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IDA PAPER P-2162

Ada SOFTWARE ENGINEERING EDUCATION AND TRAINING REQUIREMENTS WITHIN THE U.S. ARMY

Catherine W. McDonald
Teresa L. Anderson

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December 1988

Prepared for
Ada Joint Program Office

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IDA Paper P-2162, *Ada Software Engineering Education and Training Requirements Within the U.S. Army*, provides the results of a study that examined the Ada software engineering education and training needs of the U.S. Army. This study began with an in-depth look at the structure of the Army to identify all job classifications that may have an impact on the hardware and/or software life cycle. The next step was to identify the type of education and or training necessary for these job categories and where Army personnel may obtain the required level of training. The final step was to identify any deficiencies in the area of Ada software engineering education and training within the U.S. Army and make the appropriate recommendations to the Ada Joint Program Office (AJPO).

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Catherine W. McDonald
Teresa L. Anderson

December 1988

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EXECUTIVE SUMMARY

Background

Ada education and training is an important factor in ensuring that the Department of Defense's (DoD) language of choice is used to its fullest potential. The responsibility of monitoring the Ada program, which includes education and training, falls to the Ada Joint Program Office (AJPO). The AJPO tasked the Institute for Defense Analyses (IDA) to identify the Ada education and training needs of the Army, keeping in mind that to use Ada effectively one must also use good software engineering techniques. This report communicates the results of that tasking.

Findings

Officers, enlisted personnel and civilians in the Army have several options available to them for obtaining Ada education or training. Courses are available through the Army, the other Services and the DoD. Over 175 academic institutions offer Ada and software engineering courses and there are numerous workshops, symposia, courses, etc. available through the private sector.

There are approximately 35,000 enlisted personnel assigned to positions that may require the soldier to use Ada. Training for these assignments is obtained at the Army's Computer Science School. Both the Advanced Individual Training (AIT) course and the Advanced Non-Commissioned Officer Course (ANCOC) include Ada in the program and a stand-alone Ada programming course is being developed The AIT course is taught every week with an average class size of 18, depending upon the number of new recruits. The ANCO course is offered 4 to 5 times a year with the class size ranging from 17 to 34 per session.

There are approximately 11,600 officers, assigned to one of five functional areas, that need Ada training. The five functional areas are Comptroller, Operations Research/Systems Analysis, Research and Development, Systems Automation, and Contracting and Industrial Management. Within the Army, the officer may attend the Computer Science School, the Army Materiel Command (AMC) Software Engineering Intern Program, or the Army Management Engineering College (AMEC), all of which offer Ada training. Army officers may also attend courses at the Air Force Institute of Technology (AFIT), Keesler Air Force Base, or the Defense Systems Management College (DSMC). All three facilities offer Ada courses at least once a year. Class sizes at these facilities range from 12 to 35, depending on the availability of hands-on experience.

Most of the Army's software development and maintenance, other than Mission Critical Computer Systems (MCCS), will be done by Army civilians. There are approximately 12,175 civilians ranging from Computer Specialist to Computer Scientist that need Ada training. The engineers receive Ada training if they go through the AMC Intern Program, the Professional Development Center (PDC), or the AMEC. The Intern Program is a two-year program that offers several Ada and software engineering courses. The courses at PDC and AMEC run anywhere from one to 14 weeks with an average class size of 24. Civilians may also attend courses at Keesler, AFIT and DSMC.

Recommendations

The Army offers its new personnel numerous opportunities to obtain Ada education and training. Education and training received prior to the first assignment and early in one's career generally includes an introductory Ada course and software engineering. As a person's career progresses, it may be necessary to take additional Ada courses offered by the Army, other Services, or the DoD. However, the availability of Ada training for senior personnel in all three areas (enlisted, officer, and civilian) is lacking. Most of the senior managers attended the basic training courses prior to the inclusion of Ada in the curriculum. They now need to be introduced to Ada at the appropriate level.

Specific recommendations from this study include:

1. Approve the request by the Computer Science School to develop at stand-alone Ada course to meet the needs of the Senior NCOs who have already completed their course work but have not been introduced to Ada.

2. Incorporate Ada into the curriculum at facilities attended by senior officers (i.e., the Army War College and the Command and General Staff College).

3. Open Ada courses restricted to specific personnel (enlisted, officer or civilian) or to specific commands (i.e., Information Systems Command or Army Materiel Command) to all Army personnel.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the assistance of the numerous members of the U.S. Army who provided valuable background information for this study. Although it is impossible to thank everyone, the authors would like to especially thank CPT Chris Demery, U.S. Army Computer Science School, and Mr. Dennis Turner, U.S. Army Communications-Electronics Command, for their assistance in verifying Appendix D. Mr. Turner was also helpful in providing an expanded list of projects for Appendix B. Mr. Mark Oestmann, of the School for Engineering and Logistics, Red River Army Depot and Mr. Bruce Gray, U.S. Army Communications-Electronics Command, Ada Technology Branch, contributed substantial details regarding the Software Engineering intern program. Mr. Bob Beat provided information on the Army Management Engineering College and Mr. John Hovell was most helpful in explaining the role of the Professional Development Center.

The authors also appreciate the insights on education and training given by members of the Ada Software Engineering Education and Training Team, specifically Capt Will Bralick, USAF and Ms. Wanda Barber, Software Development Center, Ft. Lee. They would also like to express their appreciation to Mr. Al Miller of Logicon, who provided valuable insight into the potential problems and difficulties such as were encountered while doing a similar study for the Navy.

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PREFACE

The purpose of IDA Paper P-2162, *Ada Software Engineering Education and Training Requirements Within the U S. Army*, is to communicate the results of a study conducted by the Computer and Software Engineering Division (CSED) of the Institute for Defense Analyses (IDA) for the Ada Joint Program Office (AJPO). The study identifies who within the Army needs Ada software engineering education or training, the level needed, and where this education or training might be obtained. This document was prepared in response to subtask 4(e) of Task Order T-D5-296, Amendment No. 4, "Technical support in evaluating the Ada education and training programs within the Army." Because of time and financial limitations, no attempt was made to evaluate Ada courseware within the Army or their instructors. It is projected that P-2162 will be used to assist in evaluating training needs within the Army and provide guidance during the development of future Army Ada programs.

The document was reviewed on 28 November 1988 by the members of the CSED Peer review: Ms. Audrey A. Hook, Dr. John F. Kramer, Dr. Reginald Meeson, Ms. Katydean Price, Dr. John Salasin and Dr. Robert Winner.

1.0 INTRODUCTION

This paper provides the results of a study that examined the Ada software engineering education and training needs of the U.S. Army. The Army contracts out a majority of its software development and maintenance for mission critical computer systems (MCCS). Army personnel in computer-related positions are concerned with administrative systems or microcomputer applications (enlisted personnel), serve as contract monitors (officers), or develop and maintain administrative or command and control systems (civilians).

1.1 Background

In 1976, Department of Defense (DoD) Instruction 5000.31 added Ada to the "Interim List of DoD Approved Higher Order Programming Languages." [DOD 76] On 31 July 1986, the Under Secretary of the Army issued a memorandum stating that "Ada is the standard" (for the Army) and that "exceptions will be extremely difficult to obtain." [AMB 86] Then, in the spring of 1987, the DoD issued two new directives that mandated the use of Ada throughout the Services and DoD. DoD Directive 3405.1 requires the use of Ada in all applications and DoD Directive 3405.2 establishes the policy of using Ada in weapon systems. [DOD 87b, DOD 87a] Since that time, several projects have been developed within the Army using Ada. Appendix B contains a list of Army projects that have used or are using Ada. Over half of these projects have been contracted out by the Army. In fact, most Army software development and maintenance for MCCS are done by contractors. However, there are positions in the Army related to software development and maintenance, and these personnel need to be identified and, where appropriate, trained in Ada.

The Ada Joint Program Office (AJPO), as part of its charter, is responsible for coordinating Ada education and training activities.[DOD 80] In keeping with its charter, the AJPO has been investigating the various Ada education and training activities available within the Services and DoD. Through the identification of already existing Ada education and training, the AJPO can encourage the exchange of these resources within the Services and DoD. This type of information is now available through the AJPO's Information Clearinghouse, the AJPO's on-line bulletin board, the Catalogue of Resources for Education in Ada and Software Engineering (CREASE) and the Ada Software Engineering Education and Training (ASEET) Team (sponsored by the AJPO). This study provides the AJPO with an analysis of the Army's requirements for Ada and the availability of education and training to meet these needs.

1.2 Scope

This study began with an in-depth look at the structure of the Army to identify all job classifications that may have some impact on the hardware and/or software life cycle. The next step was to identify the type of Ada software engineering education and/or training necessary for these job categories and where Army personnel may obtain the required level of training. The last step was to identify any deficiencies in the area of Ada software engineering education and training within the U.S. Army and make the appropriate recommendations to the AJPO.

Section 2.0 discusses the Army personnel structure for those positions involved in the software development life cycle. Section 3.0 suggests the level of Ada software engineering education and training, if any, that is necessary for each job category discussed in Section 2.0. In Section 4.0 the reader will find a list of training opportunities available to Army personnel. Some of the training is specific to the Army while other training is available through the other Services or DoD agencies. Section 5.0 provides three tables that summarize the data provided in Sections 2.0, 3.0, and 4.0. Section 6.0 summarizes the study and provides recommendations for meeting the Ada software engineering education and training requirements of the Army. A glossary is provided in Section 7.0, Section 8.0 lists the references used during this study and the bibliography is located in Section 9.0.

Four appendices are provided to assist the reader. Appendix A includes detailed information on the courseware presented in Section 4.0. Appendix B provides information on those Army projects known to the authors that have used or are presently using Ada. Appendix C is a copy of the ASEET Team database on universities teaching Ada and software engineering with Ada. Appendix D provides a detailed discussion of the various Army computer-related personnel positions. This last appendix was prepared to help the authors better understand the structure of the Army.

2.0 ARMY PERSONNEL POSITIONS

2.1 Introduction

All three types of personnel in the Army (enlisted, officers, and civilians), may be assigned to positions involved in the software development life cycle. The enlisted soldiers and officers are concerned primarily with the use and application of functioning large scale embedded computer systems. The civilians provide a majority of the technical support in the Research and Development (R & D) Centers. (See Appendix D for a more detailed description of the Army personnel structure.) There are three enlisted fields, three Signal Corps (SC) officer speciality areas, five additional officer functional areas, and six civilian specialties which may have a need for some sort of Ada training, although not every employee in each specialty would require Ada training. Each of these specialties is summarized below.

2.2 Enlisted Personnel

There is only one Career Management Field (CMF) for enlisted personnel in the computer field. The Automatic Data Processing (ADP) CMF is given the Military Occupational Specialty (MOS) code of 74 and includes the three positions discussed below. Figure 1 provides a breakdown of the 3500 enlisted personnel assigned within MOS 74 during FY 87.

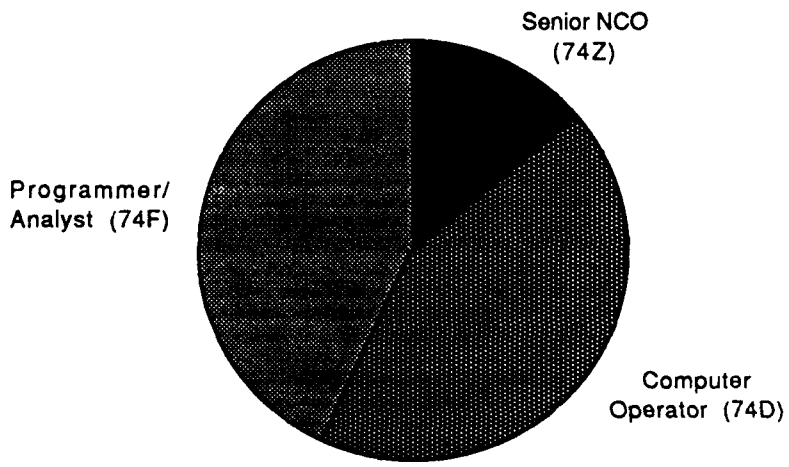

Figure 1. Enlisted Personnel with Computer-Related Positions[1]

The first position is the Computer/Machine Operator field (74D). The primary duties of the 74D at the junior level incorporate computer operation, maintenance, administration, and computer input/output control. At the higher levels of experience, the duties become more supervisory in nature and include inspection and evaluation tasks.

[1]Data provided by SGM Whit, US Army Total Army Personnel Agency (TAPA).

The Programmer/Analyst field (74F) is in the same area of expertise as 74D, but is more applications oriented. The junior levels are involved with developing charts, diagrams and instructions; preparing reports, flow charts and block diagrams; and having some program review responsibilities. At the more senior levels, duties involve more supervision and management tasks, and may also include systems operation, evaluation, and administration.

These two fields merge together at the E8 (Master Sergeant) level, and become the Data Processing Non-Commissioned Officer (NCO) (74Z) field. Because of this, both 74D and 74F soldiers receive additional training in their non-specialty area to assist them in supervising Operators and Programmers. Duties are mostly in the management and administration areas, including supervising the preparation of reports and studies, scheduling system operating and down time, serving as liaison with related functions, and conducting periodic inspections of programming methods and security procedures. [ARM 87]

2.3 Officer Corps

Officers in computer-related positions can be found in one of three specialty areas in the SC branch of the Army or in one of five functional areas (FAs). Of the fifteen branches in the Army, the SC is the only branch which has computer-related areas of concentration (AOC), as well as the five functional areas. The other branches only focus on the computer-related functional areas: Comptroller, Operations Research/Systems Analysis, Research and Development, Systems Automation, and Contracting and Industrial Management. The intensity of computer use or knowledge needed varies greatly among all these functional areas, and thus, the level of training will also be varied. A brief description of each of these positions is given below. (See Appendix D for more details.)

The SC is responsible for the Army's command, control, and communications systems, including hardware, software and related equipment. The systems are designed and built primarily by contract, and then used extensively within the SC. The first AOC is the Communications-Electronics (C-E) Automation area (25B), where the main duties focus on automated systems in networks which support tactical operations. The specific emphasis of 25B is on distributed database systems, teleprocessing systems and data communications systems supporting battlefield systems. On the other hand, the usage and maintenance of SC resources is the main emphasis of the C-E Operations (25C) area. These officers are involved in the installation, operation, and maintenance of automation and communications systems. Their principal duties include planning, coordinating and supervising the training, operation, supply, maintenance and resource allocation within a Signal unit or facility. Every Signal Corps officer is trained initially as an Operations Officer. The third AOC is C-E Engineering (25D). This position's responsibilities include test and evaluation of hardware and software both for developmental and non-developmental programs, and the direct application of electrical, electronic and automation theories and principles to the design, test, acceptance, and installation of computer based communications systems. [DAP 86]

Figure 2 shows a breakdown of personnel assigned to the five functional areas with no distinction made between branches. In FY 87, there was a total of 11,600 officers assigned to those five FA's.

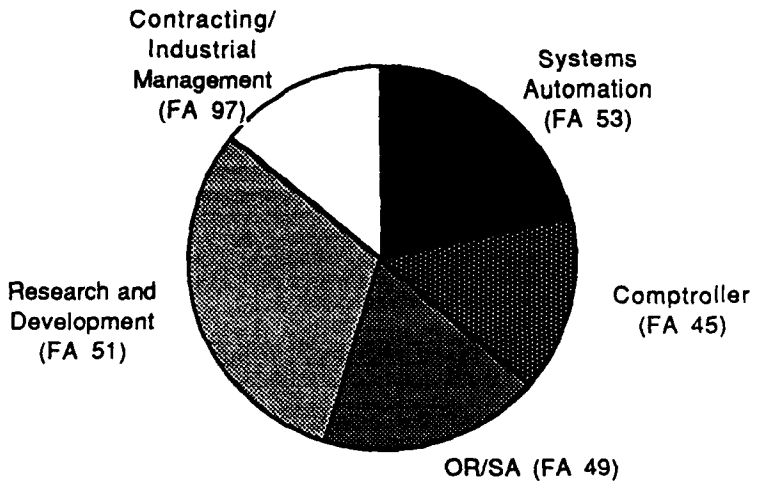

Figure 2. Officers in Computer-Related Functional Areas[2]

The first functional area is the Comptroller (FA45). The officer assigned to this area serves as resource manager for programming and planning. The officer is tasked with monitoring costs versus performance targets, as well as preparing recommendations for program budgets.

The second functional area is Operations Research/Systems Analysis (OR/SA) (FA49). This discipline focuses on the application of analytic methods to solve complex strategic and tactical problems. Many analyses require an in-depth knowledge of mathematics, economics, statistics and the use of computer simulation to properly test and document the system's reactions, and recommend modifications if needed. The systems can be operational or managerial, small and simple, or large and complex. For this reason, the ability to accurately model and analyze these systems is crucial for the FA49 officer.

The next functional area is Research and Development (FA51). Members of FA51 participate in the development of materiel and systems from concept through validation and deployment, in addition to providing support for operational tests and subsequent evaluations at system milestones. These officers also serve as management liaisons to coordinate system design with requirements and funding. Finally, the FA51 officer is tasked with determining future Army needs and cost effective ways to fulfill these needs.

A fourth functional area is Systems Automation (FA53). These officers manage software development, software and hardware integration, automated systems, and related support services. A combination of computer science, systems engineering, and information management enables the Systems Automation officer to serve as the integrator of military functions, scientific technology and management tools to solve Army

[2] Data provided by Maj Lake (FA 45), Maj Harris (FA 49), Capt Castner (FA 51 and 97), and Maj Moore (FA 53), TAPA.

automation problems. This field is the most computer science intensive and is often paired with the C-E Automation specialty.

The final functional area is Contracting and Industrial Management (FA97). Members of this FA actively participate in the procurement of advanced systems to meet the Army's needs through civilian and government contracts. From contract formulation and negotiation to administration and maintenance, the FA97 officer is involved with all aspects of the contracting process. This position is particularly intensive in the contract preparation and monitoring area.[DAP 86]

2.4 Civilian Personnel

As indicated earlier and shown in Figure 3, a majority of the Army personnel assigned to computer-related positions are civilians. Although it appears that Army officers run a close second, it should be understood that most officers serve in managerial type positions. As managers, these officers are not usually tasked with hands-on development or maintenance work. Almost all of the civilians are directly involved in hardware or software development and/or maintenance.

