effort is to design, develop, implement, and evaluate an information center for basic skills. It will include information and techniques to reach MOS baseline skills, English-as-a-second-language, life coping skills and learning strategies. This center will synthesize information consistent with the state-of-the-art in educational research and practice, and then will disseminate through TAGCEN cost-effective techniques for adoption. Following an initial needs assessment, a prototypical information center will be developed. The utility of such a center will be determined. If cost-effective, then it will be transferred to a non-R&D agency.

Revised Screening Techniques. An effective revised basic skills education program will dramatically change how soldiers perform in both the training base and first duty assignment. For example, for the Hispanic soldier, there will be extremely effective English-as-a-Second-Language courses coupled with efficient and effective learning strategies and life coping skills modules. In addition, modules will be available for teaching prerequisite knowledges and skills in the soldier's MOS. All of these activities will require revising current screening techniques (e.g., Armed Services Aptitude Battery (ASVAB). Thus, new screening, classification and assignment techniques will be developed and validated.

Revision of Functional Approach Concepts. Army policy has directed a functional (job related) approach to the development of a curriculum to teach prerequisite educational skills necessary to (1) complete training for the award of an MOS, (2) job proficiency, and (3) achieving career development. Of necessity, this development effort must rely on the existing state-of-the-art. This research base was created in the early 1970's, and limited R&D in functional approaches has been conducted since them. Further, ARI is involved in the evaluation of the TRADOC developed basic skills curriculum. One of the outcomes of the evaluation will be to provide "early warning" of curriculum which are not effective and, thus, indicate what R&D in functional approaches to the teaching of basic skills must be conducted.

The majority of the ARI initiatives have the potential to improve the Instructional Subsystem.

Life Coping Skills in Europe. Major concerns of the U.S. Army in Europe (USAREUR) regarding retention and performance have prompted an investigation of the particular context of military life in USAREUR and its implications for the adjustment of personnel assigned overseas.

Problems such as low rates of reenlistment, high personnel turnover because of attrition, behaviors requiring disciplinary action and health-related early discharge may be due, in part, to soldiers' inability to adjust to the USAREUR environment. The major tasks to be accomplished are to (1) delineate USAREUR-specific life coping skills needed by first-term enlistees; (2) select/develop and validate instruments to measure life coping skills; (3) assess the extent to which first-term enlistees in Europe possess these life coping skills; (4) review and critique current programs within USAREUR which address life coping skills; (5) determine the relationship between coping skills and successful adaptation to USAREUR; and (6) develop and pilot test a prototype instructional program which addresses an aspect of life coping skills in USAREUR which has been determined to be important, lacking among large numbers of first-term enlistees, and not adequately addressed by existing programs.

Functional Literacy Tutor. Work is beginning on the design of a hand-held computerized device which will teach job-related vocabulary to soldiers of varying aptitude levels. Each tutor will contain up to 200 MOS-specific vocabulary items. The tutor will be battery operated with a single line display and speech output. A drill and practice paradigm will be part of each device. The production of the prototype device is expected to be completed in late FY 82. The device will be evaluated in early FY 83, and the design specifications will then be finalized.

GAMBLE (Game-Based Learning). Instructional games generate high interest and motivation among users, as well as provide a simulated environment for the development and maintenance of information processing and decision-making skills. The results of past and ongoing experiments at ARI have demonstrated that experience using a PLATO-presented logic game (MASTERMIND) facilitated the learning of logic diagrams similar to electronic troubleshooting tasks. The current objective of this research is to develop a methodology for categorizing instructional games to serve as a basis for a model for the design of game-based learning programs.

Extension of Navy/AF Research on Readability of Technical Documentation. The Navy and Air Force have R&D programs in technical documentation. Their research documents the lack of a relationship between reducing reading demands of documentation via standard readability formulas and improvement in reading comprehension. In addition, they have focused mainly on written text. ARI plans to build on their efforts by focusing on text and graphics displayed electronically (e.g., Computer-Assisted Instruction). An analysis and synthesis of design criteria for Computer-Assisted Instruction (CAI) courseware will be conducted. Then, an evaluation of selected alternatives to improve learning in a CAI context will be conducted. Finally, a pamphlet which provides CAI courseware developers with guidelines will be completed.

Evaluating Computerized Tutors. One of the most expensive aspects of the revised Basic Skills Education program is the cost of curriculum development using traditional instructional systems development approaches. An alternative approach is the use of intelligent Computer-Assisted Instruction (CAI) techniques to develop computer programs that represent the best instructional strategies to teach basic skills. These computer programs would be independent of content. Strategies will be investigated to teach, based on type of learning (e.g., procedures), type of teaching style (e.g., tutorial), purpose of the learning (e.g., learning procedures to be remembered vs. used), and soldier motivational levels.

Formulating Strategies for Technical Documentation. The objective of this effort is to develop technical documentation guidelines for designing CAI courseware. A three-year effort will be conducted. In the first year, analysis and synthesis of design criteria for CAI courseware will be conducted. An evaluation of selected alternatives to improve learning in a CAI context will be conducted. Finally, a draft pamphlet which provides CAI courseware developers guidelines will be completed.

Research in Learning Strategies. The R&D base in learning strategies is limited. Thus, a framework for learning strategies curricula in an Army context will be designed. This framework will be built upon the state-of-the-art in cognitive psychology, existing learning strategies curricula, and consideration of Army rquirements and learner deficits. A prototype learning strategies curriculum will be developed and evaluated for use with soldiers. Since TRADOC will pilot a curriculum in learning strategies based on the current state-of-the-art, ARI will focus on the 1985-1990 timeframe.

Motivation of Marginal Soldiers via Game Based Approaches. Many "marginal" soldiers are "turned off" by traditional educational strategies to promote learning. Yet these same soldiers seem to learn with minimal difficulty all of the complex electronic games available in bars and recreation facilities. ARI plans to build a device, to encourage practice in reading skills, that capitalizes on this phenomenon. It will rely on voice chips, powerful microprocessors, intelligent computer-assisted instruction to generate an entertaining but educationally sound game. The effort will be to design, develop, implement, and evaluate such a device for use in recreation rooms and education centers.

Interactive Videodisc. ARI currently has underway a three-year research effort to develop validated guidelines and documentation, including authoring guidelines, for a microprocessor controlled videodisc system. These will include: Instructional System Development procedures; guidelines for the use of graphics; specifications for a videodisc training delivery system; and specifications for a videodisc authoring/production system. During the third year, the revised procedures and system will be evaluated as they are applied by Army training developers. To date, work on a brassboard videodisc training delivery system, the brassboard videodisc authoring/production system, preliminary Instructional Systems Development procedures, and preliminary guidelines for the use of graphics have been completed. Videodisc training materials have been prepared for mastering using these procedures and systems. Future work will involve validating these procedures in the setting of the user to produce additional interactive videodisc training materials, generated by the target population for instructional developers.

PLANIT. Programming Language for Interactive Teaching is a Computer-Assisted Instruction (CAI) authoring system which is transportable to computer systems with FORTRAN or TACPOL compilers. During FY 81, PLANIT's transportability has been extended to permit operation on systems with a PASCAL capability. PASCAL is the base upon which the DoD-wide ADA language system is being built. Having PASCAL/PLANIT capability will insure immediate, uninterrupted installation of extant PLANIT packages (e.g., Embedded Training packages) on ADA-driven systems.

Microprocessor PLANIT. The installation of PLANIT on a microprocessor, if possible, would open individualized CAI to the many users of microprocessor-based tactical computer terminals, as well as the spectrum of commercial microprocessors. PLANIT, normally used on large computers with multi-terminal capability, has been installed on a hybrid microprocessor (August 80). In this capacity, it has permitted the tremendous capability of this language to be harnessed to provide the logic for an interactive, microprocessor-controlled videodisc system. Continuing work is underway to release it from this "hybrid" mode and permit it to operate in a stand-alone microprocessor mode.

PLATO-Basic Skills. A preliminary evaluation of the use of computer-assisted instruction for basic skills training was conducted at Ft. Belvoir, VA. Using the University of Illinois PLATO computer-based instruction system, ARI designed curricula in mathematics and language arts to meet the local needs of the Education Center. Curricula were built from existing PLATO courseware, and replaced about 1/3 of standard instruction. Results with a small sample of students indicated that on each achievement measure, students using the CAI curriculum had higher scores than those receiving standard instruction. These differences, however, were not statistically significant. These curricula are in daily use and students have logged several thousand hours of computer use in the past 24 months. The focus of the Basic Skills Education Program has changed since the evaluation from general to functional, job related literacy training. ARI is currently developing courseware which will be directed towards teaching mathematical skills required for first aid and mathematical learning strategies. The curriculum will be designed to make maximum use of the computer to assist a student's pre-entry performance, and provide remediation only in deficient skills. This courseware will be evaluated late FY 81.

PLATO Map Reading. With ARI assistance, the University of Illinois ROTC unit developed computer-assisted courseware in map reading on the PLATO system. Eight lessons provide about 40 hours of individualized instruction in basic map reading topics. Two of the lessons are concerned with training terrain visualization, or visualizing three-dimensional forms via their two-dimensional contour line representations. The first lesson teaches the basic rules of contour lines; the second allows a student to view three-dimensional terrain forms from points on simplified contour maps. These lessons are currently being used in ARI research which is investigating the effects of individual differences and two forms of student-computer interaction on computer graphic effectiveness. Results will have implications for selection of training media and will provide an initial evaluation of the use of computer-based instruction for map reading training.

The value of each of these initiatives to a long-term ACES system must be speculative. However, as a conglomerate the initiatives clearly indicate that the future ACES Instruction Subsystem (instructional delivery and management) and, to a lesser degree, the Executive, Evaluation and the Fiscal Subsystems will be technology based and/or supported (addressing deficiency #14). Some of the specific initiatives (e.g., Functional Vocabulary Tutor) may cause programmatic and policy changes (e.g., some of BSEPII becomes electronic), therefore, some contracting may be replaced by alternative instructional methods. Others (e.g., involving PLANIT and PLATO) may facilitate the sharing and dissemination of courseware (#3).

Vertical Installation Automation Baseline (VIABLE)

Project VIABLE is intended to meet future Army ADP needs at the installation level. VIABLE is being undertaken by the U.S. Army Computer Systems Command. Data-based management systems are an integral part of VIABLE ADP Resources (ADPR). The VIABLE ADPR are to replace the ADPE at 47 sites (40 BASOPS sites, 5 MACOM Headquarters, and 2 "test beds"). The VIABLE ADPR includes hardware and software to support batch and interactive installation requirements and executive software including programming language processors and selected supporting (non-applications) software. Existing Standard Army Multi-command Management Information System

(STAMMIS) application programs will be changed from the current ADPE to the VIABLE ADPR (primarily a batch-to-batch transition).

Value to ACES at this point can only be speculative. ACES requirements are not part of this initiative. Conceivably, VIABLE if modified could provide a way to meet the MIS deficiencies of ACES, but an explicit requirement of priority would have to be established within the ADPR.

Joint Optical Information Network (JOIN)

JOIN is an initiative of the Recruiting Command. The system will consist of an interactive videodisc, microcomputer, monitor and printer. It will have the capability to deliver audiovisual material to the potential service member. Currently, a series of videodiscs are being produced to show Army jobs, programs, and units/stations of assignment. Just as JOIN is intended to facilitate the recruiter/applicant interaction, the materials could be used by counselors to assist the service member in better defining their career goals. In addition, the JOIN station could be used as an independent (e.g., counseling or instruction) delivery device in a learning center. Part of the implementation of JOIN includes maintaining information on the career selections of applicants. Career selection data could be used to project school and educational support needs during the applicant's Army career. To date, however, no specific ACES requirements are involved in this initiative and, therefore, without modifications to the software data base, hardware and, more importantly, priorities for use, this initiative will not satisfy any ACES deficiencies.

Summary

The impact of the various initiatives on the deficiencies cited earlier is shown in Figure 8. Cells have been filled in where the initiative will impact the deficiency by design. The answer to whether the initiatives can ameliorate other deficiencies is contingent on modifications in intended use, or hardware, or both. Several of the initiatives are currently at a stage in their development where hardware can still be specified in such a way that compatibility can be enhanced. Also, the addition of relatively minor features may permit expanded use of the technology (e.g., adding raw data input to the DA 1821-R automation to enable AEC use). Modifying systems outside ACES to serve ACES requirements and/or using existing materials is another way to fill more cells in the matrix (e.g., using videodiscs developed for JOIN or modify JOIN to accommodate ACES).

The proliferation of initiatives compounds two deficiencies (#12, 13), i.e., "unsystematic use of technology" and "incompatibility of technology acquisition." The initiatives address specific problems in ACES subsystems and may indeed make some processes more efficient. However, the potential incompatibility of these initiatives with technologies in operation may well dilute such positive effects.

The principal deficiencies that are addressed by these new initiatives fit into the area of providing better, more accurate, and timely data for counselors, instructors, and headquarters personnel.

Notwithstanding the above possibilities for meeting some of the deficiencies, it is still the case that none of the initiatives deal with

SYSTEM DEFICIENCIES		TECHNOLOGY INITIATIVES					R & D INITIATIVES							
		TASS (TAGO)	ATARRS/OMS (FORSCOM	AIDS (FORSCOM)	PLATO (TRADOC)	TIMESHARING (AEC)	AREIS	AARTS	1821 AUTOMATION	UMD VIDEODISC	SDMS	ARI R & D	VIABLE	JOIN
POLICY	1. Inconsistent Program Evaluation Data													
	2. Lack of Acceptable Course Mastery Criteria													
	3. Nonstandard Curricula													
	4. Insufficient Counseling Time													
	5. Lack of Priority Scheme for Information Needs													
DATA	6. Inaccessibility of Individual Soldier Longitudinal Data		x		x	x								
	7. Inadequate Counseling Capabilities (Data)				x		x	x						
	8. Inaccessibility of Accurate, Up-to-Date Individual Soldier Data			x	x		x	x		x	x	x		
	9. Incompatibility of Data Bases													
	10. Inability to Monitor Soldier's Progress in ACES Programs			x	x	x				x	x	x		
	11. Lack of Current/Accurate Accessible Cost Data								x					
TECHNOLOGY	12. Incompatibility of Technology Initiatives								x					
	13. Unsystematic Use of Technology													
	14. Insufficient Automation Support For ACES Subsystems	x	x	x	x	x	x	x	x	x	x	x		

Figure 8. Impact of All Initiatives on System Deficiencies

most of the policy problems. Moreover, it is important to note that the deficiencies regarding unsystematic and incompatible technology developments still remain as long standing obstacles to be overcome.