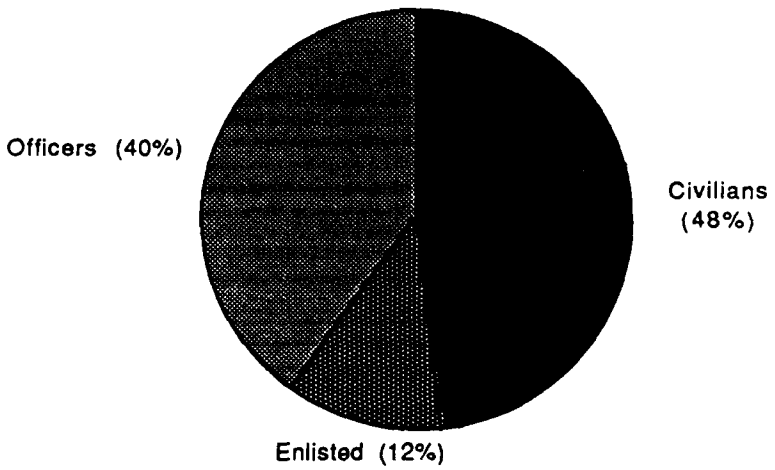

Figure 3. Total Army Personnel Distribution[3]

[3]Data obtained from "DoD Selected Manpower Statistics Fiscal Year 1987."

There were a total of 14,013 civil service employees in FY 87, serving in the six specialty areas which are directly related to the computer field. Figure 4 gives the distribution of these positions. The position of Software Engineer for civilians was not in place during FY 87, and therefore was not included.

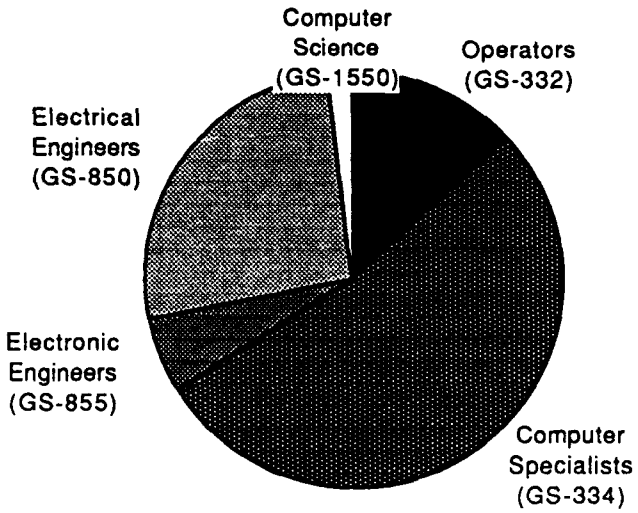

Figure 4. Civilian Personnel in Computer-Related Positions[4]

Two of these specialty areas do not require college degrees, but do require some related experience. The others all require a minimum of a bachelor's degree, and often advanced degrees are needed for promotion.

The Computer Operator series (General Schedule (GS)-332) encompasses the operation or supervision of the controls for digital computer systems. Although a computer science degree is not required, the operator must be able to read, interpret, and respond to system messages and other information relayed through the main control console.[OPM 84]

The Computer Specialist series (GS-334), which also does not require a degree, is closely aligned with the professional series. The specialist serves in one of six subspecialties: Computer Systems Analyst, Computer Programmer, Computer Programmer Analyst, Computer Systems Programmer, Computer Equipment Analyst, or Computer Specialist. As a designer, analyst, and programmer, the GS-334 is involved in implementing problem-solving systems. Personnel in this series also maintain current knowledge of computer equipment and peripherals, as well as any specialized activities associated with the development and design of data processing systems.[OPM 80]

[4] Data provided by Lori Cummings, TAPA, Civilian Classification Division.

The Electrical/Electronics Engineering series (GS-850/855) are actually two separate series, but their duties are similar enough that they are often grouped together. Both job areas deal with electrical phenomena and the principles, techniques, and practices of electrical and electronics engineering. A great many electrical engineers are currently serving in software design jobs or other positions requiring advanced programming skills.[OPM 71]

The Computer Engineering series (GS-854), the newest field of the group, was created in January 1988 to meet a growing DoD need for computer engineering professionals. The series combines principles and applications from mathematics, computer science, and electrical/electronics engineering in positions which concentrate on computer hardware and software, system architecture and integration. A majority of the work is concentrated in the research and development area.[OPM 88a]

The Computer Science series (GS-1550) is specifically geared toward positions involving computer science methods and techniques in the solution of complex problems through the use of digital computers. In order to successfully compete, each professional should have an understanding of mathematics and statistics, as well as information systems, computer architecture, and structured programming concepts. Like the GS-854, a majority of these positions are in the research and development area. [OPM 88b]

3.0 ADA SOFTWARE ENGINEERING EDUCATION AND TRAINING NEEDED

This section provides an evaluation of the Army positions summarized in Section 2.0 with respect to the type of Ada software engineering education and training required for personnel in these positions. Where applicable, recommendations are made concerning the extent of education or training needed. The education and training sites referenced in this section are summarized in Section 4.0.

3.1 Enlisted Personnel

Three enlisted personnel positions have been discussed that are associated with computers and the related technology: Computer/Machine Operator, Programmer/Analyst and Data Processing NCO. As a Computer Machine Operator, a soldier does not require any Ada training. The operator's only concern is to run and maintain the hardware. However, if the operator is promoted to Data Processing NCO, further training will be necessary. The NCO acts as supervisor to both the Operators and Programmers. To fulfill the supervisory duties, the Data Processing NCO must have an understanding of the Ada language and corresponding software engineering concepts. This could be obtained through an introductory course such as "Fundamentals of Ada Programming/Software Engineering" provided by Keesler Air Force Base (AFB). The Programmer/Analyst is concerned with writing, analyzing, editing and testing computer programs and applications. Since Ada is the DoD language of choice and is not restricted to embedded systems, these programmers should be encouraged to use Ada in their projects. Training would include how to write Ada programs using good software engineering techniques and an introduction to the Ada Programming Support Environment (APSE). This training will better prepare the programmer for promotion to Data Processing NCO.

3.2 Officers

In the SC there are three speciality areas related to computer technology: C-E Automation, C-E Operations and C-E Engineering Officers. All three positions are concerned with the maintenance of command, control and communications systems at a supervisory level. The C-E Operations Officer's duties are hardware-related and therefore, this position requires no Ada software engineering education or training. The Automation Officer and Engineering Officer must have an undergraduate degree in electrical/electronics engineering, computer science or another technical discipline. Both officers, as supervisors in the design and development of automated software systems, may be involved in the practical application of automation theory in the design, implementation and integration of software for telecommunications and teleprocessing systems. In this capacity, the officer must, when using Ada, have a good working knowledge of the language. With the background required, these officers should be familiar with the concepts related to high order languages, but need to be trained in using Ada software engineering techniques.

Five functional areas were discussed in Section 2.0: Comptroller, Operations Research/Systems Analysis, Research and Development, Systems Automation and Contracting and Industrial Management. The Comptroller should have some understanding of the language and its benefits when conducting cost and economic analyses related to software. The Comptroller must also understand software engineering concepts and how these concepts may impact performance analyses (i.e., a lot of time will be spent up front doing analysis and design prior to actual coding; this does not mean a project is behind

schedule or not cost-effective). This training could be in the form of a 4-8 hour tutorial or part of an entry level training course.

The Operations Research/Systems Analysis, System Automation, and Research and Development fields may be involved in the development, implementation and maintenance of software systems. All three fields require a bachelor's degree in a technical discipline and encourage officers to obtain an advanced degree. The Systems Automation Officer is also required to have either a major or minor in computer science. Based on these educational requirements, officers assigned to the development of software systems should have a good background in either computer science or software engineering. The officer's education then needs to be supplemented with some degree of Ada training. This training should include both the syntax and semantics of the language. Emphasis should be placed on using good software engineering techniques to develop programs and tools that improve productivity, with special attention given to developing skills necessary to evaluate and select tools for inclusion in an APSE.

The Contracting and Industrial Management Officer may have to monitor a contract dealing with the development and maintenance of software for the Army. If the software is to be done in Ada, this officer must understand and recognize the basic concepts of Ada. Like the Comptroller, the Contracting Officer must have some understanding of software engineering. This type of training could be included as part of the advanced courses offered to Contracting and Industrial Management Officers at the Army Logistics Management Center (ALMC) or the Defense Systems Management College (DSMC).

3.3 Civilian Personnel

Civilian positions within the Army that would require some type of Ada training are the computer specialist, computer engineer and computer scientist. A civilian in the Electrical/Electronics Engineering series does not need to be trained in Ada unless he/she is assigned to a software design job or a position that requires advanced programming skills. In these cases, the civilian would need to understand both the Ada language and related software engineering concepts. The computer specialist is not required to have a college degree and may need to be trained in the syntax and semantics of the language, along with how to use software engineering concepts when developing a program or system. The computer engineer and computer scientist have at least a bachelor's degree and should be familiar with software engineering concepts and at least one high order language. Training should include both an introductory and advanced Ada course. As Ada is introduced into more university curriculum and service-related schools, the need for separate Army-sponsored Ada training will decrease.

4.0 OPPORTUNITIES FOR ADA EDUCATION AND TRAINING

4.1 Introduction

Within the Army, several institutions exist for the purpose of providing additional military specific training. Although these schools are primarily for Army personnel, both active duty and civilians, classes may be opened to other Services and DoD personnel upon request. Likewise, the other Services and the DoD operate training schools which are open to the Army. Finally, commercial courses taught by software companies and courses available through academic institutions are also options for receiving additional education and training.

4.2 Army Programs

The Army's training program consists of two categories: training received prior to the first assignment and training received at various points during the career. The first group includes the civilian software engineering intern program sponsored jointly by the ALMC School for Engineering and Logistics at Red River Army Depot, Texarkana, TX and the Ada Technology Branch of the Communications-Electronics Command (CECOM), located at Ft. Monmouth, NJ. The Professional Development Center (PDC) in Falls Church, VA provides training support for the members of the Informations Systems Command (ISC). This category also includes the Signal Corps' Computer Science (CS) School at Ft. Gordon, GA which provides initial training for all enlisted members in the 74 field. For cadets at the U.S. Military Academy (USMA) at West Point, NY, courses in Ada and software engineering are part of the curriculum for computer science majors.

The second category includes the Systems Automation course at the CS School for FA53 officers, as well as a shorter Branch Automation (4H) skill course for officers. The CS School also runs a combination operations/programming course for senior enlisted personnel who are going into Data Processing NCO (74Z) positions. Officers who attend the Command and General Staff College (CGSC) at Ft. Leavenworth, KS, or the Army War College (AWC) at Carlisle Barracks, PA, are given a choice of several optional courses as part of the curriculum. The optional computer course selection at both schools ranges from microcomputer fundamentals to structured programming. For mid-career civilians, the Army Management Engineering College (AMEC) at Rock Island Arsenal, IL, provides four courses for those employees needing additional programming skills.

4.2.1 AMC Software Engineering Intern Program

The Intern program for new civilian software engineers was created two years ago by the Army Materiel Command (AMC) to meet a growing need for college graduates with software engineering knowledge and experience. The program is two years in length; the first year is spent at Red River and the second at Ft. Monmouth.

Each member of the program is a recent college graduate with a degree in either electrical or computer engineering or a related engineering field. They are then hired by the Army as either a GS-5 or GS-7 depending on their college grades. Before entering the program they are assigned to one of nine Software Development Centers (SDC), which then pays for their training. In return, they are committed to that center after completion of the training. The 52-week course at Red River covers DoD structure and procedures, Army policies, and all aspects of software engineering theory, systems engineering, and software development and testing for MCCS. [POI 88a] After finishing the instructional

portion of the course, the AMC interns are sent to the Ada Technology Branch at CECOM. (ISC interns usually report directly to their SDC after the first year.) Here they receive extensive hands-on training working on actual Army programs. At the same time, the interns attend Monmouth College as graduate students in Software Engineering. Their projects at CECOM transfer to the college as their thesis work, and they complete their master's degree by the end of the second year of the intern program. During this time, they are also promoted to the next grade.

Once the interns have completed their training, they return to one of the AMC software development centers as software engineers and developers. After one year, the graduates are promoted non-competitively to the next grade, usually either GS-11 or GS-12. After that, they continue to work on various projects for the remainder of their career, following a normal GS progression of responsibility.[GRA 88]

Graduates from Red River are committed to work for the Army for one year; graduates from Monmouth College have a three-year commitment. After that they are free to leave the Army. To date, 21 software engineers have completed the program, 32 interns are in their second year, and approximately 50 new interns will start at Red River early in 1989. [OES 88]

4.2.2 Professional Development Center

The PDC is the primary training center for ISC civilian personnel assigned to the Washington, D.C. area. The Center's mission is to provide fundamental and advanced computer training to civilian employees throughout ISC. The role is seen both as advisory and instructional in nature. The PDC provides guidance to other subcommands on training as well as providing the facilities and instructors for the courses themselves.

The PDC has two classrooms with enough personal computers (PCs) for each member of a class to have their own workstation, as well as lecture rooms for seminars and discussions. The center once served as the training base for several ADP intern classes, providing the lab work for the first six months of training. These new computer specialists received training in microcomputer basics, data processing and programming fundamentals, mainframe systems and the COBOL language. The program was recently redefined to include an introductory Ada course as part of the curriculum. The advanced COBOL training was removed and taught instead as a stand-alone course. The plan was to teach only Ada once the need for COBOL no longer existed.

At one time, the PDC had evolved a position entitled Technical Training Program Management Officer (TTPMO), which was responsible for coordinating the training done at PDC. The hope was that the position would expand to include identifying the training needs by individual program throughout ISC, locating possible training within the command, and ensuring that training needs were met once training was completed. However, because the position was not an official one, when the original TTPMO left for another assignment, he was never replaced.

Despite the excellent facilities available at the PDC, the staff has been cut several times in the last few years. Each time an Ada programming course has been developed at the PDC, the instructor gets transferred before the course materializes. For each new instructor, the development must begin again. This situation has made continuity between instructors next to impossible. Currently, a staff of four, (three full-time and one part-time), must develop and present all the courseware. Often, instructors from AMEC will

teach both the "Ada Programming" and the "Software Engineering with Ada" courses at the PDC in order to take advantage of the excellent facilities. At the same time, the PDC instructors are allowed to attend these courses as preparation for teaching the courses themselves.

The PDC is currently in a re-evaluation phase. The six-month training program for ADP interns no longer exists. In its place are individual courses that can be taken according to the need of the student, resulting in the need for more instructors who can provide individualized assistance. Thus, they are petitioning for additional manpower in order to continue to provide quality training and an official TTPMO who will be responsible for coordinating training throughout ISC. [HOV 88] Whether they receive these additional resources will have a great deal of impact on their continued service to the members of ISC.

4.2.3 Software Development Center, Ft. Lee

The major programming language being used throughout ISC is COBOL; however, ISC is in the process of switching to Ada. While training their COBOL programmers in Ada, most of whom are civilians, ISC discovered that COBOL programmers are slower in grasping Ada concepts because of their COBOL mind set. They also found that by exposing these programmers to Ada in a relaxed, in-house, self-paced environment prior to attending a rigorous vendor's course, the programmers progressed at a faster rate than they would without the additional exposure. Thus, the ISC SDC at Ft. Lee, VA, developed a short course which uses a self-paced Computer Aided Instruction program combined with two basic Ada concepts courses, to provide this extra practice. One on-site instructor is available to assist the students, and a vendor course is used to complete the training. Because of the additional up-front training, the vendor course has been modified, and now concentrates on advanced topics, rather than only basics. Since the COBOL to Ada transition is taking place throughout ISC, the PDC is also developing a similar set of pre-training courses to be used in the Washington, D.C. area. [WIL 88]

4.2.4 Computer Science School

The Computer Science School recently relocated its entire facility from Ft. Benjamin Harrison, IN to Ft. Gordon, GA in order to better share and utilize both the instructors and the equipment of the Signal Corps School, already at Ft. Gordon. Five separate courses are coordinated by the CS school in the area of systems automation, each with a different audience. These courses are offered from one to four times a year, depending on the class length, and average 80-90 students per class. The courses are the Systems Automation Course (SAC) (for officers in FA53), the Branch Automation Officer Course (BAOC) (for skill 4H), Advanced Individual Training (AIT) for 74F programmers, the Basic NCO Course (BNCOC) for 74F programmers, and the Advanced NCO Course (ANCOC) for 74Z Data Processing NCOs.

The SAC is a combination training course for the software engineering, hardware engineering, and automation management specialty areas. The purpose of the course is to provide new FA53 officers with the appropriate background necessary to serve as automation officers. The course covers personal computer applications, software design and development, the Ada programming language, software engineering principles, hardware design and selection, operating systems, telecommunications, systems integration, networking, and the management of these processes. Thus, the course requires a solid computer background due to the speed with which the material is covered. Since the limit for a temporary duty assignment (TDY) is 20 weeks, the course is currently

19 weeks and 4 days in length. This one-day difference is justified by the cost savings of only paying for a TDY, rather than a permanent change of station move. A plan is being developed which would extend the course to 23 weeks, broken into subject modules. This would allow an officer to attend only the modules needed, instead of the whole course, while remaining on TDY status, thus saving additional money and time. The module system would also allow the officer to receive graduate credit through the Florida Institute of Technology upon completion of the entire course. [DEM 88]

The BAOC is for officers who need basic computing skills and knowledge in order to perform their job duties. However, computer programming or applications are not the primary focus of that job. The course is two weeks long and is designed for familiarization, not expertise. The applications covered include MS-DOS®, Lotus® 1-2-3®, MultiMate®, and dBase III+™.[5] Successful completion of this course qualifies an officer to later take the SAC if needed. However, the background provided in the shorter course may not be as much as is needed for the officer to complete the SAC in good standing. Currently, the primary attendees at the BAOC are members of the Adjutant General Corps. [DEP 88]

An AIT course is given to all new soldiers upon entry into their chosen career field. The AIT for 74F programmers consists of over 400 hours of training covering problem solving, structured programming in COBOL, basic operating systems, and an introduction to microcomputer applications. Plans are currently being made to begin teaching Ada as well as COBOL, as a precursor to phasing out COBOL. Eventually, only Ada will be taught as the major programming language. [POL 88]

After promotion to E-5, the soldier attends the Basic NCO Course (BNCOC) for 74F programmers, which focuses on basic management tools and advanced programming techniques. Like the AIT course, the BNCOC is still taught in COBOL, but is being phased into Ada. Since the new 74Fs, who are receiving the Ada training currently through the AIT course, will not be attending the BNCOC for a few years, the relative shortage of advanced training is not yet critical. The Army recognizes that as more and more 74Fs receive Ada exposure from the beginning of their enlistment, the need for advanced Ada in the BNCOC will also increase. In the long run, the CS School plans to teach Ada as the sole language during the BNCOC. [POL 88].

The final course taught at the CS School is the ANCOC for the Senior NCOs in the Data Processing field. Since the NCOs have, up until this time, concentrated within their own specialty area, they need exposure to the other data processing specialty in order to effectively supervise both areas. Thus, for the operators, the course consists of two weeks of COBOL programming to expose the NCOs to structured programming. The depth of the course is just enough to allow the career operators to supervise the junior programmers. On the other hand, the programmers receive two weeks of Ada fundamentals, including hands-on exercises. Both operators and programmers receive one week of microcomputer training, which covers the same basic applications as the BAOC. Like the comparable officer training, this applications training is designed only for exposure, not for expertise. [DEP 88]

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[5]MS-DOS is a registered trademark of MicroSoft Corporation; Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation; MultiMate is a registered trademark of MultiMate International Corporation; and dBase III+ is a trademark of Ashton-Tate Corporation.