SYNTHESIS OF ALL INITIATIVES AND IMPACT ON ACES DEFICIENCIES

In assembling the effects of both the technology and R&D initiatives, we see in Figure 8 a number of interesting patterns. Perhaps the most obvious is that only half of the 14 deficiencies are addressed either in the near term (technology initiatives) or long term (R&D initiatives). Secondly, the deficiencies not significantly impacted are those dealing with the need for policy initiatives regarding evaluation standardization, priorities, and authorizations. The primary impact of the initiatives, near- and far-term, focus on overcoming the technology oriented deficiencies. The implications this has, however, for both near- and far-term ACES efforts are a perpetuation and possibly an exacerbation of existing problems based upon independent, uncoordinated technology-based projects.

As discussed earlier, the various initiatives do address automation support for the various subsystems. However, they do so with incompatible hardware and software and differentially across the various subsystems. For example, virtually all the far-term R&D initiatives will help to provide immediate access to accurate, up-to-date individual soldier data for each course. Thus, they will primarily affect the Instruction and Counseling subsystems. However, there will be little compatibility between AREIS and AARTS on the one hand, and the University of Maryland system, and SDMS, on the other.

None of the initiatives will provide for a compatible data base for all of ACES. This problem is illuminated in the near term by considering the three current technology initiatives by FORSCOM, by TRADOC and by one of the local AECs, Ft. Polk. These three efforts, while addressing the need for monitoring a soldier's progress in the ACES programs, and by providing greater accessibility of longitudinal data for an individual soldier, nevertheless will not have data bases that are compatible with one another. Quite simply, the AEC effort exists on IBM hardware, PLATO hardware is unique, as are the AIDS which FORSCOM is acquiring.

One of the implications, of the directions taken by the current incompatible technology and R&D initiatives, is that most needed management information support will be lacking for TAGO Headquarters to improve performance of executive subsystem functions, such as evaluation of programs, allocating counselors, or developing a priority scheme for information needs. Other deficiencies would remain as well, e.g., unsystematic use of the existing technologies.

One R&D initiative, will deal with such incompatibility and that is the automation of the DA 1821-R form. That at least can provide the fiscal subsystem, both at the TAGO level, as well as the MACOM and AECs level with some accurate accessible cost data. Moreover, if a given technology is required (i.e., designated hardware system), then it can provide a first step towards overcoming the deficiency of incompatibility of technology initiatives.

In short, for the near term we see five major initiatives, all of which will provide some aid in overcoming the requirement for automation support of the ACES subsystems. However, they will differentially accomplish this and will not provide a compatible data base on which to build future initiatives. With regard to the latter, we see a perpetuation of technology incompatibility, unsystematic use of such technology, and a continuing need to overcome many other ACES deficiencies.

In the next chapter, we will address possible alternative approaches for accomplishing the required actions.

ANALYSIS AND RECOMMENDATIONS

SYSTEM ASSUMPTIONS/CONSTRAINTS

Any recommendations for future technology support of ACES projects, programs, and activities will clearly be dependent upon certain assumptions, ground rules, procedures, and limitations. The following are a listing of the seven relevant assumptions that impact this report. They will be described in terms of the subsystems which they affect. Figure 9 illustrates this in capsule form.

1. Traditional Instructional Delivery. The main current method of instructional delivery is the classroom-lecture method. We assume that this will remain the primary delivery method unless ACES funds the development of alternatives. Traditionally, local installations have not funded instructional development, rather, they've contracted solely for instructional delivery (paid institutions so much per hour of instruction delivered). Since almost all ACES instruction is delivered by contracted institutions, it is logical to assume that these institutions will deliver courses in the same manner as they do at their home campuses. Here again, "stand up" lecture is the most prevalent approach.

The subsystem principally affected is instruction.

- Instructional Subsystem: One of the benefits of the lecture method is that minimal time and dollars are invested in the development of instruction. Many alternatives, on the other hand, require rigorous development activities. From the standpoint of AEC instructional management, traditional

ASSUMPTIONS/CONSTRAINTS	SUBSYSTEM AFFECTED				
	Executive	Instructional	Counseling	Evaluation	Fiscal
1. Traditional Instructional Delivery		X		X	
2. Educational Accreditation	X			X	
3. Mission (621-5)	X		X		X
4. Organizational Structure	X		X		X
5. Procurement/Management of Hardware (AR-18-1)	X	X			X
6. Educational Requirements = or Greater		X	X	X	
7. Continuing Requirements for Info	X	X	X	X	X

Figure 9. Assumptions/Constraints and their Impact on ACES Subsystems

lecture is the easiest instructional delivery method to manage, since the contractor merely has to be given a classroom and a scheduled time to be there and, then, the rest is up to the contractor. Technology-based instruction would require special facilities.

2. Educational Accreditation. One of the major incentives for participation in ACES programs is the acquisition of credentials from civilian institutions and agencies by service members. These credentials may take the form of degrees, diplomas, or certificates. Because of the value of these types of accreditation programs to the overall success of the ACES mission, we anticipate that they will continue to be a mainstay of the program.

The subsystems principally affected are executive and evaluation.

- Standards for award of credentials are set by the accrediting agency/institution. These standards usually acknowledge traditional areas of achievement, such as, length and/or type of work, and conventional course achievement (e.g., a grade in a three-credit hour course). In order for technology to be adopted in those programs which promise credentials to the service member, the accrediting institution/agency has to recognize and credit achievement in technology-based instruction and/or simulation. Although the initiative can be taken by those in ACES to negotiate recognition of technology-based instruction and job simulation, the final determinant remains outside the ACES system, under the aegis of the accrediting institutions/agencies.

- Evaluation Subsystem: In monitoring the activities of enrollees in the programs associated with accreditation, there are dimensions to the programs which make non-automated data management extremely difficult. Difficulties arise primarily due to the length of time a service member may be in a program. The duration of the involvement is such that the service member is likely to be at several different installations, conceivably under different MACOMs, during participation. Accurate records have to be maintained of such things as courses taken and hours worked in order for the sponsor to award appropriate credit and the ESO to accurately report the number of enrollees at the installation.

3. Mission (AR 621-5). The mission of ACES will not change dramatically in the next decade. ACES will continue to sponsor and administer programs which improve the service members' military and civilian skills and knowledges.

The subsystem principally affected is executive.