The Computer Science School is currently developing a new stand-alone Ada programming course to be taught in addition to the other four courses. The proposed course would be three weeks in length and is intended for personnel who will miss Ada training in other areas because of their training cycle. In other words, if a current 74Z NCO has already taken the ANCOC without the new section on Ada, the stand-alone course would allow him to be exposed to Ada without having to take a more expensive commercial course. The proposal has received strong support from the general staff at the school and approval by the Training and Doctrine Command is pending. [ENG 88]

4.2.5 U.S. Military Academy

The USMA at West Point, NY teaches Ada to all its computer science majors, as well as any engineering, math or science majors who wish to take an Ada course. This course is part of a first year curricula and is designed to teach software engineering principles using Ada as the tool. In addition to the technical majors, the humanities and public affairs majors (about half of the cadets) must take a sequence of courses in the math, science, or engineering area. Usually, around 15% of these cadets choose to take the Ada course as part of that sequence.

All computer science majors are required to purchase PCs with two floppy disk drives, for use in completing class assignments. However, most of the available Ada compilers require more memory than is feasible on any size personal computer. The lack of memory means that the students must use terminals provided in a common laboratory area, which limits the number of students with adequate access to the equipment. It is then difficult for the lab to upgrade its equipment because of the number of terminals and increased cost involved. A second software engineering course is required for CS majors later in the curriculum, but it is not yet taught in Ada, primarily due to the equipment shortage. [HAT 88]

4.2.6 Senior Service Schools

Officers who attend a senior service school in residence are usually permitted one elective course in an area of their choice. The electives are offered strictly as a supplement to the regular instruction and thus cannot be offered to those attending the school by correspondence.

At the CGSC, attended by only 40% of all eligible senior Captains and Majors, four 30-hour courses are offered as electives: fundamentals of microcomputers, advanced information systems and networks (requires a master's degree), FORTRAN programming, and Pascal programming. These courses are taught by non-permanent members of the staff and occasionally by visiting faculty from nearby academic institutions. Currently, there is not an Ada programmer on the staff, nor is one expected in the near future, especially with pending budget cuts. Thus a course in Ada has not been scheduled, even though the need exists. [FAS 88]

The AWC, which is open only to a select group of senior managers (LTC, COL), previously had a course on Computer Systems, which covered various aspects of computers as related to systems management, acquisitions and program monitoring. One section of the course discussed programming languages, including Ada, and the reasons why a standard DoD language was created. Although the course did not cover any syntax, it gave a good synopsis of the benefits and pitfalls of Ada compared to other languages. [AND 88] Currently, due to a restructuring of the curriculum, the Computer Systems

course is no longer taught. A one-day Information Management Overview covers various aspects of computer use, but Ada is not covered as part of the curriculum except when brought up by the students during class discussions. [ROB 88]

4.2.7 Army Management Engineering College

There are four courses taught by AMEC, formerly known as the Army Management Engineering Training Activity, which expose students to both the fundamentals and the advanced features of Ada and software engineering. The courses include "Ada Programming Language," "Ada and Software Engineering Overview," "Ada Tasking," and "Software Engineering in Ada," and range from 1 1/2 days to 2 weeks.

The first course, "Ada Programming Language," covers most of the major concepts of the language in the two weeks allotted to the course. Class time is spent in lectures or working with hands-on exercises. All attendees at this class must have at least one year of experience in a high order programming language, preferably Pascal.

The second course, "Software Engineering in Ada," is one week in length The "Ada Programming Language" course or its equivalent is a prerequisite, since the course is designed for experienced Ada programmers who are involved in Ada system design and development. The emphasis is on design methodologies and techniques rather than the language syntax. The course culminates with a design project.

The remaining two courses, "Ada and Software Engineering Overview" and "Ada Tasking," provide introductions to Ada-specific topics within a shorter time frame, 1 1/2 and 3 1/2 days, respectively. The former is designed to give program managers and engineers the insight to decide the applicability of Ada to a particular project. The course will cover the basics of Ada and concentrate on the value and merit of the language compared to others.

The second short course, "Ada Tasking," focuses on the use of Ada's unique tasking features for real-time systems. The student must have successfully completed both the "Ada Programming Language" and the "Software Engineering in Ada" courses, or have equivalent experience. This course also includes a final design project. [POI 88b]

AMEC also offers an ADP intern program, which is designed for new or mid-career computer specialists (GS-334). The initial training is 14 weeks in length, which helps develop basic programming skills. Additional training is given in the following nine weeks which reflect the programmer's area of expertise. The training is currently taught in two tracks: COBOL (for the COBOL track) and C (for the office automation track). Beginning in June 89, AMEC will begin a pilot track, which will focus on UNIX®[6], C, and Ada.

In addition to the courses taught at AMEC, on-site training is available by request for large groups of students, usually 20-25 employees, at one installation. Although AMEC is primarily for members of the AMC, its courses are open to ISC, but the on-site training is not. This restriction is due mainly to manpower shortages. [BEA 88]

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[6] UNIX is a registered trademark of AT&T Corporation.

4.3 Department of Defense Schools

Within the DoD, several joint service schools are operated to provide advanced military training. Although they are not strictly computer related, many of the project management and acquisition courses discuss Ada and its related issues during the course.

4.3.1 Department of Defense Computer Institute

The Department of Defense Computer Institute (DoDCI), located at the Washington Navy Yard, Washington, D.C., does not teach any courses focusing on a single programming language. Its focus is on Automated Information Systems (AIS) and Computer Security. The "Management of AIS for Senior Executives" course has an overview of software which includes a discussion of the advantages/disadvantages of various languages, software tools and methods, and various computer software applications. For the intermediate executives, the AIS management course covers the area of system design and development thoroughly. Lectures start with fundamentals and proceed through analysis, design, acquisition, and installation of the system.

In addition to these two courses, DoDCI also teaches courses on AIS Acquisitions and AIS Concept Development and Design. The acquisitions course covers current acquisition policy, concept development, workload requirements, contracting, and maintenance. The second course covers many of the same areas. Discussions include project planning and control, requirements analysis, and software considerations. However, none of the four courses taught at DoDCI explicitly covers Ada and its relationship to system analysis, design, acquisition and management. The basic concepts of Ada may be briefly covered when the audience requests it, but otherwise, it is not even mentioned. [NDU 88]

4.3.2 Defense Systems Management College

The DSMC, located at Ft. Belvoir, VA, concentrates on the systems management life cycle, from design through installation. For those managers involved with computer systems, the course "Management of Software Acquisition" provides a background for making comparisons and accurate evaluations. This course is taught four times a year with an average class size of 35. A majority of the students are DoD civilians, with the remainder of the students being active duty military officers. Included in the course is a half day block on Ada taught by a visiting lecturer from the Software Engineering Institute (SEI). The material discussed includes a description of the Ada support mechanisms (i.e., the AJPO), a general description of the language features, and an Ada design example. The coded example is designed to allow the students a chance to work through a piece of actual code, but in no way is it an attempt to teach programming concepts. The major portion of the lecture is focused on managing the transition to Ada and avoiding some common transitional pitfalls. The acquisition of compilers, tools, environments, training, and other relevant areas are also discussed in this context. [O'NE 88]

The College also hopes to offer an elective two-or three-week Ada programming course beginning in the spring of 1989. This course would be for non-programmers and would focus on common Ada terminology, basic programming, and include a cursory introduction to the advanced topics. The major stumbling block to such a course has been the lack of laboratory facilities to allow for hands-on exercises. [CAR 88]

4.4 Other Services

In addition to the joint schools open to all three Services, each Service operates their own set of schools and training facilities which are often open to the other Services.

Currently, the Air Force has an Ada Training Team based at Keesler AFB, MS, which travels to various locations to give courses as well as offering courses at Keesler. The courses include a two-day executive overview, a nine-day fundamentals course, and a four-week advanced programming course. [VEG 88]

The Air Force also offers both general and graduate level courses in software engineering and Ada at the Air Force Institute of Technology (AFIT) in Dayton, OH. These courses are based in the Department of Mathematics and Computer Science and the only restriction is academic prerequisites. The courses include "Introduction to Software Engineering with Ada," "Introduction to Computer Science," "Concurrent Software Systems," and "Advanced Software Environments." The courses range from 10 weeks to 15 weeks in length, and all four include hands-on experience. Previous computer programming experience is advised due to the content and pace of the courses. [CRE 88]

In the Navy, a major training focus for Ada is at the Naval Postgraduate School (NPGS) in Monterey, CA. The NPGS has recently converted the majority of its computer science courses to Ada. These courses include an introductory course, a software engineering course and a data structures course emphasizing Ada. Each of the courses is taught on alternate quarters, with an average class size of 50 students. The NPGS has both Sun workstations and PCs available for student use in completing assignments. The master's program, which is 21 months (7 quarters) in length, is open to all civil service personnel and military officers meeting the academic prerequisites. The average student has between 5-10 years in the service and about 10% of the current enrollment is Army personnel. [YUR 88] Through prior arrangements with the Admissions Office, students are permitted to take individual courses without enrolling in the entire program. However, because of funding, priority is given to full-time students when filling classes and a single course student may be bumped. Repeated attendance by a single installation at one course could result in a tuition charge in order to offset the additional expenses. Such a charge would be agreed upon by the NPGS and the installation in question. [CAL 88]

4.5 Courses at Academic Institutions

Currently, over 175 academic institutions offer a total of 265 courses in the Ada programming language, software engineering principles or both. The courses are taught through community colleges, undergraduate and graduate curricula, almost always for credit. Prices vary by school and state residency criteria may apply [CRE 88]. The academic courses offer a good alternative when only one or two employees need training. Moreover, the larger financial base of most academic institutions allows for a greater variety in equipment and hands-on experience, which can be extremely valuable for the installation needing the training.

4.6 Commercial Courses

In addition to the courses taught by the Army and other DoD organizations, several commercial courses are available at various costs. The individual courses vary in presentation manner, length, audience, material covered, follow-up assistance, exercises, and availability. The majority of the courses are available at the vendor site, for less cost

and fewer personnel, while having the vendor come to the site needing training means higher cost and usually the need for a full classroom of students [CRE 86]. Because of their cost and the time and travel involved, the use of commercial courses should be limited and employed only when no other alternatives are available.

5.0 SUMMARY TABLES

This section consists of three summary tables for Army enlisted, officer, and civilian personnel. Each chart includes career classifications, job titles, job codes, the level of Ada training necessary, and where within the Army or DoD this training may be obtained. Although training can be obtained outside of the DoD, the authors felt it would be more cost effective if the Army obtained all of its Ada education and training from within the DoD. Therefore, no attempt was made to evaluate private sector training or university courseware.

The numbers used in the Training Needed column are based on a graduated knowledge of Ada and Software Engineering. Each level assumes that the previous level has been satisfied. The levels are defined as follows:

Level 0 - No Ada Training Needed
Level 1 - Concepts and Vocabulary
Level 2 - Ada Literate
Level 3 - Able to Contribute to Project
Level 4 - Complete Understanding of Language

The level 0 designation is given to those positions which do not require any knowledge of Ada for the performance of the job. These positions are often support and equipment related.

A level 1 position is defined as needing the most basic understanding of Ada and Software Engineering. An employee at level 1 is able to understand and recognize basic concepts and vocabulary, without necessarily knowing how to apply them.

At level 2, employees are required to read and understand professional literature covering Ada. They should also be able to discuss Ada with other professionals in a competent manner.

Level 3 applies to the position where a sufficient Ada background is necessary to substantially contribute to an ongoing project. Although the level 3 person does not have complete mastery of the language, he/she is able to provide analytical support to other team members.

A level 4 position uses Ada as a main job function. A complete and thorough understanding of the language and related software engineering principles is needed. This person also serves as a reference point to other persons at lower levels.

The names of the training courses correspond to those discussed in Section 3. The abbreviations are listed in Section 1.3. "CS School" refers to the proposed stand-alone Ada course at the Computer Science School, while "Keesler" refers to the courses offered by the Air Force's Ada Training Branch at Keesler AFB, MS. "AMC Intern" refers to the two-year program at Red River and Ft. Monmouth.

Table I. Summary of Training for Army Enlisted Personnel

Army Position	Career Management Field	Job Title	Job Code	Ada Training Needed	Training Within DoD	Available: Within Army
Enlisted	Automatic Data Processing	Computer/Machine Operator	74D10-40	0		
		Programmer/Analyst	74F10-40	3 or 4	Keesler	AIT, BNCO
		Data Processing NCO	74Z50	2 or 3	Keesler	ANCO

Table II. Summary of Training for Army Officers

Army Position	Branch	Area of Concentration	Related Functional Areas	Job Code(s)	Ada Training Needed	Training Within DoD	Available Within Army
Officer	Corps of Engineers	Engineer, General	Comptroller	21A, 45	1	Keesler, AFIT	CS School
			Operations Research/ Systems Analysis	21A, 49	3 or 4	Keesler, AFIT	CS School
			Research and Development	21A, 51	2 or 3	Keesler, AFIT	CS School
	Signal Corps	C-E Automation	-----	25B	2 or 3	Keesler, AFIT DSMC	BAOC, CS School
			Systems Automation	25B, 53	4	Keesler, AFIT DSMC	SAC, CS School
		C-E Operations	-----	25C	0		
			Operations Research/ Systems Analysis	25B, 49	3 or 4	Keesler, AFIT	CS School
			Contracting and Industrial Management	25C, 97	2	Keesler, AFIT	BAOC, CS School
		C-E Engineering	-----	25D	2	Keesler, AFIT	CS School
			Research and Development	25D, 51	2 or 3	Keesler, AFIT	BAOC, CS School
			Contracting and Industrial Management	25D, 97	2	Keesler, AFIT	BAOC, CS School

Table II. Summary of Training for Army Officers (Continued)

Army Position	Branch	Area of Concentration	Related Functional Areas	Job Code(s)	Ada Training Needed	Training Within DoD	Available Within Army
Officer	Adjutant General Corps	Adjutant General, General	-----	42A	0		
			Comptroller	42A, 45	1	Keesler, AFIT	BAOC, CS School
			Operations Research/ Systems Analysis	42A, 49	3 or 4	Keesler, AFIT	BAOC, CS School
			Systems Automation	42A, 53	4	Keesler, AFIT DSMC	SAC, BAOC, CS School

Table III. Summary of Training for Army Civilians

Army Position	Classification	Series Title	Job Title	Series Code	Ada Training Needed	Training Within DoD	Available Within Army
Civilian	Technical	Computer Operator	Computer Operator	GS-332	0		
		Computer Specialist	Computer Systems Analyst	GS-334	2 or 3	Keesler, AFIT	AMEC
			Computer Programmer	GS-334	4	Keesler, AFIT	AMEC, PDC
			Computer Programmer Analyst	GS-334	4	Keesler, AFIT	AMEC
			Computer Systems Programmer	GS-334	4	Keesler, AFIT	AMEC
			Computer Equipment Analyst	GS-334	0		
			Computer Specialist	GS-334	2 or 3	Keesler, AFIT	AMEC, PDC
		Computer Science	Computer Scientist	GS-1550	3 or 4	Keesler, AFIT	AMEC
			Supervisory Computer Scientist	GS-1550	3	DSMC, DoDCI	
	Engineering	Electrical Engineering	Electrical Engineer	GS-850	3	Keesler, AFIT	AMC Intern, CS School
			Supervisory Electrical Engineer	GS-850	2 or 3	DSMC, DoDCI	
		Electronics Engineering	Electronics Engineer	GS-855	3	Keesler, AFIT	AMC Intern, CS School
			Supervisory Electronics Engineer	GS-855	2 or 3	DSMC, DoDCI	
		Computer Engineering	Computer Engineer	GS-854	4	Keesler, AFIT	AMC Intern, CS School
			Supervisory Computer Engineer	GS-854	3	DSMC, DoDCI	

6.0 FINDINGS AND RECOMMENDATIONS

There are numerous Army-sponsored schools and training centers throughout the United States. In several cases, Ada and software engineering courses are already available; in others it is merely a question of incorporating Ada into an existing course or adding an Ada course. This can be done with minimal effort and cost.

Since a majority of MCCS are developed through contract, the most urgent Ada training needed is for those who will be evaluating proposals and those who will be monitoring/managing the large projects. These people need to have an understanding of the language and the software engineering concepts that should be incorporated when using Ada.

6.1 Findings

Finding: There are several skill areas within the Army that require some degree of Ada training:

- Enlisted
  - Programmer/Analyst
  - Data Processing NCO
- Officers
  - C-E Automation Officer
  - C-E Engineering Officer
  - Comptroller
  - Operations Research/Systems Analysis
  - Systems Automation
  - Research and Development
  - Contracting and Industrial Management
- Civilian
  - Computer Specialist
  - Computer Engineer
  - Computer Scientist

Finding: New enlisted personnel in computer-related positions are introduced to Ada prior to their first assignment. The main concern is introducing Ada to the senior enlisted personnel.

Most of the enlisted personnel in the job fields listed above are programmers in the applications arena. Prior to being assigned, they have attended the Computer Science School. If they are recent graduates, they have been exposed to the Ada language through the AIT or the ANCOC for CMF 74. This appears to be appropriate training for these job skill levels. However, it is also important to train the senior enlisted personnel who attended the Computer Science School prior to the introduction of Ada. The Computer Science School has proposed the development of a stand-alone Ada course to meet this need. It is strongly recommended that the Army approve the development of this course to meet the needs of these Senior NCOs.

Finding: There are various opportunities for SC officers to receive Ada training throughout their career.

Prior to their first assignment, each officer must attend the SC Officer Basic Course. This course, along with the Advanced Course taken after two assignments, is designed to familiarize the officer with Army procedures and how to lead troops. In all three C-E areas (Automations, Operations and Engineering), the officer will already have a degree in electrical/electronics engineering, computer science or a related discipline. Since there are numerous academic institutions that now offer software engineering and/or Ada in their curriculum, there is a good possibility that new SC officers will already have some knowledge of the Ada language and understand software engineering concepts. Both C-E Automation Officers and C-E Engineering Officers must also complete course work at the AFIT. While assigned to AFIT, the officers may have an opportunity to take one or more of the Ada and software engineering courses offered through the Department of Math and Computer Science.

Finding: Since officers in the Operations Research/System Analysis, Systems Automation and Research and Development fields must have a good working knowledge of the Ada language, additional training may be necessary.

The Systems Automation Officer must take the Systems Automation Course at the Computer Science School which covers both Ada and software engineering. The proposed stand-alone Ada course at the Computer Science School would also be beneficial to these officers, especially those in R&D, who need Ada training to complement their degrees. The Contracting Officer may receive specialized training at DSMC, AFIT, or AMEC. All three of these schools offer some degree of Ada training. Additional training is also available through various schools sponsored by other Services or the DoD.

Finding: Ada is not taught at the Command and General Staff College or the Army War College.

The CGSC and the AWC are attended by a select group of career Army officers who will be managing major projects. It is important that these officers be allowed to select a course that introduces them to the Army's adopted programming language, Ada. At the present time, FORTRAN and Pascal are taught annually at the Command and General Staff College. It is recommended that an introductory Ada course also be taught once a year. As the use of FORTRAN and Pascal decreases within the Army, such courses can be combined and eventually deleted from the curriculum. At the Army War College, a one-day Information Management Overview covers various aspects of computer use. A short tutorial on Ada (approximately 2 hours) should be included in this overview. Interested officers could obtain additional Ada training at the Computer Science School, Keesler AFB, NPGS or AFIT.

Finding: Several training opportunities are available for Army civilian personnel: AMC Software Engineering Intern Program, Professional Development Center and the Army Management Engineering College.

The AMC intern program for new civilian software engineers appears to be an excellent means for educating personnel in software engineering and Ada. Unfortunately there are funding problems associated with this program. The AMC intern program is open to all Army personnel; however, it is a one-year assignment. Specific commands would have to pay for their personnel to be gone for one whole year, which can be very expensive

(cost of the school + loss of manpower). Since the courses have already been developed and the expertise is at Red River, the Army should consider allowing officers and enlisted personnel who need specific Ada or software engineering with Ada training to take individual parts of the program. Commands would only have to release personnel for 6 to 8 weeks to take specific courses. This approach would certainly be more cost effective for the commands who need to train personnel in specific areas related to Ada and software engineering but can not afford to reduce their manpower for a full year.

The PDC offers fundamental and advanced computer training to civilian employees throughout ISC. The center offers an introductory course in Ada, and the plans are to teach only Ada once COBOL is no longer needed. Since the six-month training program is being broken down into individual courses, it may be more cost effective to allow all qualified Army civilians or officers to attend these courses, regardless of command.

The AMEC, located at Rock Island, offers Ada training for AMC and ISC personnel. In addition to four Ada-specific courses, AMEC offers a 14-week ADP intern program which will include Ada as of June 1989. Officers and enlisted personnel may also attend courses at AMEC, but only AMC personnel can receive remote site training. This provides Ada training opportunities in Illinois, Virginia (PDC), Texas (AMC), and Georgia (Computer Science School).

Finding: Various other training schools within the other Services and DoD are available to Army personnel.

The Air Force allows other Services to attend their courses at Keesler AFB and AFIT. Keesler personnel offer courses both on-site at Keesler and at remote sites. The courses offered include "Orientation to Ada Software Engineering," "Fundamentals of Ada Programming and Software Engineering" and "Ada Applications Programmer Course." AFIT offers four courses related to Ada: "Concurrent Software Systems," "Advanced Software Environments," "Introduction to Software Engineering with Ada," and "Introduction to Computer Science." The Navy, through its postgraduate school in California, offers several courses using Ada. These courses are open to both civilians and officers.

Some DoD training is open to all the Services. One example would be the Defense Systems Management College at Fort Belvoir, VA, which offers a course on the "Management of Software Acquisition," which includes Ada. In addition, a two- or three-week Ada programming course is scheduled to begin in the spring of 1989 at DSMC. Unfortunately, the DoD Computer Institute in Washington, D.C. does not offer any courses in Ada.

Finding: Two other means for obtaining Ada education and training are available to all Army personnel: local universities and the private sector.

Many universities offer courses in Ada and software engineering. The CREASE, which is available through the National Technical Information Service, provides a list of universities known to offer Ada courses. The ASEET Team is developing two databases that include information on Ada and software engineering with Ada courses: one includes universities that teach Ada and software engineering and the other includes the Services and DoD agencies that offer Ada-related courses. The most recent version of the university database is included in Appendix D.

Several organizations in the private sector offer Ada training. This training is usually very expensive with registration fees averaging over $1,000 per person, exclusive of any TDY costs. Such courses are often offered on location at the requesting installation; however, in this case, the Army must pay all traveling expenses incurred by the instructor(s) as well as the registration fees. Since the Army has numerous training courses available to select from within the Army, other Services, and DoD or at a local university, this type of training is not recommended unless very specific, one-time training is needed.

5.2 Recommendations

Based on the findings, the following recommendations should be made by the AJPO to the U.S. Army:

1. Approve the development of the proposed stand-alone Ada course at the Computer Science School.

2. Incorporate Ada into the curriculum at the Army War College and the Command and General Staff College.

3. Emphasize the need for Ada training at the DoD Computer Institute.

4. Allow personnel to take individual Ada and software engineering courses at Red River rather than commit to a full year.

5. Allow Army civilians and possibly officers to attend Ada courses at the Professional Development Center, regardless of command.

6. Encourage Army personnel to attend other Service-sponsored or DoD-sponsored Ada courses as appropriate.

7.0 GLOSSARY

ADP	Automatic Data Processing
AFIT	Air Force Institute of Technology
AFB	Air Force Base
AIS	Automated Information Systems
AIT	Advanced Individual Training
AJPO	Ada Joint Program Office
ALMC	Army Logistics Management Center
AMC	Army Materiel Command
AMEC	Army Management Engineering College
ANCOC	Advanced Non-Commissioned Officer Course
AOC	Area of Concentration
APSE	Ada Programming Support Environment
ASEET	Ada Software Engineering Education and Training
AWC	Army War College
BAOC	Branch Automation Officer Course
BNCOC	Basic Non-Commissioned Officer Course
C-E	Communications-Electronics
CECOM	Communications and Electronics Command
CGSC	Command and General Staff College
CMF	Career Management Field
CREASE	Catalogue of Resources for Education in Ada and Software Engineering
CS	Computer Science
DoD	Department of Defense
DoDCI	Department of Defense Computer Institute
DSMC	Defense Systems Management College
FA	Functional Area
GS	General Schedule
ISC	Information Systems Command
MCCS	Mission Critical Computer Systems
MOS	Military Occupational Specialty
NPGS	Naval Postgraduate School
NCO	Non-Commissioned Officer
OR/SA	Operations Research/Systems Analysis
PC	Personal Computer
PDC	Professional Development Center
R&D	Research and Development
SAC	Systems Automation Course
SC	Signal Corps
SDC	Software Development Center
SEI	Software Engineering Institute
TDY	Temporary Duty
TTPMO	Technical Training Program Management Officer
USMA	United States Military Academy

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APPENDIX A
ADA TRAINING COURSES FOR THE ARMY

This appendix contains a more detailed description of the various course curricula, known to the authors, which are available to Army personnel. Additional courses may be under development or currently operational. The Army Program of Instruction (POI) was the primary reference, when available. In some cases, informal course outlines or telephone conversations form the basis of the course topics listed. These topics may change depending on the audience and time alloted. While every effort has been made to accurately reflect the course goals and objectives, the authors' interpretation may vary from the instuctors.

Training Organization

Org. Name: AF Technical Training School, Ada Training Branch

Contact: Mr. Pete Wilson

Address: 3390 TCHTG/TTMKPA
Keesler AFB, MS 39534-5000

Phone: (601)377-3110 **Autovon:** AV 868-3110

* *

Course Information

Course Name: Orientation to Ada Software Engineering

Audience: Sr Exec, Mid-Up Mgrs, Proj Mgrs **Hands-On:** N

Location: TTC or User's Site (MTT) **Length:** 2 Days

Prerequisites: None

Topics: The software crisis; SE and Ada; Design Methods; Standards; Managing the Transition to Ada; SW/HW Issues; Mgmt/Training Issues; Risks and Benefits

Notes or Special Concerns: Cost of Mobile Training Team is paid by requesting organization; must request space in annual schedule.

Training Organization

Org. Name: AF Technical Training School, Ada Training Branch

Contact: Mr. Pete Wilson

Address: 3390 TCHTG/TTMKPA

Keesler AFB, MS 39534-5000

Phone: (601)377-3110 **Autovon:** AV 868-3110

* *

Course Information

Course Name: Fundamentals of Ada Programming/SW Engineering

Audience: Proj Mgr; Sys Conf Mgr; Prog; Designer **Hands-On:** Y

Location: TTC or User's Site (MTT) **Length:** 9 Days

Prerequisites: Fundamental programming concepts knowledge; (Serves as Prereq for Application Prog Course)

Topics: Fundamentals of Ada Systems; Basic Ada Types; Control Structures; Subprograms; Packages; Exceptions; Generics; Tasks; Progam Design using Ada; Developing SW using Ada

Notes or Special Concerns: Cost of Mobile Training Team is paid by requesting organization; must request space in annual schedule.

Training Organization

Org. Name: Defense Systems Management College

Contact: LTC Caro

Address: DSMC, Course Director, Mgmt SW Acq
Ft. Belvoir, VA 22060

Phone: (703) 664-5198 **Autovon:**

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Course Information

Course Name: Management of Software Acquisition

Audience: Program Mgrs, Acquisition Mgrs **Hands-On:** N

Location: Ft. Belvoir, VA (DSMC) **Length:** 1 week

Prerequisites: None

Topics: Expectations; Software Engineering; Ada language; Transition to Ada adoption; Transition stages and mechanisms; Compilers; Tools and Environments; Risk Management (Topics for Ada section only)

Notes or Special Concerns: Mr. Don O'Neill at the Software Engineering Institute teaches the module "Managing the Transition to Ada Adoption," a four hour block which is part of the "Management of Software Acquisition Course". He may be contacted at: (412) 268-7619

Training Organization

Org. Name:	AF Technical Training School, Ada Training Branch
Contact:	Mr. Pete Wilson
Address:	3390 TCHTG/TTMKPA
	Keesler AFB, MS 39534-5000
Phone:	(601)377-3110
Autovon:	AV 868-3110

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Course Information

Course Name:	Ada Application Programmer
Audience:	Programmers; SW Engineers
Hands-On:	Y
Location:	TTC or User's Site (MTT)
Length:	4 Weeks

Prerequisites: Knowledge of fundamental programming concepts; Recent experience in a high order language

Topics: Fundamentals of Ada Systems; Scalar Types; Control Structures; Compposite Types; I/O; Subprograms; Packages; Exceptions; Private Types; Derived Types; Access Types; Generics; Tasks; Low Level Features; Designing w/Ada; SW Design w/Ada; Application Project

Notes or Special Concerns: Cost of Mobile Training Team is paid by requesting organization; must request space on annual schedule.

Training Organization

Org. Name:	Signal Corps Computer Science School
Contact:	Capt. Mike Hunter
Address:	SAC Coordinator, CS School
	Ft. Gordon , GA
Phone:	
Autovon:	AV 780-3236

* *

Course Information

Course Name:	Systems Automation Course
Audience:	Info Sys Analyst; SW Eng; Config Mgr
Hands-On:	Y
Location:	Ft. Gordon, GA
Length:	19 w, 4 d
Prerequisites:	BS in CS or Info Sys Eng or minor in same; equivalent experience; completion of 4H skill course
Topics:	Info Mgmt; Computer Security; HW/SW Operating Systems; Data Communications; System Design; Structured Programming; DBMS; Ada Systems Development; Life Cycle Mgmt; Acquisition Mgmt; Resource Mgmt
Notes or Special Concerns:	

Training Organization

Org. Name:	Signal Corps Computer Science School
Contact:	Capt. Mike Hunter
Address:	SAC Coordinator, CS School
	Ft. Gordon, GA
Phone:	
Autovon:	AV 780-3236

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Course Information

Course Name:	Branch Automation Officer Course
Audience:	Ofc or Civ needing Automation Skills
Hands-On:	Y
Location:	Ft. Gordon, GA
Length:	10 w, 3 d
Prerequisites:	Assignment to position requiring branch expertise first, and automation knowledge second.
Topics:	Info Mgmt; Computer Security; HW/SW Operating Systems; Data Communications; System Design; Structured Programming; DBMS; Ada Systems Development; Acquisition Mgmt;System Testing
Notes or Special Concerns:	Completion of course qualifies student tc serve in a position requiring automation knowledge. May also be used as prerequisite to Systems Automation Course, although this is not recommended.

Training Organization

Org. Name: Software Development Center - Lee

Contact: Barbara Wilson

Address: USAISSDCL

Ft Lee, VA 23801-6065

Phone: 804-734-4901 **Autovon:** AV 687-4901

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Course Information

Course Name: COBOL to Ada Transition Course

Audience: COBOL Programmers **Hands-On:** Y

Location: Ft Lee, VA **Length:** 3 Weeks

Prerequisites: GS-334, COBOL programmer assigned to SDC-L; anticipated participation on Ada project

Topics: Basic Ada concepts, emphasis on typing and distinctions between Ada and COBOL. Also covers various design methodologies used in software development.

Notes or Special Concerns: Used to prepare ISC COBOL programmers to take vendor training. Includes an 8 hr self-paced CAI tutorial using the PLATO system, and 4 hrs of hands-on programming to get feel of language. Comparable course under development at PDC.

Training Organization

Org. Name: Army Management Engineering College

Contact: Bob Beat

Address: AMEC

Rock Island, IL 61299-7040

Phone: (309)782-4041 ext 218 **Autovon:** AV 793-4041 ext 218

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Course Information

Course Name: Ada Tasking

Audience: Experienced Comp Prog, Comp Spec **Hands-On:** Y

Location: Rock Island, IL **Length:** 3 1/2 days

Prerequisites: Completion of Ada Programming Language and Software Engineering in Ada courses.

Topics: Task specification and body; rendezvous; families; real-time modules; developing and testing real-time systems.

Notes or Special Concerns: Course may be taught on site for class size of 20-24 students. Must reserve place on annual schedule.

Training Organization

Org. Name: ALMC School for Engineering and Logistics

Contact: Mark Oestmann, Dept of Eng

Address: Red River Army Depot

Texarkana, TX 75507

Phone: (214) 334-3335 **Autovon:** AV 829-3335

* *

Course Information

Course Name: Software Engineering Using Ada I

Audience: Engineers, Programmers **Hands-On:** Y

Location: Red River Army Depot, TX **Length:** 13d (105hr)

Prerequisites: Civilians grade GS-05 to GS-07, who are qualified entry-level engineers in AMC, another Army Command, Service, or DoD

Topics: Introduces the advanced programming features of the Ada programming language includng data abstraction and types, packages, generic program units, and input/output.

Notes or Special Concerns: Course is part of two year AMC Software Engineering Intern Training Program. Program also includes four other training blocks where Ada is used extensively.

Training Organization

Org. Name:	Air Force Institute of Technology
Contact:	Capt. Will Bralick
Address:	Dept of Math and Computer Science
	Wright-Patterson AFB, OH 45433
Phone:	(513) 255-3098
Autovon:	AV 785-3098

****

Course Information

Course Name:	Concurrent Software Systems
Audience:	Programmers, Sys Analysts, Engrs
Hands-On:	Y
Location:	Dayton, OH
Length:	15w
Prerequisites:	Previous programming experience is recommended.
Topics:	Software Engineering, Design Concepts, and Technical Programming. Includes: real-time progarmming, exceptions, generics, strong typing, tasking, packages, abstract data types and problem solving.
Notes or Special Concerns:	Students inlude military officers and DoD civilian employees. Offered for graduate credit. Course is taught when there is sufficient demand.

Training Organization

Org. Name: Air Force Institute of Technology

Contact: Capt. Will Bralick

Address: Dept of Math and Computer Science
Wright-Patterson AFB, OH 45433

Phone: (513) 255-3098 **Autovon:** AV 785-3098

* *

Course Information

Course Name: Introduction to Computer Science

Audience: Programmers, Sys Analysts, Engrs **Hands-On:** Y

Location: Dayton, OH **Length:** 10 weeks

Prerequisites: No academic prerequisites. Previous programming experience is recommended.

Topics: Exceptions, generics, strong typing, packages, abstract data types, and problem solving, with emphasis on engineering.

Notes or Special Concerns: Students include military officers and DoD civilians. Offered for graduate credit; taught every semester.

Training Organization

Org. Name: Air Force Institute of Technology

Contact: Capt. Will Bralick

Address: Dept of Math and Computer Science
Wright-Patterson AFB, OH 45433

Phone: (513) 255-3098 **Autovon:** AV 785-3098

* *

Course Information

Course Name: Introduction to Software Engineering with Ada

Audience: Programmers, Sys Analysts, Engrs **Hands-On:** Y

Location: Dayton, OH **Length:** 10 weeks

Prerequisites: No academic prerequisites. Previous programming experience is recommended.

Topics: In-depth study of algorithmic problem solving, data structures, and software engineering. Covers exceptions, generics, strong typing, tasking, packages, abstract data types, and problem solving.

Notes or Special Concerns: Students include military officers and DoD civilians. Offered for graduate credit. Course is taught when there is sufficient demand.

Training Organization

Org. Name: Army Management Engineering College

Contact: Bob Beat

Address: AMEC

Rock Island, IL 61299-7040

Phone: (309)782-4041 ext 218 Autovon: AV 793-4041 ext 218

* *

Course Information

Course Name: Ada Programming

Audience: Comp Prog, Sys Analysts, Comp Spec Hands-On: Y

Location: Rock Island, IL Length: 2 weeks

Prerequisites: At least 1 year of experience in a High Order Language (HOL); Pascal is recommended but not required

Topics: Subprograms, tasks, packages, types, attributes, objects, operators, expressions, statements, generics, elaboration, exceptions, I/O, overloading, scope, and visibility; Design concepts, and modular programming

Notes or Special Concerns: Course may be taught on site for class size of 20-24 students. Must reserve place on annual schedule.

Training Organization

Org. Name: Army Management Engineering College

Contact: Bob Beat

Address: AMEC
Rock Island, IL 61299-7040

Phone: (309)782-4041 ext 218 **Autovon:** AV 793-4041 ext 218

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Course Information

Course Name: Software Engineering in Ada

Audience: System Developers, programmers **Hands-On:** Y

Location: Rock Island, IL **Length:** 1 week

Prerequisites: Thorough knowledge of Ada as a Design Language; Completion of Ada Programming Course or equivalent

Topics: Object oriented Design; Data flow analysis; Function parsing; Ada as a design language; Normalization of data structures; Reusability and packages; Testing strategies; Ada Program Support Environment

Notes or Special Concerns: Course may be taught on site for class size of 20-24 students. Must reserve place on annual schedule.

Training Organization

Org. Name: ALMC School for Engineering and Logistics

Contact: Mark Oestmann, Dept of Eng

Address: Red River Army Depot

Texarkana, TX 75507

Phone: (214) 334-3335 **Autovon:** AV 829-3335

* *

Course Information

Course Name: Software Engineering Using Ada II

Audience: Engineers, Programmers **Hands-On:** Y

Location: Red River **Length:** 13d (105hr)

Prerequisites: Civilians grade GS-05 to GS-07, who are qualified entry-level engineers in AMC, another Army Command, Service, or DoD

Topics: Completes presentation of advanced language features of the Ada programming language including record types and discriminated records; private types and generics; concurrency and tasking; and real-time considerations such as interrupts and pragma interface.