- Executive Subsystem: Society and, most likely, the Army will change, however, in that technology will become more pervasive in all aspects of the work and social environment. The inclusion of programs, by ACES, which use and teach about technology will be necessary for ACES to continue to achieve its mission.

4. Organizational Structure. The organization of ACES is likely to remain unchanged. The current organization relies on policy and budgetary information being initiated at the upper levels (DAAG-ED) and transmitted down to the installation via the MACOMs. The bulk of the data will remain at the installation level and be transmitted in amalgamated and condensed forms, back up the organizational chain. The subsystems principally affected are counseling and executive.

- Counseling Subsystem: Needs for immediate viewing of information will remain only at the counselor level. Since the counselor/service member interactions are dynamic, thare is no way to predict the specific information required during the counseling sessions.
- Executive Subsystem: Because ACES is tied so closely to the civilian and other military service programs, there will be an ongoing need, at all levels within the organization, for access to information which is outside the immediate ACES. These needs are felt most acutely at either end of the organization. For example, the AECs need a great deal of information about local course offerings, while DAAG-ED requires up-to-date information about Congressional activities.

5. Procurement and Management of Hardware (AR 18-1). Goals of AR 18-1 are to permit greater flexibility and streamlining in the acquisition of computer systems than the Army had previously. Decision-making is encouraged at the lowest practical level, and decentralization of procurement is to allow functional management for automation.

Changes to existing systems which are estimated to cost more than $100K will require a Mission Element Needs Statement (MENS). Wherever possible, mission needs are to be met by using existing systems, which implies review of what is available in the field before procurement of new systems. Functional users or proponent agencies identify the initial requirements in terms of data and requirements to protect data (Privacy Act of 1974). The AR specifies responsibilities of various agencies and components of the Army to meet automation and communications needs. The Assistant Chief of Staff for Automation and Communications (ACSAC) has responsibility for providing guidance for Army-wide automation, policy management, planning and resource management. ACSAC personnel also resolve issues concerning proponent interest in multi-functional systems. Their primary interest, however, is performing coordination functions for Class II systems (most of the ACES systems are Class IV or V). The Deputy Chief of Staff for Operations and Plans (DCSOPS) has responsibility for establishing Army-wide automation priorities and developing policy guidance for such documents as MENS or letters of authority, etc.

In addition to 18-1 itself, selected technical bulletins cited therein (18-100, 18-101, 18-109) are also relevant to this discussion. These bulletins specify the guidance for conducting the required Automation Economic Analysis (AEA) when considering automation alternatives to support a particular Army mission. Life cycle resource requirements have to be prepared for each automation alternative.

- Costs presented in the AEA represent the resource commitment that would be incurred if the proposed alternative were promulgated. Automation life cycle cost estimate forms are submitted for each automation initiative. They include cost data for the current fiscal year, as well as projecting out on a year-by-year basis to the system termination. Functional costs and savings resulting from a specific alternative should be included in the AEA for consideration against the baseline costs of continuing the present system.

- Cost tradeoffs should be presented in the AEA such as equipment that is purchased off the shelf that could reduce R&D costs.

- R&D costs include concept development, project and system management, and other developmental costs.

- Investment costs include ADPE purchase; communications equipment purchase; site preparation and installation; software development, conversions, and procurement; in-house training requirements; system definition, design, development and deployment time; and other one-time "investment type" cost factors.

- Operational costs, such as civilian salaries, military pay and allowances, and contractor costs, as well as maintenance and support costs, are also included.

The total constant dollar costs estimated during the AEA are used as a basis for providing PPBS input. Total costs for a particular project and system, and the labor expended by category (military, DA civilian, or other, e.g., contractor) for a particular automated system are used for this purpose.

The automation life cycle savings and benefit estimate form is designed to reflect dollar and personnel cost avoidance and/or savings. Data are presented on the basis of both constant dollar savings and benefits, and non-quantifiable benefits. The entries include, as appropriate for justification of the automation alternative, direct dollar savings, personnel man-year savings, cost avoidance, and personnel man-year avoidance figures. When all the data are collapsed into life-cycle estimates, they include three main areas of cost. These are research and development cost estimates, investment cost estimates and operation and support costs. The alternative automation approaches are then compared in constant dollars, as to the amount of savings and benefits on a fiscal-year by fiscal-year basis.

An AEA is required at each automation life-cycle milestone. At milestone 0, limited cost and resource information are available so a detailed AEA is not expected. Rather, an AEA at that point in time would include projected costs. By the time of Milestone 1 of the automation life cycle is reached, detailed information is more readily available and the complete series of AEA reports are required. As the project progresses through Milestones 2, 3 and 4, the accuracy of data in the AEAs is expected to increase. The automation life cycle present value estimate and cost schedule form must be maintained with current data, since it is the primary source of up-to-date cost information which is used in developing POM input.

The primary subsystems affected are: Executive, Fiscal, and Instruction.

- Executive: The Adjutant General (TAG) is responsible for policy and procedures for acquiring, managing, and using administrative systems, as well as the functional management of administrative system applications that operate on Army ADPE. The Commanding Generals of MACOMS are responsible for implementing Army automation objectives, maintaining control of automation resources, performing periodic review and evaluating automated systems and automation management, planning for the use of automation, approving automated system life-cycle actions, assisting in the development of

Army automation standards, acting as a proponent agency for major systems assigned by the HQDA functional proponent, and providing a (Project Management Office) PMO as the focal point for each command automation function or category.

The currently contemplated ACES systems are Class IV[1] and Class V[2] systems. It is likely that whatever system or systems ACES ultimately ends up with may fit either or both of those configurations.

- Fiscal Subsystems: Heads of Army staff agencies and MACOMS can approve the competitive acquisition of ADP equipment (not to exceed 10 computers per requirement) up to a cost of $300K (or $100K annual lease). If the ADP is dedicated to scientific and engineering applications, the total cost can be up to $500K or $200K annual lease. ADP support services can be acquired when annual cost per requirement does not exceed $500K. Non-competitive acquisition of ADP can be obtained also. Such acquisitions cannot exceed 10 computers per requirement where the total cost does not exceed $50K purchase or $18K annual lease).

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[1]Systems which are operated as standard systems within a single MACOM and are expected to cost less than $3 million are Class IV systems.

[2]Class V systems are systems which have an estimated development cost of less than $100K. Class V systems can be acquired by direction from a MACOM or HQDA.

Finally, the heads of Army staff and MACOMS can approve the acquisition of ADP maintenance services and necessary supplies. Outside approval has to be obtained if the acquisition affects a standard ADP systems configuration. TAGO is the functional proponent for all administrative systems. This means that TAG or a TAG designee must approve the acquisition of all administrative systems that run on Army ADPE. Part of the TAG procedure must be to verify that time is not available on existing ADPE to meet the requirement, and that existing ADP systems cannot be enhanced to satisfy the requirement.

- Instruction Subsystems: AR 18-1 does not make special provision for either word processors or "learning devices." Issue: By changing the name of the device to be acquired, can one avoid AR 18-1 limitations entirely? This is especially critical for instructional delivery if the user is intent on procuring either a separate system, or stand-alone microcomputer terminals, since there are many instances where the existing ADPE at a site can be modified to allow the administration of CBI, even though that may not be most desirable approach.