Notes or Special Concerns: Course is part of two year AMC Software Engineering Intern Training Program. Program also includes four other training blocks where Ada is used extensively.

Training Organization

Org. Name: Air Force Institute of Technology

Contact: Capt. Will Bralick

Address: Dept of Math and Computer Science
Wright-Patterson AFB, OH 45433

Phone: (513) 255-3098 **Autovon:** AV 785-3098

* *

Course Information

Course Name: Advanced Software Environments

Audience: Programmers, Sys Analysts, Engrs **Hands-On:** Y

Location: Dayton, OH **Length:** 10 weeks

Prerequisites: *Previous computer programming experience is recommended.*

Topics: Software Engineering, Design Concepts, Technical Programming, and Programming Support Environments. Includes real-time programming, tasking, packages, abstract data types, and problem solving.

Notes or Special Concerns: Students include military officers and DoD civilians. Offered for graduate creoit. The course is taught when there is sufficient demand.

Training Organization

Org. Name: Army Management Engineering College

Contact: Bob Beat

Address: AMEC

Rock Island, IL 61299-7040

Phone: (309)782-4041 ext 218 **Autovon:** AV 793-4041 ext 218

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Course Information

Course Name: Ada and Software Engineering Overview

Audience: Prog Mgrs, Engrs, Comp Spec **Hands-On:** N

Location: Rock Island, IL **Length:** 1 1/2 days

Prerequisites: Knowledge of software development process, basic computer hardware principles, and a high order language.

Topics: Discussion of Ada language features especially those supporting software engineering; the software support environment; Intro to OOD; Ada programming environment; requirements for fully supporting Ada

Notes or Special Concerns: Designed for Program Managers or Engineers who must decide on the applicability of Ada to their operational environment. Course may be taught on site for class size of 20-24 students. Must reserve place on annual schedule.

Training Organization

Org. Name: ALMC School for Engineering and Logistics

Contact: Mark Oestmann, Dept of Eng

Address: Red River Army Depot
Texarkana, TX 75507

Phone: (214) 334-3335 **Autovon:** AV 829-3335

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Course Information

Course Name: Simulation using Ada

Audience: Engineers, Programmers **Hands-On:** Y

Location: Red River **Length:** 11d (90hr)

Prerequisites: Civilians grade GS-05 to GS-07, who are qualified entry-level engineers in AMC, another Army Command, Service, or DoD

Topics: Provides an introduction to digital simulation techniques and the application of the tasking features of the Ada progamming language as tools in the development and testing of real-time embedded computer systems software.

Notes or Special Concerns: Course is part of two year AMC Software Engineering Intern Training Program. Program also includes four other training blocks where Ada is used extensively.

Training Organization

Org. Name: ALMC School for Engineering and Logistics

Contact: Mark Oestmann, Dept of Eng

Address: Red River Army Depot
Texarkana, TX 75507

Phone: (214) 334-3335 **Autovon:** AV 829-3335

* *

Course Information

Course Name: Advanced Microprocessors

Audience: Engineers, Programmers **Hands-On:** Y

Location: Red River **Length:** 11d (90hr)

Prerequisites: Civilians grade GS-05 to GS-07, who are qualified entry-level engineers in AMC, another Army Command, Service, or DoD

Topics: Provides programming techniques required when one or more target processors is a micro. Special emphasis given to Ada interface with assembly language. Covers real-time application of Ada/Assembly interface techniques.

Notes or Special Concerns: Course is part of two year AMC Software Engineering Intern Training Program. Program also includes four other training blocks where Ada is used extensively.

Training Organization

Org. Name: ALMC School for Engineering and Logistics

Contact: Mark Oestmann, Dept of Eng

Address: Red River Army Depot
Texarkana, TX 75507

Phone: (214) 334-3335 **Autovon:** AV 829-3335

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Course Information

Course Name: Software Engineering Workshop

Audience: Engineers, Programmers **Hands-On:** Y

Location: Red River **Length:** 14d (110hr)

Prerequisites: Civilians grade GS-05 to GS-07, who are qualified entry-level engineers in AMC, another Army Command, Service, or DoD

Topics: Consists of participation in a "large-scale" software development project to apply software engineering tools and techniques learned in previous courses.

Notes or Special Concerns: Course is part of two year AMC Software Engineering Intern Training Program. Program also includes four other training blocks where Ada is used extensively.

APPENDIX B
U.S. ARMY ADA PROJECTS

This appendix includes a list of Army programs known to the authors, which are currently using or plan to use Ada in all or part of the system. The list was compiled from the current Ada Information Clearinghouse list, conversations with Ada technology divisions and articles in the public domain. Some active programs may have inadvertently been left out or the information may have changed. The authors have made every effort to ensure the list's accuracy.

Each project listed contains several pieces of information. The point of contact is usually either the program manager or the Army liaison to the contractor. Both civilian and Autovon (AV) phone numbers are given when known. A status of PL indicates a program in the planning phase, a DV indicates current full-scale engineering development and a C indicates the project is completed and operational. These status indicators, however, may change during the completion of this report. Several programs recently began development, while others are nearing completion and still others may never reach full-scale development due to budgetary or contractor limitations.

1	**Project:**	Bradley Fighting Vehicle System
	Acronym:	. **Majcom:** AMCCOM
	Contact:	Dan Nathan
	Phone:	AV 880-3585
	Status:	DV **Location:** Piccatinny Arsenal, NJ
	Description:	Troop carrier, armored fighting vehicle. Target acquisition components and some ballistics being done in Ada.
2	**Project:**	Chemical Biological Mini Mass Spectrometer
	Acronym:	CB-MMS **Majcom:** AMCCOM
	Contact:	Bob Marenelli
	Phone:	AV 880-3430
	Status:	PL **Location:** Piccatinny Arsenal, NJ
	Description:	Man carriable device to detect biological or chemical agents in environment. Monitoring device and miniaturized mass spectrometer being written in Ada. May be cancelled in favor of Mini-Detector.

3	**Project:**	Chemical Biological Mini-Detector
	Acronym:	CB-MD **Majcom:** AMCCOM
	Contact:	Bob Marenelli
	Phone:	AV 880-3430
	Status:	PL **Location:** Piccatinny Arsenal, NJ
	Description:	Man carriable device to detect biological or chemical agents in environment. Monitoring device being written in Ada. May be cancelled in favor of Mini Mass Spectrometer.
4	**Project:**	Digital Turret Distribution Box
	Acronym:	DTDB **Majcom:** AMCCOM
	Contact:	Chong Liao
	Phone:	313-574-6497
	Status:	DV **Location:** Warren, MI
	Description:	Control of logic and switching functions in the Bradley Fighting Vehicle Weapon Station.

5	**Project:**	Howitzer Improvement Program Auto Fire Control System
	Acronym:	HIP AFCS **Majcom:** AMCCOM
	Contact:	Dan Nathan
	Phone:	AV 880-3585
	Status:	DV **Location:** Picatinny Arsenal, NJ
	Description:	Program will correct current shortcomings in four primary areas: responsiveness, survivability, terminal effects and random acesss memory. One of the principle components of this effort is development and fielding of the AFCS. Includes operator console, hydraulic support, and maneuver control components.
6	**Project:**	M-60A3 Modified Fire Control System
	Acronym:	MFCS **Majcom:** AMCCOM
	Contact:	Doo J. Lee / Dan Nathan
	Phone:	AV 880-6069 / AV 880-3585
	Status:	DV **Location:** Picatinny Arsennal, NJ
	Description:	The M21 Balistic Computer System of the M-60A3 tank fire control system is being converted from an analog to a digital device. This program will be used to provide Ada code for the upgraded M21 ballistic Computer System. Includes ballistic and siting correction modules.

7	**Project:**	Nuclear Biological Chemical Reconnaissance System
	Acronym:	
	Majcom:	AMCCOM
	Contact:	Bob Marenelli
	Phone:	AV 880-3430
	Status:	DV
	Location:	Piccatinny Arsenal, NJ
	Description:	Lightweight armored vehicle to detect nuclear, biological or chemical agents in environment. Monitoring device being written in Ada.
8	**Project:**	Search and Destroy Armor
	Acronym:	SADARM
	Majcom:	AMCCOM
	Contact:	Dan Nathan
	Phone:	AV 880-3585
	Status:	DV
	Location:	Piccatinny Arsenal, NJ
	Description:	Ammunition with sensor to improve accuracy.

9	**Project:**	Airborne Target Handover System/Avionics Integration
	Acronym:	ATHS/AI **Majcom:** AVSCOM
	Contact:	Robert Kanyok/John Berry
	Phone:	AV 693-3653/AV 693-1929
	Status:	DV **Location:** St. Louis, MO
	Description:	The Multiplex Remote Terminal Unit uses Ada for all functions. The Control Display Unit is a modification of an earlier program and uses PL/M
10	**Project:**	Apache Multi-Stage Improvement Program
	Acronym:	Apache MSIP **Majcom:** AVSCOM
	Contact:	Robert Kanyok/Julius Romano
	Phone:	AV 693-3653/AV 693-1971
	Status:	PL **Location:** St. Louis, MO
	Description:	All new software or hardware will be requied to use Ada. Currently in Demonstration/Validation phase. RFP is being prepared. Contract is scheduled for March 1989.

11	**Project:**	Cockpit Emergency Procedures Trainer
	Acronym:	CEPT **Majcom:** AVSCOM
	Contact:	Stephen M. Sekach
	Phone:	AV 693-3653
	Status:	DV **Location:** St. Louis, MO
	Description:	Original contractor defaulted, so under new contractor. All software will be written in Ada. Will be part of training program for the UH-60A Black Hawk Helicopter.
12	**Project:**	Command Instrumentation System Trainer
	Acronym:	CIST **Majcom:** AVSCOM
	Contact:	Stephen M. Sekach
	Phone:	AV 693-3653
	Status:	DV **Location:** St. Louis, MO
	Description:	The entire software package will be written in Ada, with the exception of a small portion dealing with I/O. Used as part of the UH-60A Black Hawk Helicopter training program.

13	**Project:**	Generic Aircraft Maintenance Management System
	Acronym:	GAMMS **Majcom:** AVSCOM
	Contact:	Fredrick H. Reed
	Phone:	314-263-3653/AV 693-3653
	Status:	PL **Location:** St. Louis, MO
	Description:	Real-time data acquisition system. Ada will be required is project is developed. Current funding problems have resulted in no development plans at this time.
14	**Project:**	Integrated Inertial Navigation System
	Acronym:	IINS **Majcom:** AVSCOM
	Contact:	Ron Kurowsky
	Phone:	AV 995-3550
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	Airborne inertial navigation unit which provides navigational information to pilot in aircraft. Rewriting in Ada from Fortran; may also retest.

15	**Project:**	Light Helicopter Experimental Family
	Acronym:	LHX **Majcom:** AVSCOM
	Contact:	Robin Sova
	Phone:	314-263-3653/ AV 693-3653
	Status:	DV **Location:** St. Louis
	Description:	The RFP requires the use of Ada for all software used in the aircraft. This includes flight control, navigation, communication, engine controls, controls and displays, fire control, etc.
16	**Project:**	Microwave Landing System
	Acronym:	MLS **Majcom:** AVSCOM
	Contact:	Gary Clerie
	Phone:	AV 992-0032
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	Currently, the Air Force is the lead service for the MLS, and the Army has not yet provided funding. The ground equipment is all in Ada, while a commercial design was used for the avionics (programmed in Pascal under waiver). Also contact Allen Geberson, AV 478-5502 (USAF, Ground Equipment) or Lt. Chris Caldwell, AV 478-8915 (USAF, Avionics)

17	**Project:**	Miniature Global Positioning System
	Acronym:	MGPS (MGU) **Majcom:** AVSCOM
	Contact:	Jorge Rivera/Paul Olsen
	Phone:	AV 995-3532/3912
	Status:	PL **Location:** Ft. Monmouth, NJ
	Description:	Currently in the planning stages. If developed through a competitive or sole-source mode, will use Ada. However, if NDI or CFE, the language will be whatever is currently used.
18	**Project:**	OV-1 Aircraft Survivability Equipment Remote Terminal Unit
	Acronym:	ASE RTU **Majcom:** AVSCOM
	Contact:	Don Murdoch
	Phone:	201-544-4324 /AV 992-4324
	Status:	PL **Location:** Ft. Monmouth, NJ
	Description:	Includes Equipment Training Module, which is being developed in Ada. Contract for overall RTU has just been awarded.

19	**Project:**	OV-1 Aircraft Survivability Equipment Training
	Acronym:	ASE **Majcom:** AVSCOM
	Contact:	Don Murdoch
	Phone:	201-544-4324 /AV 992-4324
	Status:	PL **Location:** Ft Monmouth, NJ
	Description:	This system will add to system hardware as a real-time trainer/simulator. Majority of system will be developed in Ada.
20	**Project:**	Special Operating Aircraft Map Display Generator
	Acronym:	SOA MDG **Majcom:** AVSCOM
	Contact:	John Mundy
	Phone:	314-263-3653/AV 693-3653
	Status:	DV **Location:** St. Louis, MO
	Description:	The Map Display Generator uses a 1750A procesor performing chart memory management, SIBAN, bit interface handling, map control and perspective field computing. The entire software package is written in Ada, except those areas that are time critical, hardware dependent or deal with I/O. Assembly language will be used in these cases.

21	**Project:**	Special Operating Aircraft Remote Terminal Unit
	Acronym:	SOA RTU **Majcom:** AVSCOM
	Contact:	John Mundy
	Phone:	314-263-3653/AV693-3653
	Status:	DV **Location:** St. Louis, MO
	Description:	The RTU supports MH47E and MH60K aircraft in initalization, I/O management and signal conditioning. It also has built-in testing capabilities. The entire software package is written in Ada, except those areas that are time critical, hardware dependent or deal with I/O. Assembly language will be used in these cases.
22	**Project:**	T-800 Engine Monitor
	Acronym:	**Majcom:** AVSCOM
	Contact:	Robin Sova
	Phone:	AV 693-3653
	Status:	PL **Location:** St. Louis, MO
	Description:	The T-800 Engine Monitor will be selected with the T-800 Engine. The proposals for the T-800 are being evaluated. Ada is required, but the extent of usage will not be known until the contract is awarded.

23	**Project:**	TACMS-Inertial Guidance Unit
	Acronym:	TACMS IGU **Majcom:** AVSCOM
	Contact:	William Gilbert
	Phone:	AV 746-8311
	Status:	PL **Location:** Redstone Arsenal, AL
	Description:	This progrm will recode Jovial and Z8002 Assembler language missile IGU computer program components to Ada, simulate real time operation to establish IGU microcomputer design requirements, design and build the required flight micro system, verify and validate, and deploy the system.
24	**Project:**	UH-60 Multi-Stage Improvement Program
	Acronym:	UH-60M **Majcom:** AVSCOM
	Contact:	Jim Maguire
	Phone:	AV 885-4315
	Status:	PL **Location:** St. Louis, MO
	Description:	It is unknown if Ada will be used until the Avionics subcontractor is selected.

25	**Project:**	UH-60A Black Hawk Composite Trainer
	Acronym:	
	Majcom:	AVSCOM
	Contact:	Stephen M. Sekach
	Phone:	AV 693-3653
	Status:	C
	Location:	St. Louis, MO
	Description:	Trainer's computer system control actual aircraft systems, as well as simulation of other non-installed systems. System was integrated at Ft. Rucker, AL and is currently in use full-time. Additional contact: Robert Gordon, Program Manager for the Trainer, Validity Corp.
26	**Project:**	Noncommunications Jammer 2000
	Acronym:	
	Majcom:	AVSCOM
	Contact:	Joan Hardy
	Phone:	201-544-2794
	Status:	DV
	Location:	Ft Monmouth, NJ
	Description:	Operational program exists to develop, fabricate, and demonstrate a radar jammer capable of protecting against current and future threat radiators. Being non-vehicle specific, the project has applicability to all services. Ada will be both the design language and the operational language.

27	**Project:**	Ada Designed/X.25/VSLI/VHSIC Chip
	Acronym:	
	Majcom:	CECOM
	Contact:	Al Kerecman
	Phone:	201-544-2957
	Status:	PL
	Location:	Ft Monmouth, NJ
	Desc iption:	Software shall be developed or designed in Ada for the X.25 protocol. All X.25 required functions at the Datalink (frame) and Network (packet) level will be designed in Ada using the selected Ada-based design language.
28	**Project:**	Advanced Aerial Radio System
	Acronym:	AARS
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Being developed in Ada, in-house.

29	**Project:**	Advanced Field Artillery Tactical Data Systems
	Acronym:	AFATDS **Majcom:** CECOM
	Contact:	Chris Barnett
	Phone:	405-351-2621
	Status:	DV **Location:** Ft Sill, OK
	Description:	AFATDS will be the automated command and control system which is intended to serve as both a subordinate system and objective control element of the fire support functional system. It will replace TACFIRE.
30	**Project:**	Advanced Quicklook Elint TDOA
	Acronym:	**Majcom:** CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	

31	**Project:**	AN/APR-39A(XE-2)
	Acronym:	
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Radar warning receiver system. Being done in Ada; minor problems in timing tests, working on solving. Successful completion may negate other contractors' arguments against using Ada in advanced signal processing systems.
32	**Project:**	AN/UPD-7
	Acronym:	
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Radar surveillance system to track moving ground targets. Ada is required as part of contract award.

33	**Project:**	Army Test Program Set Support Environment
	Acronym:	ATSE **Majcom:** CECOM
	Contact:	Charles Walton
	Phone:	201-532-4310
	Status:	DV **Location:** Ft Monmouth, NJ
	Description:	To provide an interactive, automated environment for Test Program Set (TPS) development and management
34	**Project:**	Battlefield Electronics CEOI System
	Acronym:	BECS **Majcom:** CECOM
	Contact:	Jim Wagner
	Phone:	AV 992-5848
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	Communication system providing decentralized CEOI functions for single and frequency hopping information. Not currently using Ada, but future improvements will given adequate funding.

35	**Project:**	Cameo Bluejay
	Acronym:	
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	PL
	Location:	Ft. Monmouth, NJ
	Description:	Scheduled to be done in Ada. Contractor disputing time feasibility, increasing time and cost factors.
36	**Project:**	Communication Deception System
	Acronym:	CDS
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Intelligence system which aids in jamming communication lines and preventing identification of signal origination.

37	**Project:**	Firefinder II
	Acronym:	
	Majcom:	CECOM
	Contact:	Gene Crostley
	Phone:	AV 639-6950
	Status:	PL
	Location:	Ft. Sill, OK
	Description:	Firefinder II addresses specific shortcomings of the current Firefinder radar acquisition systems used by Army and Marine units. Currently receiving ATIP money to investigate advantages of Ada in the Tacfire portion of system. Funding for eventual recode is still questionable.
38	**Project:**	Forward Entry Device
	Acronym:	FED
	Majcom:	CECOM
	Contact:	Milt Smith
	Phone:	405-351-2554
	Status:	DV
	Location:	Ft Sill, OK
	Description:	Software division is providing support to contractor developing code in Ada. Following all 2167A guidelines. Will interact with the AFATDS program. Uses standard ACS hardware.

39	**Project:**	Generic Target Acquisition Device
	Acronym:	GTAD **Majcom:** CECOM
	Contact:	Milt Smith
	Phone:	405-351-2554
	Status:	C **Location:** Ft Sill, OK
	Description:	Simulates target acquisition for use in testing other sensor devices and systems. All code is written in Ada. Occassionally modified for different test beds.
40	**Project:**	Intermediate Forward Test Equipment
	Acronym:	IFTE **Majcom:** CECOM
	Contact:	R. Burchacki
	Phone:	201-532-3362
	Status:	DV **Location:** Ft Monmouth, NJ
	Description:	System software to include the Run time System Software, on ATLAS compiler, simulation software, and maintenance, self-test, diagnostic software.

41	**Project:**	Joint Surveillance, Target Acquisition, Reconasaince System-DGSM
	Acronym:	JSTARS-DGSM **Majcom:** CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	PL **Location:** Ft. Monmouth, NJ
	Description:	Ada is required as part of the contract award.
42	**Project:**	Maneuver Control System Program
	Acronym:	MCS **Majcom:** CECOM
	Contact:	Salvatore LaForgia
	Phone:	201-684-7647
	Status:	DV **Location:** Ft Monmouth, NJ
	Description:	Army Command and Control System which uses transportable computers & tactical communication systems to send, process, & display combat data to support commanders & staffs at corps & subordinate echelons. Provides current info & decision aids in text & graphics to support timely reports.

43	**Project:**	Mobile Automated Field Instrumentation System
	Acronym:	MAFIS
	Majcom:	CECOM
	Contact:	Hubert Bahr
	Phone:	817-288-9308
	Status:	DV
	Location:	Ft Hood, TX
	Description:	Allows for real time monitoring of two sided mechanized combat where weapon engagements are simulated. Only the Command and Control Subsystem of MAFIS is being written in Ada.
44	**Project:**	Multi-Sensor Target Acquisition System
	Acronym:	MTAS
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Ada is primary development language, except where faster processing requires the use of assembly language.

45	**Project:**	Multiple Launch Rocket System Fire Direction System Ada Conversion
	Acronym:	MLRS FDS
	Majcom:	CECOM
	Contact:	Gene Crostley
	Phone:	AV 639-6950
	Status:	DV
	Location:	Ft. Sill, OK
	Description:	Original system written in assembly type language on now obsolete hardware. Recode will use standard ACS hardware. System consists of fire control system which communicates with fire direction system at the Platton, Company, and Battalion levels.
46	**Project:**	Net Control Station - JTIDS
	Acronym:	NCS-J
	Majcom:	CECOM
	Contact:	Jim Wagner
	Phone:	AV 992-5848
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Manned control station, performs secure network communication assignments. Will also be used by the Air Force. Entire system is in Ada.

47	**Project:**	Net Planning Program
	Acronym:	
	Majcom:	CECOM
	Contact:	Jim Wagner
	Phone:	AV 992-5848
	Status:	PL
	Location:	Ft. Monmouth, NJ
	Description:	Communications Security key management system; under contract negotiation currently. Will use Ada for all development
48	**Project:**	Regency Net
	Acronym:	
	Majcom:	CECOM
	Contact:	Ron Durkel
	Phone:	AV 992-7940
	Status:	C
	Location:	Ft Monmouth, NJ
	Description:	RN software provides automated functions on a distributed basis for the RN HF radio communication system

49	**Project:**	Remote Relay/AEB Repeater
	Acronym:	
	Majcom:	CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Being developed in Ada, in-house. Communications link system.
50	**Project:**	Single Channel Objective Tactical Terminal (AN/TCS-124)
	Acronym:	SCOTT
	Majcom:	CECOM
	Contact:	Jim Wagner
	Phone:	AV 992-5848
	Status:	DV
	Location:	Ft. Monmouth, NJ
	Description:	Automated tactical record traffic monitor; receives and transmits messages. Will also be used by the Air Force.

51	**Project:**	Single Subscriber Terminal (AN/UGC-144)
	Acronym:	SST **Majcom:** CECOM
	Contact:	Jim Wagner
	Phone:	AV 992-5848
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	Single channel satellite terminal used for classified communications. Will allow real-user to prepare messages at PC-like keyboard for use with JINTACS (interoperability network). Entirely in Ada.
52	**Project:**	Tactical Communications Jammer-A Bluejay
	Acronym:	TACJAM-A **Majcom:** CECOM
	Contact:	Genap Dada
	Phone:	AV 992-1296
	Status:	DV **Location:** Ft. Monmouth, NJ
	Description:	Mobile Forward Area Jamming capability to support Division and Corps combat operations. Use of Ada still in question because of time constraints and lack of compilers for faster signal processors.

53	**Project:**	US Army Europe Tactical Command System
	Acronym:	UTACCS **Majcom:** CECOM
	Contact:	Frank Nissen
	Phone:	201-532-2970
	Status:	DV **Location:** Ft Monmouth, NJ
	Description:	System supports operation of the Army's Echelons Above Corps in message composition, routing and storage. System supports communications through Army Tactical Data System and on LANS.
54	**Project:**	Vehicle Magnetic Signature Duplicator
	Acronym:	VEMASID **Majcom:** CECOM
	Contact:	Stephan Schaedel
	Phone:	703-664-5787
	Status:	PL **Location:** Ft Belvoir, VA
	Description:	The VEMASID program is an electric countermeasure system designed to assist in neutralizing magnetic landmines. Monitors system status, performs built-in tests, and relays messages to operator. Converts assembly code to Ada.

55	**Project:**	Army Worldwide Military Command and Control Systems (WWMCCS) Information System
	Acronym:	AWIS **Majcom:** ISC
	Contact:	LTC Dick Delaney
	Phone:	968-1266
	Status:	DV **Location:**
	Description:	Will provide complete command and control system Army wide. Modules include: mobilization, movement management, operations, engineering, intelligence, communication, and command level information management. Entering detailed design phase early in 1989.
56	**Project:**	Combat Service Support Control System
	Acronym:	CSSCS **Majcom:** ISC
	Contact:	Brenda Blew/Roy Matson
	Phone:	AV 687-4839/ AV 992-8201
	Status:	DV **Location:** Ft Lee, VA/Ft. Monmouth, NJ
	Description:	One of five nodes of overall command and control system. Tracks personnel, supplies, other support areas.

57	**Project:**	Department of the Army Information Network
	Acronym:	DAIN **Majcom:** ISC
	Contact:	LTC Bailey
	Phone:	703-355-7229/7230
	Status:	DV **Location:** Ft. Belvoir, VA
	Description:	DAIN is an information network to support decision, administrative and operating needs for HQ DA and selected FOAs. Will provide full-range of communications, processing and storage services including: data, text, image, voice and graphics. The use of Ada will be based on evaluations made during the definition and design phase.
58	**Project:**	Department of the Army Movement Management System - Redesign
	Acronym:	DAMMS-R **Majcom:** ISC
	Contact:	Doug Patrick
	Phone:	AV 687-4874
	Status:	PL **Location:** Ft Lee, VA
	Description:	

59	**Project:**	Reserve Component Automation System
	Acronym:	RCAS **Majcom:** ISC
	Contact:	LTC Parrish
	Phone:	703-845-4481
	Status:	PL **Location:** Ft. Belvoir, VA
	Description:	Personnel, Pay, Mobilization, Training, Unit Admin System for the Army National Guard. Since system was mandated by Congress, Ada not specified. However, expected to be factor in prime selection. RFP has not yet been released.
60	**Project:**	Standard Army Retail Supply System - Master Control Program
	Acronym:	SARSS-MCP **Majcom:** ISC
	Contact:	Barry Lichvar
	Phone:	AV 697-1722
	Status:	DV **Location:** Ft Lee, VA
	Description:	Master control system done in Ada; controls execution of two major comonents on Corps level computer. Will be operatorless system. Performing test, analysis and control.

61	**Project:**	Standard Financial System Redesign		
	Acronym:	STANFINS-R	**Majcom:**	ISC
	Contact:	Charles Petefish		
	Phone:	AV 699-3143		
	Status:	PL	**Location:**	Ft. Ben-Harrison, IN
	Description:	STANFINS-R is a redesign of a general accounting module, including cost accounting, cost accounting standards, and budget execution functions.		
62	**Project:**	Standard Installation Division Personnel System Version 3.0		
	Acronym:	SIDPERS-3	**Majcom:**	ISC
	Contact:	LTC Ron Reed		
	Phone:	703-325-6950		
	Status:	PL	**Location:**	Alexandria, VA
	Description:	The SIDPERS-3 is a total army field personnel support system performing field strength mgmt and accounting from individual to entire DA. Present system is in three sections, Guard, Reserve and Active. SIDPERS-3 will combine sections.		

63	Project:	Total Army Authorization Document-Redesign		
	Acronym:	TAAD-R	Majcom:	ISC
	Contact:	John Schoenecker		
	Phone:	703-756-5684		
	Status:	PL	Location:	Ft. Belvoir, VA
	Description:	1/5 of system will be in Ada		
64	Project:	Flir Mission Payload Subsystem		
	Acronym:	FMPS	Majcom:	MICOM
	Contact:	Capt John Comer		
	Phone:	205-876-4905		
	Status:	DV	Location:	Redstone Arsenal, AL
	Description:	Processes data to control the FMPS functions which include autotracking a target, ranging or designation with the laser, and reponding to manual sightline control commands from the gound.		

65	**Project:**	Forward Area Air Defense Non-Line-Of-Sight System
	Acronym:	FAAD-NLOS **Majcom:** MICOM
	Contact:	Col Koropay
	Phone:	AV 746-8454
	Status:	PL **Location:** Redstone Arsenal, AL
	Description:	Currently under contract evaluation.
66	**Project:**	Forward Area Defense Command, Control and Intelligence System
	Acronym:	FADC2I **Majcom:** MICOM
	Contact:	Col Taylor/ Dana Willbangs
	Phone:	205-895-3441/3780
	Status:	DV **Location:** Redstone Arsenal, AL
	Description:	Low to Medium altitude system to provide data on air targets to ground crews manning gun stations. Currently in preliminary design phase, using Ada PDL. Will be done completely in Ada.

67	**Project:**	Hellfire Tactical Missile
	Acronym:	
	Majcom:	MICOM
	Contact:	Richard Shingler
	Phone:	AV 746-1117
	Status:	DV
	Location:	Redstone Arsenal, AL
	Description:	Laser guided, tactical air to ground anti tank missile launched from Helicopters. Being developed by staff of 60, including 8 software engineers. (All contractor personnel).
68	**Project:**	Non-Cooperative Target Recognition System for Forward Area Air Defense
	Acronym:	NCTRS FAAD
	Majcom:	MICOM
	Contact:	LTC Stoldt
	Phone:	AV 746-9210/1278
	Status:	DV
	Location:	Redstone Arsenal, AL
	Description:	

69	**Project:**	Radio Frequency Interferometer
	Acronym:	RFI
	Majcom:	MICOM
	Contact:	James Mullins
	Phone:	AV 746-1426
	Status:	DV
	Location:	Redstone Arsenal, AL
	Description:	
70	**Project:**	Robotized Wire Harness Assembly System
	Acronym:	RWHAS
	Majcom:	MICOM
	Contact:	Mike Anderson
	Phone:	205-876-9954
	Status:	C
	Location:	Redstone Arsenal, AL
	Description:	Ada S/W in RWHAS is a batch program called the Data Generator(DG). It provides a link between a CAD wire harness program & the CAM RWHAS by automatically producing data used by robots to manufacture a wire harness. It uses multiple file I/O to get wire connector, tooling info. Fully Flexible Manufacturing System.

APPENDIX C
UNIVERSITIES TEACHING ADA

This appendix includes a list of 195 universities that the authors know are teaching software engineering and/or Ada. References for this information include Version 5.0 of the *CREASE* and the Software Engineering Institute's (SEI) *Software Engineering Education Directory*, January 1988. This database is constantly changing and updates may be obtained from the Ada Software Engineering Education and Training (ASEET) Team.

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
1	Alabama A&M	Structured Programming with Advanced Languages: Ada	Dept of Computer & Info Sciences P.O. Box 88	Normal	Alabama	35762	Dr. Hrishikesh Saha	205-859-7339
2	Auburn University	Advanced Programming in Ada	Comp Sci and Eng Dept 111 Dunstan Hall	Auburn	Alabama	36849	Dr. Thomas Phillips	205-826-4330
3	Birmingham-Southern College	1-Alternative Languages 2-The Ada Programming Lang.	Div. of Science and Math 800 8th Ave West	Birmingham	Alabama	35254	Richard Turner	205-226-4870
4	Univ. of Alabama at Birmingham	Formal Specifications and Software Development	Sch of Natural Sci Dept of Comp & Info Sciences	Birmingham	Alabama	35294	Dr. Warren Jones	205-934-2213
5	University of Ala/Huntsville	Software Development and Design Using Ada	CSC Department	Huntsville	Alabama	35899	Warren Mosely	205-895-6088
6	University of Alabama	Ada and Concurrent Programming	Dept. of Comp Sci	Univeristy	Alabama	35487	Dr. Wen-Kai Chung	205-348-6363
7	University of Southern Alabama	Programming Lang: Ada	Div of Computer & Information Science	Mobile	Alabama	36688	Marino Niccolai	205-460-6390
8	University of Alaka	Computer Programming II (includes Ada as a second language)	Dept of Math & Computer Science Chapman Building	Fairbanks	Alaska	99775	Barbara Lando	907-474-7332
9	University of Alaska Southeast	Ada for Programmers	School of Bus & PA 1108 F. Street	Juenau	Alaska	99801	Timothy J. Fullam	907-789-4402
10	Arizona State University	Introduction to Ada	Computer Science Department	Tempe	Arizona	85287	Dr. Terry Mellon	501-965-2774
11	Azusa Pacific University	Structured Programming 2 - Ada	Computer Science Department P.O. Box APU	Azusa	California	91702	Wendell Scarborough	818-969-3434
12	CA State Polytechnic Univ/Pamona	1-Ada 2- Software Engineering	Department of Computer Science	Pamona	California	91788	Dr. Kenneth McDonald	714-869-3440

Universities Teaching Ada

	Univerisity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
13	CA State Univ/ Long Beach	Software Engineering with Ada	Comp Sci & Eng Dep 1250 Bellflower Blvd.	Long Beach	California	90840	Joel Carissimo	213-498-4285
14	CA State Univ/ Northridge	Software Engineering with Ada	Dept. of Computer Sceince, School of Engineering	Northridge	California	91320	Shawn Barkataki	818-885-3398
15	CA State University	Advanced Software Practices	Department of Computer Science	Chico	California	9592041	Paul Luker	916-895-6442
16	California Lutheran University	CS 212A: Ada Programming	60 West Olsen Road	Thousand Okas	California	91360	Roy James Guild	805-493-3362
17	California State Univ/LA	Ada Programming	Dept of Math & Comp Science 5151 State Univ Dr	Los Angeles	California	90032	Mr. Fraser	213-224-3287
18	CSU/Dominguez Hills	High Level Languages: Ada	1000 E. Victoria St Building NSM A132	Carson	California	90747	Dr. R. Huddlestone	213-224-3287
19	Harvey Mudd School	1-Programming Languages 2-Introduction to Programming	Dept. of Computer Science	Claremont	California	91711	Dr. Michael Erlinger	714-621-8225
20	Merritt College	Software Engineering with Ada		Oakland	California		Dr. Richard D. Riehle	
21	National University	9-Software Eng. Project I 10-Software Eng. Project II 11-Softwre Eng. Project III		San Diego	California	92108	Prof. Peter Sibley	619-563-7123
22	National University	5- Data Base Mgt. 6-Princ of H/W & S/W Integr 7-Expert Systems 8-V & V Techniques	in Software Engineering	San Diego	California	92108	Prof. Peter Sibley	619-563-7123
23	National University	1-Princ of S/W Engineering 2-Intro to Appl Prog Lang-Ada 3-Adv. Appl Programming 4-Advanced Software Engin	School of Engineering and Computer Sciences Master of Science	San Diego	California	92108	Prof. Peter Sibley	619-563-7123
24	San Jose State University	Software Engineering with Ada	Dept. of Math & Computer Science	San Jose	California	95192	Evelyn E. Obaid	408-924-5139

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
25	Stanford University	Oject-Oriented Design with Ada	School of Eng. Dept. of Comp Sci	Stanford	California	94305	Proj Stuart Reges	415-723-9798
26	Univ. of California/ Santa Barbara	Programming Languages	Computer Science Department	Santa Barbara	California	93106	Laura Dillon	805-961-3411
27	University of CA at Irvine	Ada	Information & Comp Science Dept	Irvine	California	92717	Dr. Dennis Volper	714-856-7403
28	Pikes Peak Community College	Introduction to Ada Programming	3675 S. Academy Blvd.	Colorado Springs	Colorado	80906	Vivian M. Challen	303-576-7711
29	University of Colorado at Colorado Springs	Introduction to Software Engineering	Sch of Eng & Appl Science Dept of Comp Sci	Colorado Springs	Colorado	80933	Dr. Robert Sebesta	303-593-3325
30	University of Colorado at Denver	Parallel Computing with Ada	Math Department University Box 170 1200 Larimer St.	Denver	Colorado	80204	Dr. Zenas Hartvigson	303-556-8442
31	University of S. Colorado	1-Ada and Software Eng II 2-Software Engineering with Ada	Computer Science Department 2200 N. Bonforte	Pueblo	Colorado	81001	Robert Cook	303-549-2752
32	Central Connecticut State U	Advanced Topics in Computer Science: Ada	Department of Math & Comp Sci 1615 Stanley St	New Britain	Connecticut	6050	A. Zoe Leibowitz	203-827-7568
33	Central State University	Advanced Topics in Computer Science: Ada	1615 Stanley Street	New Britain	Connecticut	6050	A. Zoe Leibowitz	203-827-7568
34	Southern Connecticut State Univ	1-Ada Programming 2-Organization of Programming Languages	Computer Science 501 Crescent Street	New Haven	Connecticut	6515	Dr. JoAnn Parikh	203-397-4514
35	University of New Haven	Programming in Ada	Depart of Industrial Eng & Computer Science	West Haven	Connecticut	6516	Gary Walters	203-932-7067
36	American University	Data Structures	Dept of Comp Sci and Information Sciences	Washington	D.C.	20016	Richard A. Holzsager	202-885-1470