6. Educational Requirements Same or Greater (Target Population Characteristics). During FY 81, approximately 20% of Army enlistees did not have a high school diploma. During the previous year, more than 40% of all Army service members did not have a high school diploma.[3] This increase in the number of soldiers with high school

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[3]Extracted from: Karb, Lawrence (Assistant Secretary of Defense for Manpower Reserve Affairs and Logistics), DoD Press Conference on FY 81 Recruiting results, November 1981, Washington, DC.

diplomas reverses the trends of previous years. This is not surprising since there is usually a negative correlation between the state of the economy and recruitment success (Cowin, et al., 1980). Although the percentage of Category III and IV soldiers recruited dropped during FY 81, there are still a disproportionately large number (c. 75%) enlisting in the Army. Given these facts, the following long-term assumptions seem appropriate:

- The number of enlistees who have high school diplomas will go down as the U.S. economy improves.
- Most of the enlistees in the Army will continue to be Category III and IV personnel.

This continuing requirement will markedly affect the instructional, counseling and evaluation subsystems. ACES programs (e.g., BSEP, ESL) are specifically targeted for providing the baseline skills and knowledge required for MOS proficiency.

The subsystems principally affected are instruction, counseling, and evaluation.

- Instruction Subsystem: Because the individuals involved have exhibited that they do not benefit from traditionally delivered instruction (in the schools they came/graduated from), their needs may be better served by adopting innovative instructional approaches (e.g., functional, technology-based, etc.) which can adapt to individual needs.

- Counseling Subsystem: The demand for counseling will at least be as great as it is presently, with an emphasis on remedial programs, if the character of enlistees is as cited above. Needs for educational advice and help in coping with the increasingly high technology Army will likely compound this effect.

- Evaluation Subsystem: With the increased requirement for individualized instruction and advice, a critical need will exist for timely, reliable, longitudinal data to be available to the ESOs and counselors for immediate and accurate decision-making.

7. Continuing Requirements for Information. ACES is, and will continue to be, an information-based system. It uses, dispenses and generates information both internally and for use by others. Like other systems, ACES requires management information in such areas as accounting, policies and procedures scheduling, resource allocations, evaluation, etc. In addition, those data which are particular to an instructional system such as evaluative, enrollment, throughput, course catalogues, instruction needs assessment, etc., are required.

All subsystems will be affected by a continuing requirement for information. Because the ACES system revolves around the servicemember as both the primary user and originator of instructional data, it makes sense to consider this as the nucleus of the system of the future. Other data requirements build upon the instructional data or, conversely, affect the data by virtue of policy directives from the top down.

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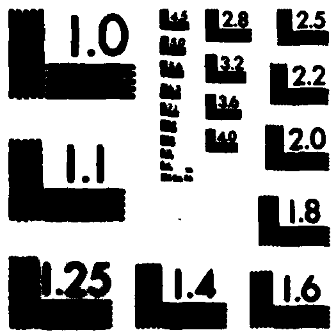

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ANALYSIS OF TECHNOLOGY REQUIREMENTS

In this section, we describe potential hardware configurations and costs as applied to handling ACES instructional and information requirements. The assumed model focuses on BSEP II requirements, yet should encompass all ACES needs for hardware. In addition, we will assume certain courseware and software costs to arrive at total costs for using state-of-the-art technology in a coordinated manner to address ACES system deficiencies.

Assumptions

A number of assumptions are made concerning the number of students, the availability of students per day, and the amount of time that the students will be using an interactive terminal for instructional purposes. The assumptions regarding students and AECs are as follows:

(1) There are 369 AECs.

(2) There are 6,000 students (soldiers) per day enrolled at the AECs for BSEP II.

(3) There are, therefore, approximately 17 students per day per AEC.

(4) The soldiers are available 4 hours per day for instruction at each AEC.

Since the students are available for 4 hours a day, out of an 8-hour total day, we assume therefore that half the students, or 9, will be available per shift. Therefore, all students could be covered by 9 terminals, resulting in one terminal per student per shift.

(5) We further assume that the terminals will have a 75% reliability.

Therefore, rather than 9 terminals, we would need 12 to handle the student load at any point in time.

(6) 50% of the course will be administered via the computer.

Thus, rather than 12 terminals to handle each student per shift, only half the number of terminals--6 will be required at any point in time. If we now apply a 1/3 error factor, then a total of approximately 8 instructional terminals are required per AEC in order to accommodate each student at his own terminal. For all AECs then, the total number of terminals would be 2,952, or approximately 3,000 to allow for one terminal per student per shift.

(7) If instead of 50% course administration via CAI we assume 25%, then the requirement would be 4 instructional terminals per AEC, or a total of 1,500 (1476) dedicated CBI terminals for all the AECs. (The same total would apply if we retain a 50% CAI assumption and share one terminal for two students.) Adding one terminal per AEC for data base management (DBMS) and one terminal at each MACOM and DAAG-ED, we assume 1900 total.

Specific alternative approaches to meeting generic system requirements were considered to arrive at comparative costs. The generic system which was postulated has the following characteristics.

In the AECs:

- Five intelligent terminals (4 for CBI, 1 for DBMS)
- Sufficient hard storage (e.g., disc) to maintain ACES records for all active personnel at the installation, cost/fiscal data, counseling information
- A printer
- Communications devices
  - local
  - remote

MACOMs:

- One intelligent terminal
- Sufficient processing power to produce consolidated reports from all AECs, run comparative and cumulative analyses on AEC data
- Sufficient hard storage to accommodate quarterly and annual data from the AECs
- A printer
- Communications devices (remote)

DAAG-ED:

- One intelligent terminal
- Sufficient processing power to analyze reports from MACOMs and AECs, and run simulations on projected ACES needs
- Sufficient hard storage to maintain annual records of ACES from MACOMs and AECs
- Sufficient long-term storage (e.g., tape) to maintain five-year historical records of ACES
- A printer

- Communications devices (remote).

Although the generic system specified an "intelligent" terminal, as a practical matter, we did not preclude having the "intelligence" in a local mainframe when we looked at alternatives. The key to the system is that there is processing power at each level of the organization.

Costs

Three alternative approaches were costed to meet the generic system requirements. If a system is designed that draws upon state-of-the-art microcomputer student terminals, interactive videodisc, local networking, and an $800 per station communications cost, we are assuming a cost of approximately $8,000 per station (videodisc and communications account for the difference between this number and the Appendix B detailed cost data).

The cost of a comparable student station for other configurations (e.g., local timesharing, remote mainframe-based network) also tends to be approximately $8K per station when the total system costs are amortized across users.

Therefore, hardware costs per se are not the primary factor one should consider when designing an ACES technology base. However, the terminal cost figures are instructive as seen in Table 2 for estimating funding requirements to accommodate varied percentages of CAI/CMI and other ACES information requirements. If we take the likely case to be 25% CAI and 1900 terminals (for both CAI and DBMS uses), then the cost for hardware would be approximately $3 million per year spread over five years.