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
37	Gallaudet University	Data Structures using Ada	Dept of Math/Computer Science	Washington	D.C.	20002	Howard L. Egan	202-651-5315
38	Howard Unviersity	1-Advanced Prog. Langauges 2-Real-Time Systems	Systems & Computer Science School of Eng.	Washington	D.C.	20059	Don Coleman	202-636-6595
39	Brevard Community College	1-Intro to Ada Programming 2-Advanced Ada	Business Division 1519 Clear Lake Rd	Coco	Florida	32926	Dennis Koile	305-632-1111
40	Embry-Riddle Aeronautical University	Intro to Software Engineering	Computer Science ERAU (PD-AAC)	Daytona Beach	Florida	32014	Dr. Jagdish Agrawal	904-239-5590
41	Florida Atlantic University	Software Engineering	Department of Computer Science	Boca Raton	Florida	33431	Dr. Neal Doulter	305-393-3180
42	Florida Institute of Technology	Ada and Its Programming Environment	150 University Ave. Dept of Comp Sci	Melbourne	Florida	32901	Luwana Clever	305-768-8091
43	Florida State University	1-Real-Time Programming 2-Software Engineering with Ada	Compu Sci Dept Room 206 Love Building	Tallahassee	Florida	32306	Greg Riccardi/Ted Baker	904-644-2296
44	St. Peter's Jr College	Ada Programming	2465 Drew St.	Clearwater	Florida	34615	Jim Hill	813-791-2530
45	Univ. of Central Florida	1-Software Engineering I 2-Software Engineering II	Dept of Computer Eng CEBA 207	Orlando	Florida	32816	Dr. Darrell Linto	305-275-2236
46	University of Miami	Softwre Development with Ada	Elec & Comp Eng P.O. Box 248294	Miami	Florida		Susan D. Urban	305-284-3452
47	Armstrong State Univ	Comparative Languages	Dept of Comp Sci Dept of Math & Comp Sci	Savannah	Georgia	31419	Dr. Sigmund Hudson	912-927-5317
48	Atlanta Univ	1-Design and Programming Languages 2-Software Engineering	Dep Math & Com Sci James Brawley Dr., SW	Atlanta	Georgia	30314	Steven Ornburn	404-681-0251

Universities Teaching Ada

	Univerisity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
49	Georgia Insitute of Technology	Abstraction and Specification in Program Development	School of Inofrmaiton/Comp Sci	Atlanta	Georgia	30332	Richard LeBlanc	404-894-2592
50	Georgia State University	Software Engineering	Dept. of Math & Compu Sci	Atlanta	Georgia	30303	Dr. Scott Owen	404-651-2253
51	La Grange College	Introduction to Object Oriented Design	Computer Science Department 601 Broad Street	LaGrange	Georgia	30240	Tony Valle	404-882-2911
52	Morehouse College	Introduction to Ada	Dept of Comp Sci P.O. Box 137	Atlanta	Georgia	30314	William McGuiver	404-525-1501
53	Univ of Georgia	Software Engineering	Dept of Com Sci 415 Boyd Graduate Studies Center	Athens	Georgia	30602	Dr. Orville Weyrich	404-542-2911
54	Chaminade University	Special Topics: Ada	Computer Science Department 3140 Walai	Honolulu	Hawaii	96816	Ward Hayward	808-735-4805
55	Leeward Community College	The Programming Language	96 045 Ala Ike	Pearl City	Hawaii	96782	LeRoy C. Johnson	808-455-0273
56	DePaul University	1-Programming in Ada 2-Software Engineering	Comp Sci & Info Sy 243 S. Wabash	Chicago	Illinois	60604	George Knafl	312-341-8381
57	Elmhurst College	Software Engineering	Dept of Math & Comp Sci 190 Prospect Ave	Elmhurst	Illinois	60126	John Jeffrey	312-279-4100
58	Illinois Institute of Technology	1-Software Eng. With Ada 2-Concurrent Programming	Dept of Comp Sci SP Building, IIT Central	Chicago	Illinois	60616	Fred Maymir	312-567-5142
59	McKendree College	1-Ada Programming I 2-Ada Programming II 3- Ada Programming III 4-Ada Programming IV	Computer Science Department 701 College Road	Lebanon	Illinois	62254	Capt. Roy Rogge	618-537-4481
60	Parks College of St. Louis Univ.	Software Engineering with Ada	Computer Science Department	Cahokia	Illinois	62206	Dr. C.C. Kirkpatrick	618-337-7500

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
61	Southern Illinois Univ at Edwardsville	1-Programming Lang Concepts 2-Topics in S/W Eng Using Ada	Department of Computer Science	Edwardsville	Illinois	62026	Dr. Hattemer	618-692-2386
62	Western Illinois University	The Language Ada	Department of Compter Science	Macomb	Illinois	61455	Dr. David Ballew	309-298-1452
63	Ball State University	Principles of Software Engineering	Dept. of Comp Sci Program in Comp Sci	Muncie	Indiana	47306	Prof. W.F. Brown	317-285-8644
64	Indiana State Univ at Terre Haute	Ada for Systems Programming	Math & Comp Sci Holmstedt Hall	Terre Haute	Indiana	47809	Dr. Guy Hale	812-237-2130
65	Indiana Univ-Purdue Univ/Fort Wayne	1-Data and File Structures 2-Object-Oriented System Development	Comp Tech Dept. 2101 Coliseum Blvd. E.	Fort Wayne	Indiana		Karl Rehmer Mark Temte	219-481-6176 219-481-6803
66	Rose-Hulman Institute of Technology	Introduction to Ada	5500 Walbash Ave	Terre Haute	Indiana	47803	Cary Laxer	812-877-1511
67	University of Evansville	Ada Programming	Dept of Compu Sci 1800 Lincoln Ave	Evansville	Indiana	47722	Mr. Bruce Mavis	812-479-2652
68	Cornell University	Programming Language Concepts	Dept. of Computer Science	Mt. Vernon	Iowa	52314	Tony DeLaubenfels	319-895-8811
69	Iowa State University	Software Engineering	Dept of Computer Science	Ames	Iowa	50011	Albert L. Baker	515-294-4377
70	Simpson College	Introduction to Programming Ada	Dept. of Comp Sci 701 N. C Street	Indianola	Iowa	50125	Richard A. Bee Be	515-961-1586
71	University of Iowa	Prgramming Language Concepts	Dept. of Computer Science	Iowa City	Iowa	52242	Raymond Ford	319-335-0707
72	Hutchinson Community College	Ada Language Programming	1300 North Plum Street	Hutchinson	Kansas	67501	John Morrell	316-665-3500

Universities Teaching Ada

	Univerisity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
73	St. Mary College	1-General Programming I 2-General Programming II	Comp Sci Dept 1100 South 4th Street	Leavenworth	Kansas	66048	Victor Meyer	913-682-5151 x319
74	Wichita State University	1-Ada 2-Ada & Software Engineering 3-Intro to Software Eng, 4-S/W Testing & Reliability	Comp Sci Dept Box 83	Wichita	Kansas	67208	Mark Rutter James E. Tomayko	316-689-3156 316-689-3155
75	Eastern Kentucky Univ	Advanced Programming Techniques with Ada	Dept of Statistics/Comp Science Wallace 402	Richmond	Kentucky	40475	Don Greenwell	606-622-5942
76	Northern Kentucky Univ	Programming Lanugages	Dept of Math and Computer Science	Highland Heights	Kentucky	41076	Don Galli	606-572-5320
77	University of Kentucky	Programming Languages	Dept of Comp Sci 915 Patterson Office Tower	Lexington	Kentucky	40506	Prof. Harris	606-257-3961
78	Western Kentucky Univ	Ada Programming	Dept of Computer Science	Bowling Green	Kentucky	42101	Dr. Crenshaw	502-745-4642
79	Louisiana Tech University	1-Software Methodology 2-System Design	Department of Computer Science	Ruston	Louisiana	71272	Prof. Margaret Schaar	318-257-2298
80	University of South Western Louisiana	1-Ada Programming II 2-Programming in Ada/Intro to Software Engineering	119 Stevens Memorial Hall	Lafayette	Louisiana	70503	Jagadeesh Namdigan	318-231-5647
81	University of Maine/Orono	Software Engineering	Comp Sci Dept 222 Neville Hall	Orono	Maine	4469	Dr. Larry Latour	207-581-3941
82	Johns Hopkins University	Software Engineering with Ada	Cont. Prof. Programs-GWC Whiting School of Eng.-Merryman Hall	Baltimore	Maryland	21218	Mr. Gralia	301-338-8728
83	Towson State University	Software Engineering Using Ada	Dept. of Computer and Information Sciences	Towson	Maryland	21204	Mr. Helmut Theiss	301-321-2633
84	Univ. of Maryland at College Park	1-Programming in Ada 2-Software Design & Dev 3-Software Development in Ada	Dept of Comp Sci	College Park	Maryland	20742	Dr. Rombach	301-454-2002

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
85	Univ. of Maryland/ Eastern Shore	Topics in Programming Languages: Ada	Dept of Math and Computer Science	Princess Anne	Maryland	21853	Edward Chapin	301-651-2200
86	Univeristy of Maryland	1-Introduction to Ada 2-Applying Adv Features in Ada 3-Concepts in Ada	University College	College Park	Maryland	20742	Duane Jarc Helmut Theiss	301-985-7000 301-985-70
87	Boston University	1- System Design 2- Embedded Computer Software Design 3-Introduction to Ada	College of Eng. 110 Cummington St	Boston	Massachusetts	02215	Dr. Richard Vidale	617-353-2808
88	North Adams State College	1-Advanced Programming Langs 2-Systems Software Design 3-Comparative Prog Languages	Dept of Computer Science	North Adams	Massachusetts	01247	Ernie Giangrande Beverly Smith	413-664-4511
89	Southeast Mass University	1-Software System Design with Ada 2-Process Based Design	Computer Science Department	N. Dartmouth	Massachusetts	02747	Jan Bergandy	617-999-8293
90	Univ of Mass/Amherst	Software Engineering	Dept of Computer and Information Sciences	Amherst	Massachusetts	01003	Eliot Moss	413-545-2744
91	Western New England College	1-Data Structures 2-Organization of Programming Langauges	Dept of Math and Computer Science	Springfield	Massachusetts	01119	Prof. L.S. Tang Prof. Lloyd Emerson	413-782-3111
92	Central Michigan University	Alterantive Programming Langauges	Dept of Comp Sci Pearce Hall	Mt. Pleasant	Michigan	48859	Cindy Burt	517-774-3774
93	Eastern Michigan University	Softwrae Engineering	Comp Sci Dept 620 Pray-Harrold Bldg	Ypsilante	Michigan	48197	Dr. William McMillan	313-487-1063
94	Michigan State	Ada: An Introduction	2244 Lansing Avenue	Detroit	Michigan	44657	Malcolm Davis	800-778-9009
95	Oakland University	Short Course in Ada Programming	Dept of Comp Sci & Eng. Dodge Hall of Eng.	Rochester	Michigan	48063	Dr. Frank Cioch	313-370-2200
96	Saginaw University	Software Design and Development	Science 357 2250 Pierce Road	University Center	Michigan	48710	Katherine Kerr	

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
97	University of Michigan	Ada Based Software Engineering	Computer Science 3314 EACS Building	Ann Arbor	Michigan	48109-2122	Dr. Richard Volz	313-763-0035
98	Western Michigan University	Programming Languages	Dpet. of Computer Science	Kalamazoo	Michigan	49008	Dr. Kenneth Williams	616-383-6151
99	University of Minnesota	1-Software Engineering I 2-Software Engineering II 3-Software Engineering III 4-Software Eng with Ada	Dept of Computer Science	Minneapolis	Minnesota	55455	Dr. Wei-Tak-Sai	612-625-4002
100	Winona State University	Introduction to Ada	Department of Computer Science	Winona	Minnesota	55987	Mr. Daryl Henderson	507-457-5385
101	Univ. of Mississippi at Oxford	1-Software Engineering Using Ada 2-Programming in Ada	Comp & Info Sci Farley Hall, Room 331	University	Mississippi	38677	Pam Lawhead	601-232-7396
102	Univ. of Southern Mississippi	1-Operating Systems & Computer Architecture II 2-Software Engineering II	Dept of Comp Sci Box 5106 Southern Station	Hattiesburg	Mississippi	39406	Cliff Burgess Ralph Bisland, Jr.	601-266-4958 601-266-4949
103	Northwest Missouri State University	Specialized Languages: Ada	Compu Sci Dept	Maryville	Missouri	64468	Richard Detmer	816-562-1187
104	Southeast Missouri State University	Ada Programming	Compu Sci Dept	Cape Girardeau	Missouri	63701	Michael Britt	314-651-2525
105	St. Louis Community College Meramec	Ada Programming	11333 Big Bend	St. Louis	Missouri	63122	Robert L. Monsees	314-966-7526
106	University of Missouri at Columbia	Programming Languages	Dept of Comp Sci Mathematical Science Building	Columbia	Missouri	65211	William Slough	314-882-3842
107	Washington University	1-Prog Systems and Language 2-Software Eng Workshop 3-Modular Programming	Sever Inst of Tech Dept of Comp Sci	St. Louis	Missouri	63130	Dr. Grula-Catalin Roman	314-889-6190
108	Fairleigh Dickinson University	1-Advanced Programming Language Constructs Using Ada 2-Concepts of Prog Languages 3-Prog Language Concepts	Dept of Comp Sci 1000 River Road	Teaneck	New Jersey	07666	Gertrude Neuman Levine	201-692-2020/2261

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
109	Jersey City State College	1-Introductory Ada 2-Software Engineering	Ada Tech Center 2039 Kennedy Blvd	Jersey City	New Jersey	07305	Phillip Caverly	201-547-3291
110	Montclair State College	1-Programming Languages 2-Programming Langauges Design	Dept of Math/Computer Science	Upper Montclair	New Jersey	07043	Carl Bredlau	201-893-4263
111	New Mexico State University	Software Development	Department of Computer Science Prog in Comp Sci	Las Cruces	New Mexico	88003	Prof. Dan Dearholt	505-646-3724
112	New Mexico University/Las Cruces	Ada Programming	Dept of Comp Sci Box 3CU	Las Cruces	New Mexico	88003	Don Dearholt	505-646-3723
113	Univ. of New Mexico/Albuquerque	Software Engineering With Ada	Computer Science Department	Albuquerque	New Mexico	87131	Chalres Crowley	505-277-3112
114	University of New Mexico/Los Alamos	Intro to Software Engineering	Department of Computer Science	Los Alamos	New Mexico	87544	Ms Angela Coop	505-662-5919
115	Canisius College	Programming Languages	Dept. of Comp Sci 2001 Main Street	Buffalo	New York	14208	Dr. Patricia Van Verth	716-883-7000
116	Hofstra University	Ada for PL/I, Pascal or Fortran Users Advanced Programming Techniques for Business App	Dept of Comp Sci Business Computer Info Systems	Hempstead	New York	11550	Dr. Phillip J. Pnzeca Dr. Vasiliscu	516-560-5555 516-560-5716
117	Le Moyne College	1-Software Eng Project 2-Intro-Program Methodology 3-Data Structures & Program Development		Syracuse	New York	13214	James F. Smith	315-445-4544
118	Long Island Univ/CW Post Campus	1-Embedded and Scientific Systems Using Ada 2-Software Engineering with Ada	Computer Science Department	Brookville	New York	11548	Ms. Susan Dorchak	516-299-2293
119	Niagra University	1-Programming Languages 2-Topics in Computer Science	Department of Computer and Information Sciences	Niagra University	New York	14109	Dr. Hubbard	716-285-1212
120	Rochester Insitute of Technology	Algorithms and Data Structures	Graduate Computer Science Dept. One Lomb Memorial Drive	Rochester	New York	14623-0887	Dr. Peter Anderson	716-475-2529

	Univerisity	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
121	State University of New York/ Binghamton	1-Software Engineering I 2-Software Engineering II	Thomas J. Watson School of Eng, Applie Sci & Tech Dept of Comp Sci	Binghamton	New York	13901	Proj Thomas Piatkowski	607-777-4802
122	State University of New York/ Fredonia	1-Introduction to Ada 2-Ada: A Seminar for Faculty	Dept of Math and Computer Science	Fredonia	New York	14063	Dr. Joseph Straight	716-673-3459
123	State University of New York/ Potsdam	Selected Lnaguage of Ada	Department of Computer Science	Potsdam	New York	13676	David Rokh	315-267-2073
124	East Carolina University	Organization of Programming Language		Greenville	North Carolina	27834	Dr. Masao Kishore	
125	North Carolina State University	Software Engineering with Ada	Dept of Comp Sci Prog in Comp Sci	Raleigh	North Carolina	27695	Prof. K.C. Tai	919-737-7862
126	North Dakota State University	New Developments in Programming Languages	Box 5075	Fargo	North Dakota	58105	Ken Magel	701-237-8189
127	North Dakota State University	New Developments in Programming Languages	Box 5075	Fargo	North Dakota	58105	Ken Magel	701-237-8189
128	University of North Dakota	1-Ada 2-Software Eng. with Ada	Department of Computer Science	Grand Forks	North Dakota	58202	Randy Molmen Dr. Lonny Winrich	701-777-4107
129	Cleveland State University	Development of Large Programming Systems	Comp Sci Dept Euclid At 24th St.	Cleveland	Ohio	44115	Paul Jalick	216-687-4760
130	Franklin University	Organization of Programming Languages	Department of Computer Science 201 S. Grand Ave.	Columbus	Ohio	43215	Bob Vermilyer	614-224-6237
131	Kent State University	1-Ada Programming 2-Advanced Ada	Dept of Mathematical Sciences	Kent	Ohio	44242-0001	Keith Yerian	216-672-2209
132	Marietta College	Data Structures in Algorithm Analysis	Computer Science Department	Marietta	Ohio	45750	E. Robert Anderson	614-374-4600

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Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
133	Miami Univeristy of Ohio	The Ada Programming Language	Systems Analysis Department Kreger Hall	Oxford	Ohio	45056	Jim Kiper	513-529-1252
134	Ohio Northern University	Software Engineering	Department of Math and Computer Science	Ada	Ohio	45810	David A. Retterer	419-772-2346
135	Univ. of Cincinnati	Sepcial Topics: Programming in Ada	Department of Computer Science	Cincinnati	Ohio	45221-0008	Dieter Schmidt	513-475-6964
136	University of Dayton	1-Algorithms & Programming II 2-Data Structures	300 College Park CMSC Department	Dayton	Ohio	45469	Joseph Lang	513-229-3831 513-229-2192
137	University of Toledo	1-Survey of High Level Programming Languages 2-Concurrent Programming	Dept of Computer Science and Engineering	Toledo	Ohio	43606	Dr. Hilda Standley	419-537-2303
138	Cameron University	Intermediate Programming with Ada	Dept of Math Sciences West Gore	Lawton	Oklahoma	73505	Feridoon Moinian	405-581-2481
139	Central State University	1-Programming in Ada 2-Computer Networks	Dept of Comp Sci 100 N. University	Edmond	Oklahoma	73034	Bill McDaniel	405-341-2980
140	Oklahoma State University	Ada Programming Language	Department of Computing & Information Sciences, MS-219	Stillwater	Oklahoma	74078	Dr. K.M. George	405-624-5668
141	Oral Roberts University	Special Topics: Software Engineering	Dept of Math/Comp Science 7777 S. Lewis	Tulsa	Oklahoma	74171	Jeffrey Jackson	918-495-6701
142	University of Tulsa	Comparative Programming Languages	Dept of Math & Comp Sci 600 South College	Tulsa	Oklahoma	74104	Travis Tull	918-542-6000 x2228
143	Beaver College	Modern Programming Languages: Ada	Dept of Computer Science & Mathematics	Glenside	Pennsylvania	19038	Mark Balcer	215-572-2984
144	Carnegie Mellon	Software Engineering	Department of Computer Science	Pittsburgh	Pennsylvania	15213	Dr. Nico Habermann	412-268-2592