Table 2. Costs of Varied Numbers of Terminals from the Above Assumptions

Terminals per AEC	CAI	Students Per Terminal	Total # Terminals	Costs* (in $ million)
5	25%	1	1900	15.2
9	50%	1	3400	27.2

*The figures do not include maintenance costs, which will be some small percentage of the purchase price over 48 to 60-month life of the hardware. Nor do these figures include the additional costs of high technology options from incorporating R&D initiatives.

The above figures do not include maintenance costs, which will be some small percentage of the purchase price over 48 to 60-month life of the hardware.

Courseware and Software Costs

Additional costs to be included are those for courseware and software. We are assuming a 300:1 authoring to contact hour ratio to develop the computer-based material and to allow for all conversions of software for any type of terminal for completed CAI contact hours (200:1 for CAI plus 100:1 conversion costs). We also assume 900 contact hours for ACES instructional programs (e.g., ESL, BSEP I and II, etc.).

Assuming a $36/hour development/conversion cost, 900 hours of CAI would cost $9,720,000, or approximately $10 million. These costs include all required instructional systems development costs, standardization, etc. Note that these courses, then, would be available for all AECs.

If high technology courseware developments such as videodisc are added, we assume they would occupy no more than 20% of a course. Thus, standard CAI would occupy 80% and cost $8 million (instead of $10 million). The videodisc production costs which now have to be added are approximately three times the cost of CAI. This would add $2 million times 3, or $6 million, to the total, yielding a new total cost of $14 million for courseware development.

If we add the hardware costs of $3 million per year to the courseware and software estimates and these costs are distributed equally over 5 years, this would require an investment of approximately $6 million per year. An investment of this size would alleviate the deficiencies of non-standardized curricula, fragmented MIS data bases, and give all ACES organizational components the required access to automation support.

One additional automation support cost is that for the design and development of the data base to be shared across all AECs, MACOMs and TAGO Headquarters. Based upon a Navy model (NEPDIS, 1977), the cost of software development of a MIS is approximately $5 million. This cost would be constant regardless of alternative chosen for technology augmentation, and is a one-time investment cost.

RECOMMENDATIONS

In order to overcome the ACES system deficiencies noted herein and to accomplish the stated objectives of ACES, our recommendations fall into two categories. One set without the other will not suffice to accomplish ACES objectives. These areas are policy recommendations and alternative technology recommendations. Together they constitute the necessary and sufficient conditions for reaching the ACES objectives as outlined in this document. They also will address the problems outlined by the GAO and Defense Audit Agency reports and will accommodate the recommendation of the DISCOVER Foundation report.

Policy Recommendations

1. As indicated earlier, the proliferation of incompatible technologies is likely to continue unless actions are taken now to prevent this. Therefore, it is recommended that DAAG-ED establish centralized control over the specifications for development and implementation of any new ACES system technology. This can be accomplished in a number of ways.

   a. At the Headquarters level, priorities should be established for information to be gathered either for management or for instructional purposes. This means that the priority scheme should accommodate <u>all</u> ACES subsystems data requirements and should be directed by DAAG-ED.

   b. Standardized curricula should be developed, wherever feasible, by creating uniform programs of instruction. These

POI's could then be part of any RFP for instructional delivery.

c. A policy needs to be established concerning the requirements for obtaining program evaluation data at all levels so that any new technology will have to provide a means for collection of the required data and for demonstrated distribution of that information across subsystems and across existing technologies, as required.

d. The alleviation of problems caused by a continued proliferation of technology requires that DAAG-ED support at this time the design and implementation of software and hardware interfaces for those technologies where the hardware base has already been identified.

The above recommendations, if followed, will ameliorate the problems of incompatible technologies and data bases by forcing the sharing of information in required formats, and will make technology acquisition in the near term much more compatible then they are currently.

2. Another possible recommendation for long term consistency, compatibility and adequacy of technology support would be for TAGO Headquarters to allocate funds for new technology implementations along with guidance as to how such funds should be spent. This guidance would be in the form of centralized specifications developed by Headquarters and incorporating the requirements for priorities and uniformity described in Recommendation 1.

Alternative Technology Recommendations

1. At this point, let us assume a 1,500 instructional terminal system (approximately 400 additional terminals would be needed for DBMS applications). With the widespread distribution of the organizational components of TAGO, networking of some sort will be required in a system. This networking can be accomplished in at least three different ways. The discussion below contrasts the three different approaches. Unfortunately, the very nature of the systems preclude definitive cost comparisons, solely in regard to the networking characteristics. For example, when one obtains the large mainframe system, there is some software and courseware resident; however, the intelligent terminals have no resident software. So the discussion below is presented for the reader to get a feel for the minimum costs associated with the three types of networks. (Costs for a more complete system are shown in Appendix B.)

- Large mainframe computer

  One approach would be to provide a large mainframe computer with control in a centralized location, such as at TAGO, with smaller nodes available at the MACOMs and non-intelligent terminals at the local centers. The cost of purchasing such a system would be approximately $7.5 million. This figure includes approximate costs for all the necessary hardware, including communications, modems, etc., for a typical commercial system. If an attempt is made using this system to provide for down loading onto a more intelligent learning station, then the cost per intelligent terminal would add roughly $500,000 for 1,000 users. Certainly, for estimation purposes, total costs would be no more than $8-10 million.

The advantage to using such an existing system is that libraries of course materials may be available. Current versions of such a system have been designed in a dedicated way for instructional purposes. The management information requirements of ACES would require additional software development (see page 106).

- <u>Distributed network of intelligent terminals</u>

Another approach is to create a network that is completely distributed where processing capability and intelligence is available at each of the AECs (certainly within CONUS) as well as throughout the MACOMs, with another node at DAAG-ED Headquarters.

Stand-alone intelligent (microcomputer) terminals which can be linked by networking currently exist. For example, ignoring for the moment, videodisc and other enhancements, off-the-shelf hardware is available to provide a 64-terminal network for a cost of $31,000 plus the cost of 64 terminals to be networked, which would cost approximately $160,000. To approximate the cost for a baseline, 1500-terminal instructional system, the multiplier would be roughly 24 times the figure of 160,000, or a total of $3,840,000. If one adds communications costs of no more than $1 million, and $1 million for 400 data base management terminals, then the hardware/communication costs would approximate $6,000,000 for such a 1900 terminal system.

With regard to communication between terminals at different locations, software already exists so that members of a network can access nodes within their network and communicate with large computers, various files, edit statistical data sets and send electronic mail. Thus, the communications software issue is not a relevant one in making a choice in this type of network either.

- Clustering

An intermediate kind of networking could provide for a large cluster of terminals as part of a stand-alone system, and the stand-alone systems could then be linked one to another.

A local time-sharing stand-alone system which is currently available provides for 128 simultaneous users as advertised and has all the features of a good CBI system in terms of instructional management, color, graphics, electronic mail, possibility for instructional materials development and student evaluation data, as well as communications between terminals or between mainframe computers. The cost of such a system for 1,000 simultaneous users would, of course, require a multiplier of approximately 7.8 times the cost for a basic 128-terminal system (approximately $800K). This results in an overall systems cost of $6.25 million. Existing and anticipated applications of such systems are all tailored to user needs and in the future could include networking of various sized clusters. Nevertheless, all variations of the local, stand-alone, time-sharing concept examined so far range between $6-12 million to provide the 1,500 instructional terminals to potential TAGO users.

Regardless of which approach is chosen, the system of choice must be dedicated to the satisfaction of ACES objectives. Attempting to share the resources of another command or another agency will not suffice. This means that any new technology-based system will have to be acquired by TAGO solely for ACES applications.

2. Regardless of which configuration is pursued by TAGO, it will be essential that any RFP for instructional delivery in the future requires the use of the standardized technology by the contractor. This may become part of a GFE in any instructional RFP, or it could be bid as part of the costs by the prospective contractor. In any event, given that the computer will be used as an adjunctive instructional delivery device, then it will be supplementary to the lecture or seminar method used in the course (as noted in the section on Assumptions and Constraints).

Conclusions

On the basis of TAGO's R&D initiatives and current acquisitions, we recommend choosing a microcomputer-based system. This choice is consistent with what the reports by the Discover Foundation recommend for a counseling subsystem, and it appears reasonable that a microprocessor solution would be adequate as well for the instructional and management information requirements of ACES. Interfaces already exist between many of the available microcomputers and the laser videodisc, the latter having been highlighted in two of the state of the art research and development initiatives supported by TAGO.

For such a long term (1990 and beyond) acquisition, one should incorporate state-of-the-art technology in graphics, color, video, and authoring support for intelligent terminals. This recommendation has to be coupled with fulfilling the requirements for addressing and accessing the standardized data base requirements established by TAGO in Policy Recommendation 1 noted above. While plans exist for the linkage of microprocessor terminal with videodisc capability to a large mainframe, the basic approach is still one of a large centralized system, especially for course management. If TAGO is going to follow the existing approach of allowing local AECs to purchase its own computers then it would make sense to organize such a microcomputer distributed network by mandating standardized curricula, assessment criteria, etc.

Summary

In this section, the impacts of technology recommendations and policy recommendations on the overall specified list of deficiencies are summarized. The major point is that both policy recommendations together impact all the systems deficiencies; but each recommendation impacts different deficiencies.

Policy Recommendation #1 calls for the establishment of centralized control by DAAG-ED over ACES development and implementation. By exercising such control, DAAG-ED could require consistent program evaluation data, establish acceptable course mastery criteria, support standardization of curricula, allocate time for counseling, and establish priorities for dealing with information requirements. In addition to ameliorating the policy deficiencies that were identified, Recommendation #1, also impacts the technology deficiencies. It does so by calling for the establishment of a single set of guidelines and specifications by which to pursue compatible technology initiatives that would systematicaly and sufficiently support all ACES Subsystems.

Policy Recommendation #2 impacts the data deficiencies. If DAAG-ED allocates funds for new technology implementations, it can provide guidance as to how the funds are to be spent. That is, funding could be targeted and directed towards overcoming specific deficiencies inherent in the current system. It could, therefore, eliminate the various systems deficiencies related to data inaccessability and incompatibility.

Any of the alternative technology recommendations, if implemented, could overcome the technology and data deficiencies. However, this could not be done without implementing the policy recommendations mentioned above. Without such policy changes, the technology deficiencies would continue to exist. That is, without central control and guidance, there would continue to be incompatibility of the various technology initiatives, unsystematic use of these technologies, and no guarantee of sufficient automation support for all the ACES subsystems. Only at DAAG-ED is there a sufficient overview to see the needs of various AECs and MACOMs in a proper system-wide perspective. It is only at DAAG-ED that system-wide deficiencies are readily definable and recognizable and solvable.

Three alternative technology recommendations have been documented and discussed in generic terms in previous sections of this report. Which of these would be most appropriate given the ACES systems deficiencies, is yet to be determined. The final decision should be based on a detailed analysis of data elements and instructional requirements, revealed during the system acquisition process.

Given the information obtained from this study, a distributed network of intelligent terminals is considered the most viable technology alternative to overcome the systems deficiencies that were identified. A sample description of costs for such a system is given in Appendix B (in 1982 dollars). Estimates are given for $17.5 million of hardware to cover all ACES component organizations. Software costs for the development of a MIS (estimated from a Naval model, NEPDIS, developed in 1977) would be approximately $5 million. Courseware development costs were estimated at $14 million. The total cost, therefore, for a distributed network system is $36.5 million.

The choice of a clustering or large mainframe alternative is not as appropriate. These technology alternatives require either a large number of terminals per site for the clustering model to be cost effective, or an investment in the high costs of mainframe, communications, and time-sharing terminals for the large mainframe alternative. In addition, the large mainframe alternative would not be nearly as flexible a system as is necessary to satisfy the current ACES requirements, and its variable needs over time. It would be more flexible to add or subtract intelligent terminals to a distributed network as requirements and technologies change.

BENEFITS FROM IMPLEMENTATION

In July, 1981, DAAG-ED made known its automation objectives in a functional system plan. At the time, it was noted that none of the objectives were being met. They are reproduced below.

a. Program managers in the Education Directorate, TAGO, will be able to monitor the degree of achievement, rates of participation, and costs of the various ACES programs at various installations and MACOMS more effectively.

b. MACOM directors of education will be able to monitor the rates of participation and degree of achievement at each of the installations for which they are responsible and then produce their consolidated quarterly reports of educational activities (DA Form 1821) reports much more efficiently.

c. Education Services Officers (ESO) will be able to monitor rates of soldier participation, the level of achievement in programs offered at their installations, and produce their DA 1821 reports without the labor-intensive effort currently required.

d. Counselors will have an accurate record of every soldier's past participation in ACES programs and future education needs.

e. Much more timely and cost-effective program evaluation efforts at the installation, MACOM and DA level will be possible.

f. Service members will be able to gain timely and accurate information about the avilability of ACES programs and about the current status of their VEAP education accounts.

g. Service members will have access to the best computer-assisted instructional technology, for example, optical laser videodiscs.

The achievement of these goals and transformation of them into benefits can be accomplished if the recommendations noted in the last section are implemented as total systems solutions. Given the magnitude and complexity of both goals desired and benefits to be achieved with the use of technology, it must be emphasized that any choice of automation support must be a dedicated computer-based system supporting solely the ACES requirements.

For the near term, any technology choice or choices will only achieve approximations of the above noted goals/benefits. The selection of the CDC PLATO system, may be one practical and worthwhile answer with certain qualifications. It is strongly recommended that a system leasing arrangement be considered solely for dedicated use of ACES programs. The attempt to piggyback on an existing operational system, such as Ft. Leavenworth, is a mistake and should be disapproved before it gathers too much momentum. Secondly, FORSCOM should, in like manner, be permitted to continue its usage of more advanced micro terminals, such as AIDS. However, interfaces should be required between both of these technology alternatives to share information between systems and across AECs and MACOMs.

Keeping the benefits clearly in view, the technology selection in the near term must be accomplished by implementing policy recommendation #1--establishing standardized assessment criteria and, wherever feasible, standardized curricula as well.

For the far term, plans should be initiated now for distributed networking. By providing support in the next few years for software development, TAGO would be facilitating more adequate and systematic exploitation of the various microcomputers that might be acquired. This plan should include provision for various linkages or interfaces across many of the existing advanced micro terminals, as well as for interfaces with the latest videodisc equipment. This will, therefore, allow for continuation of current usage of FORSCOM purchases, as well as some of the local AEC acquisitions.

If such an integrated approach is followed, i.e., specifying the priorities of information, standardizing assessment criteria and requirements for consistent program evaluation, and this is coupled with the requirements to address the other deficiencies by systematically exploiting advanced technology, then TAGO can reach its objectives for ACES in a systematic and efficient manner.

Appendix A

SYSTEMS DEFINITION DATA COLLECTION INSTRUMENT

TOPICS

EXECUTIVE

1. How involved are you in the development of ACES plans, policies and/or procedures?

2. What is the process and the problems therein that you've encountered for disseminating information about ACES to the non-military community?

3. What information do you have to transmit to other components of ACES (e.g., AEC, MACOM, HQ DA, etc.)?

4. What is the balance within these communications between paper that has to change hands and more informal methods of communications?

5. Please list the various kinds of reports that you have to submit to other components within ACES and beside each cite the source of the information that you include in the report.

6. In what manner do you coordinate activities between ACES and local military units/organizations? Is there any way these coordination efforts could be improved?

7. How do you maintain contact with and encourage local schools and education departments to support and participate in ACES functions? Is there any way this liaison activity could be improved?

8. How do you negotiate with civilian organizations, agencies, and institutions to reach agreement on their involvement in ACES activities? Is there any way to improve this process?

INSTRUCTIONAL

9. Making sure that an instructional requirement which arises out of the needs assessment is really being met by the instructional program that you are offering.

10. Maintaining records to assure that the operational aspects of the course (e.g., scheduling, resource usage) are such that the largest majority of servicemen can avail themselves if the opportunity is provided.

11. Noting any problems in either the collection, filing and/or referencing the records that you need to monitor instructional programs.

12. Methods used to maintain control over the inventory of materials and devices in the Learning Centers and MOS libraries.

13. Making suggestions or recommendations that could facilitate/expedite preparation of SOW's for the RFPs.

14. Steps taken to ensure a curriculum-development effort you intend to contract does not already exist at another AEC and/or installation. Is there any way to improve the accuracy and completeness of these activities?

15. Procedures followed to ensure an instructional requirement you intend to contract is not already offered by a local civilian educational institution or encompassed in military training conducted at your installation.

16. Measures taken to ensure required educational publications, materials, equipment and facilities are available to instructors and students. Can these processes be improved?

COUNSELING

17. Actions taken to ensure each service member at this installation is aware of ACES programs and/or opportunities. Ways this process can be improved.

18. How do you provide advice to service members about in-service, as well as post-service, educational opportunities and their relationship to their military career progression. Suggestions for improving this process.

19. Steps to verify the likelihood of success when a service member selects a program. Needs for assistance in this endeavor

20. Ways to monitor a service member's progress within an ACES program after he becomes involved in one. Suggestions or recommendations about what would be necessary to make you more effective in this role.

21. Information the counselors need to have "at their fingertips" to be able to effectively counsel a service member.

22. Information the service member can access independently without the counselor being present (e.g., read a pamphlet about it, watch a slide/tape show, etc.).

23. Ways the counselors make sure that the information that they have and are presenting to the service member is current.

24. There are numerous different, and sometimes complicated, procedures service members must follow to take advantage of ACES programs. Way(s) you could improve your effectiveness in providing assistance in this area to service members.

EVALUATION

25 Records maintained to monitor the effectiveness of instruction.

26. Ways to improve the proposal evaluation process(es). Evaluation normally based on; e.g., costs, credentials of instructors, technology applied to instructional requirement, etc.

27. Once a contract is awarded, ideas about what is needed to assist you in effectively managing the contractor; i.e., monitoring its associated budget, ensuring the appropriate number of manhours is expended and ensuring instruction is delivered at the right time/place.

28. Procedures followed to evaluate the effectiveness of contracted instruction; e.g., cost-benefit analysis, appropriateness of delivery mode, criterion-referenced performance testing.

29. Ways contract evaluation could be improved.

30. Source(s) of the standards by which you judge the effectiveness, of the program, operation or policy, and on what basis are those standards set.

31. Amount and kind of information you collect within the space of say a year, a quarter, a month, or week. (Information regarding how well programs work).

32. Ways to improve the procedures/activities associated with the monitoring and administration of the following types of tests:

- academic
- language
- certification
- diagnostic and placement
- personnel inventory

33. Ways the processes necessary for service members to receive accreditation by the civilian community for military work experience and training, i.e., the AAP, could be improved.

34. Steps to assure the effectiveness, efficiency and ascertain the benefits of ACES facilities, operations and programs. Ways these efforts can be improved.

35. Means you use to ascertain the educational requirements of the military personnel assigned to this installation. Added forms of support useful to assist you in these endeavors.

FISCAL

36. Nature of funds under your direct control and ways you deal with them in terms of prioritizing, managing, administering the dollars.

37. Everyone operates within and must maintain a budget. Ways your activities associated with monitoring and reporting your budget could be improved.

38. In what way(s) could your activities associated with projecting future budgets be improved?

39. Ways to improve the activities necessary to report contract activities, e.g., monies and/or manhours expended on a monthly/quarterly/annual basis.

Appendix B

ESTIMATED COSTS FOR AN ACES DISTRIBUTED NETWORK

Assumptions: 5 stations per site x 369 sites (ACE's)
1 station per MACOM x 13
1 station at DAAG-ED

Site Costs:

1 Winchester 20 mbyte Unit	$3,595.00
1 Network Interface	405.00
1 Network File Server	1,995.00
5 APPLES (48K) @ $2K	10,000.00
5 Interface Cards @ $395	1,980.00
1 Modem	200.00
Site Total	$18,175.00
Basic Sites Total	$6,706,575.00

Option Per Site (AEC)

Electronic Mail	$2,251.00
High Quality Printer (DIABLO in quantity)	2,000.00
High Technology add-on (from initiatives)	10,000.00
Option Site Total	$4,251.00
All Sites	$5,258,619.00
Basic Total with options	$11,965,194.00
Add MACOM Stations @ $8,590.00	$111,670.00
Add Options @ $4,251.00	55,263.00
AECs + MACOM Total	$12,132,127.00
Add DAAG-ED Station (8590 + 4251)	12,144,968.00
If 1 Winchester Disk/station	$5,306,220.00 (add 4 per site)
Full system cost	$17,451,188.00

Software
- Software included: PASCAL, APL, DOS, BASIC
- Other Authoring software: APPLE-PILOT $150 per site

SOFTWARE

- Other software available $100-150/package
  - DBMS
  - CMI @ $500/site

add $184,500.

GRAND TOTAL SYSTEM ESTIMATE $17,635,688