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
145	Cheyney University of PA	Software Engineering Using Ada	Dept of Mathematics and Computer Science	Cheyney	Pennsylvania	19319	Jesse Williams	215-399-2435
146	Elizabethtown College	Comparison of Programming Languages	Department of Computer Science 1 Alpha Drive	Elizabethtown	Pennsylvania	17022	Ms. Barbara Tulley	717-367-1151
147	Gwynedd-Mercy College	1-Ada 2-Software Engineering Using Ada	Comp Sci Dept Sumneytown Pike	Gwynedd Valley	Pennsylvania	19437	Michael G. Gonzales	215-641-5547
148	Lebanon Valley College	Programming in Ada	Dept of Math Science	Annville	Pennsylvania	17003	Mike Fry	717-867-6188
149	Penn State University	Software Design Methods	220 Whitmore Lab	University Park	Pennsylvania	16802	Fred L. Bierly	814-863-1241
150	Slippery Rock University	Ada	Dept of Comp Sci Slippery Rock U	Slippery Rock	Pennsylvania	16057	Richard Hunkler	412-794-7133
151	University of Pittsburgh	Programming Languages	Dept of Comp Sci Alumni Hall	Pittsburgh	Pennsylvania	15260	Dr. George Novacky	412-624-8490
152	University of Scranton	Programming Languages	Computer Science Department	Scranton	Pennsylvania	18510	Dennis Martin	717-961-6115
153	Villanova University	1-The Linguistics of Programming Languages 2-Organization of Programming Languages	Computer Science Program	Villanova	Pennsylvania	19085	Robert Beck Lillian Cassell	215-645-7307
154	Widener University	Programming Languages	Dept of Comp Sci Science Division	Chester	Pennsylvania	19013	Dr. Norman Adams	215-499-4002
155	Univ of Rhode Island	Software Engineering	Dept of Compu Sci and Statistics Tyler Hall	Kingston	Rhode Island	02881	Jan Prichard	401-792-2701
156	Clemson University	Programming Systems	Dept of Electrical/ Computer Engineering	Clemson	South Carolina	29634	Dr. James Leathrum	803-656-5930

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
157	East Tenn State Univ	1-Advanced Prog Techniques 2-Software Engineering 3-Systems Design	Comp Sci Dept Box 23830A	Johnson City	Tennessee	37614-0002	Suzanne Smith	615-929-6963
158	Memphis State University	1-Ada Programming 2-Operating Systems	Department of Mathematical Sciences	Memphis	Tennessee	38152	David Vaught	901-454-2482
159	Middle Tennessee State University	Programming Languages	Comp Info Systems Box 50	Murfreesboro	Tennessee	37132	Dr. Nathan Adams	615-898-2362
160	State Technical Institute at Knoxville	Ada	Hardin Valley Road Box 22990 ATTN: CST Dept	Knoxville	Tennessee	37933	Gerald Wlaker	615-694-6468
161	Tennessee Technical University	Advanced Programming - Ada	Comp Sci Dept Box 5101	Cookeville	Tennessee	38505	Donald C. Ramsey	615-372-3691
162	Vanderbilt University	Software Engineering	School of Eng. Dept of Comp Sci	Nashville	Tennessee	37235	Dr. Stephen R. Schach	615-322-2924
163	East Texas State University	Survey of Programming Languages	Computer Science Department	Commerce	Texas	75428	Sandra Huerter	214-886-5409
164	McMurry College	Ada Programming with Applications	Computer Science Department	Abilene	Texas	79697	Louis Voit	915-691-6393
165	Prairie View A&M	1-Introduction to Ada 2-Advanced Ada	Department of Computer Science	Prairie View	Texas	77446	N. Ravindran	409-857-2715
166	Sam Houston State University	1-Ada 2-Ada: Object-Oriented Programming	P.O. Box 2206	Huntsville	Texas	77341	Dr. Burris Wuhsiung Lu	409-294-1568 409-294-1837
167	Southwest Texas State University	Advanced Software Engineering	School of Science Dept. of Comp Sci	San Marcos	Texas	78666	Dr. C.J. Hwang	512-245-3409
168	Stephen F. Austin State University	Software Development Applications	Schol of Bus Admin Dept of Comp Sci	Nacogdoches	Texas	75962	Dr. Jarrell Grout	409-568-1876

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
169	Texas Christian University	1-Ada Software Development and Programming 2-Ada Design and Development	Comp Sci Dept P.O. Box 32886	Fort Worth	Texas	76129	Ted Tenny Tom Nute	817-921-7166
170	Texas Technical University	Structured Programming and Software Engineering	Dept of Comp Sci Mail Stop 3102	Lubbock	Texas	79409	Dr. James Archer	806-742-3527
171	Univ. of Texas at Arlington	1-Introduction to Software Engineering with Ada 2-Adv. Software Engineering 3-Software Engineering in Ada	Comp Sci Eng Dept P.O. Box 19015	Arlington	Texas	76019	Dr. Paul C. Grabow	817-273-2348
172	University of Houston/Cloar Lak	1-Ada Programming Lang 2-Software Design 3-Dev of Software Tools 4-Seminars in Software Eng.	Department of Computer Science	Houston	Texas	77058	Theodore Liebfried Dr. Charles McKay Dr. Anthony Lakkos Dr. Charles McKay	713-488-9480
173	University of North Texas	Introduction to Software Engineering	Dept of Comp Sci P.O. Box 13886	Denton	Texas	76203	Dr. Jeff Harris	817-565-2801
174	University of Texas	Software Engineering	Department of Computer Science	Austin	Texas	78712	Laurie H. Werth	512-471-9535
175	Brigham Young University	Introduction to Software Design	Dept of Computer Science	Provo	Utah	84602	Prof. Scott Woodfield	801-378-2915
176	Utah State University	Software Development/Implementation	College of Science Dept. of Comp Sci	Logan	Utah	84322-4205	Prof. Greg Jones	801-750-3267
177	Utah Valley Community College	Ada: A First Language	800 West 1200 South	Orem	Utah	84057	Dr. Harrington	801-226-5000
178	Weber State College	Emerging Techniques in Computing	Computer Science Department	Ogden	Utah	84408-2401	David Hart	801-626-7093
179	Vermont Technical College	1-Introduction Ada Programming 2-Advanced Ada Programming	Electrical & Electronic Eng. Technology Dept.	Randolph Center	Vermont	05061	Dr. Carl Brandon	802-728-3391
180	Christopher Newport College	Ada Programming Language	Dept of Comp Sci 50 Shoe Lane	Newport News	Virginia	23606	Prof. Tean-Quay Lee	804-599-7065

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
181	George Mason University	Real-Time Systems Design and Development	School of Info Tech and Engineering 4400 University Dr	Fairfax	Virginia	22030	Dr. Jorge Diaz-Herrera	703-323-2713
182	Hampton University	1-Introduction to Ada 2-Advanced Ada Programming	Department of Computer Science	Hampton	Virginia	23668	Robert A. Willis	804-727-5552
183	Norfolk State University	1-Ada Programming I 2-Ada Programming II	Dept of Math & Computer Science 2401 Corprew Ave	Norfolk	Virginia	23504	George C. Harrison	804-623-8654
184	Old Dominion University	Ada Programming	Department of Computer Science	Norfolk	Virginia	23508	Hill Price	804-440-3915
185	University of Virginia	Software Engineering	Department of Computer Science	Charlottesville	Virginia	22903	Prof. Robert Cook	804-924-7605
186	Eastern Washington University	Advanced Programming in Ada	Computer Science Department	Cheney	Washington	99004	Dr. Ray Hamel	509-458-6260
187	Gonzaga University	Programming Languages	Dept Math & and Computer Science 509 E. Boone	Spokane	Washington	99258	Brian Carlson	509-328-4220
188	Alderson Braddice College	1-Computer Language: Ada 2-Software Engineering	Div of Natural Sci Dept of Comp Sci	Philippi	West Virginia	26416	Alicia Kime Gary Schubert	304-457-1700
189	Beckley College	Introduction to Ada Programming	Dept of Comp Sci P.O. Box AG	Beckley	West Virginia	25802	Stephanie Ketz	304-253-7351 ext. 14
190	Marshall University	Software Engineering with Ada	Dept of Computer & Information Sciences	Huntington	West Virginia	25701	Kathleen Warner	304-696-5424
191	West Virginia College of Graduate Studies	1-Software Engineering with Ada 2-Introduction to Ada Programming	Eng. & Science Div Information Systems	Institute	West Virginia	25112	Robert N. Hutton	304-768-9711
192	West Virginia Institute of Technology	Special Tipics - Ada Programming	Department of Computer Science	Montgomery	West Virginia	25136	Don Smith	304-442-3361

Universities Teaching Ada

	University	Courses Provided	Address	City	State	Zip Code	Point of Contact	Phone Number
193	West Virginia University	1-Ada & Object-Oriented Desig 2-AI Applications of Ada 3-Introduction to Computing 4-Software Engineering	Dept of Stats & Comp Sci Knapp Hall	Morgantown	West Virginia	26506	Dr. Frances VanScoy	304-293-3607
194	West virginia Wesleyan College	Ada Programming	Dept of Math & Computer Science	Buckhannon	West Virginia	26201	Ron Klausewitz	304-473-8000
195	Marquette University	1-Programming Languages 2-Ada Programming Language	Department of Math, Statistics & Computer Science	Milkaukee	Wisconsin	53233	Dr. George Corliss	414-224-7573

APPENDIX D
U.S. ARMY PERSONNEL STRUCTURE

1.0 INTRODUCTION

The personnel structure of the U.S. Army is best understood by making a generalization: there are essentially two armies, both managed through the Department of the Army (DA). The first army consists of all the active duty officers and enlisted personnel whose primary job is to defend the United States, either directly or in a support role. The active duty army is broken down further into locations, such as the 5th Army, Washington and the 8th Army, Korea. Within these smaller armies, each soldier is assigned to one of 15 branches, which include both combat branches, such as Infantry, Armor, and Artillery, and support branches such as the Signal Corps, Adjutant General Corps, and the Medical Corps. The second army consists primarily of civilian personnel who are responsible for managing and developing the tools and means by which the first army operates.

2.0 ENLISTED PERSONNEL STRUCTURE

Entrance into a certain enlisted field in the Army is determined by personal requests, Army needs, and scores on a military aptitude test. This exam evaluates the applicant's ability in a variety of areas including electronic and mechanical reasoning, verbal ability, and perceptual speed. Based on these scores, a soldier may be rated as technical or non-technical and is matched to job fields within that classification. The soldier then attends basic military training, as well as any specialized school or Advanced Individual Training (AIT) required by the career field. Upon completion of technical training, the soldier begins to serve in that career field.

The primary job identification for enlisted personnel is known as a Military Occupational Specialty (MOS) code. This code identifies the Career Management Field (CMF) of the soldier, as well as the specific job duties within that field. Each field is given a distinct two digit number. Based on the soldier's specialized training, this number is followed by an alphabetic character which determines the actual job being performed. Together this three character alpha-numeric code is known as the MOS. (See Figure D-1)

In order to further identify skill levels within a given MOS, the code for a particular job position includes two more digits after the MOS code. Initially, the soldier is designated a trainee, until sufficient experience in the career field has been achieved. At this point, the soldier will be given the basic code for his field, with the level designation of 10, which is the most basic level. Through successive assignments and additional schooling, enough experience is gained to progress to level 20. The tasks here become more complex, and require additional knowledge in the field. Upon designation as a level 30, the duties become more supervisory in nature. Likewise, at level 40, the responsibilities involve supervision as well as developing plans, and making training recommendations. Most career fields culminate at level 50, as a senior non-commissioned officer (NCO).

Position Requirements Codes (Enlisted Personnel)

<table>
<tr><td>2 Characters
(Numeric)</td><td>1 Character
(Alpha)</td><td>2 Characters
(Numeric)</td></tr>
<tr><td>Area of primary skill or area of expertise that is required to perform main duties of this position</td><td>Special skills or areas of expertise within main position specialty</td><td rowspan="2">Skill level that is required to perform main duties of this position</td></tr>
<tr><td>Career Management Field (2 Characters)</td><td>Job Designator (1 Character)</td></tr>
<tr><td colspan="2">Military Occupational Specialty (3 Characters)</td><td>Experience Level (2 Characters)</td></tr>
<tr><td colspan="3">Position Code (5 Characters)</td></tr>
</table>

Figure D-1

Some career fields allow for substitution into other related career fields, based on similar training requirements and experience. Substitutions are determined within each field. In addition to the opportunity to serve in a secondary career field, the soldier may also be selected to attend additional military or civilian training to prepare him for additional responsibilities.

2.1 Automatic Data Processing (CMF 74)

All enlisted personnel in computer related positions are in the automatic data processing (ADP) field. The ADP field (CMF 74) provides support for systems analysis, programming, computer and auxiliary equipment operation and coding data for use with punched cards, magnetic tapes and disks. These personnel are used in data processing units as well as elements of personnel, finance, communications, supply, and similar organizations.

After initial training, ADP personnel proceed to one of two areas of specialty: Computer/Machine Operator (74D) or Programmer/Analyst (74F). Duties of the operator include: performing system initialization and administration procedures, correcting equipment stoppages, maintaining magnetic media library, mounting and unmounting tapes and disks, and other maintenance activities as needed. The programmer/analyst prepares, analyzes, edits and tests computer programs. The 74F also conducts data system studies involving investigation, evaluation and development of data processing systems for a specific subject area.

After sufficient experience, the NCO may be selected to attend the Senior NCO Academy, in preparation for receiving more responsibility. Upon satisfactory completion, the enlisted person is moved to a supervisory position. The duties remain fairly consistent, but include more inspection, security, evaluation, and review tasks. Both ADP areas lead to the senior position of Data Processing NCO (74Z). Responsibilities at this level include

supervising systems analysis, programming, machine operations, security of automated data systems, and related activities. Duties also include determining personnel, equipment, and supply requirements, establishing and providing instruction in procedures and standards, and serving as liaison for activities support or supporting data processing systems activities.

3.0 OFFICER CORPS STRUCTURE

When an officer receives a commission in the Army, it is specified in which of the 15 branches he/she will serve, with each branch having a specific, distinct combat mission. This becomes the primary area of specialty for that officer, and is designated with a two digit code. Within each branch are specialized areas of concentration (AOC), similar to the MOS code given to an enlisted member. The three character code is known as the officer's primary specialty, and will be the main training area. (See Figure D-2)

Position Requirement Codes (Officer Corps)

2 Characters (Numeric)	1 Character (Alpha)	2 Characters (Numeric)	2 Characters (Alpha-Numeric)	2 Characters (Alpha/Alpha-Numeric)
Branch/FA of primary skill or area of expertise that is required to perform main duties of this position	Special skills or areas of expertise within main position specialty	Branch/FA of secondary skill or area of expertise that is required to perform main duties of this position	Skill Code	Language skill or a second skill requirement
Area of Concentration (3 Characters)		Enter 00 if not required	Optional Designations	
Position Code (5 Characters)				

Figure D-2

Dependent on its mission, a branch may or may not have associated fields of specialization called functional areas (FA). The functional area code is two digits, and is used both to identify an officer's training, and to specify a position's requirements. Functional areas may also have AOCs themselves, as well as skills. (See Figure D-3) To refine requirements and training even further, some AOCs may have associated skills. These are indicated by a two character code, a digit followed by a letter. Some skills are applicable to more than one area of concentration, so their use is not limited to a distinct area.

Officer Designation Code Structure

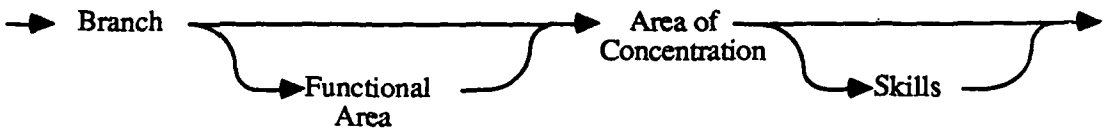

Figure D-3

Note: To read this chart, start at the left, and follow the arrows to the right side. When the line branches, either path can be taken. The areas below the main line indicate a part of the structure which is not required, but may be used for more detail if needed.

After commissioning, an officer's first assignment will be to the Officer Basic Course (OBC), oriented toward the specific branch. This course trains the officer in general military areas such as leadership, military justice, weapons and tactics, as well as general training for their specific branch. The purpose of this course is to prepare the officer for his first assignment as a troop commander. After OBC, the officer may attend additional training prior to receiving the first branch assignment, where he/she will get experience both in the branch area and in leading troops.

After one or two field assignments, most officers return to their branch school and attend the Officer Advanced Course (OAC). The course provides preparation for assignments at command and staff levels, with emphasis on planning and decision making. Prior to the tenth year of service, all officers are also required to complete the Combined Arms and Services Staff School (CAS3).

Once an officer has served at least two assignments in the primary branch and has attended the OAC, the officer may apply to become branch qualified. This designation certifies that the officer has the experience and training necessary to serve as a company grade officer within that branch. Usually a combination of troop leadership and technical expertise is the minimum prerequisite for qualification. Individual areas of concentration may also require completion of advance training courses or a graduate degree program in order to be qualified.

During this time, the officer may also serve in a branch independent assignment. These assignments include serving as a Reserve Officer Training Corps (ROTC) or U.S. Military Academy (USMA) instructor, a recruiter, or as an inspector general. These positions are designated "branch immaterial" because they require general Army knowledge and are not related to any one branch or functional area.

At the seven year point, each officer must specify what career path he would prefer to follow: single track or dual track. The single track option permits the officer to remain in his branch and specialize in at least two areas of concentration within that branch. Similarities between each branch's AOCs may result in suggested pairings of specialization and training. Those officers who choose to dual track will receive training in a functional area related to their branch. Each branch has the option of designating acceptable area of concentration and functional area pairings that meet the branches' needs and mission. In some cases, an officer may be allowed to single track into a different branch or the chosen functional area. From then on, he will receive repetitive assignments in that branch or functional area. Some branches though, have restrictions on officers leaving their primary branch to single track into another branch. Restrictions depend on the branch and Army needs.

Computer related positions within the Army are concentrated primarily in the Signal Corps (SC), which has the responsibility for reliable information systems and telecommunications. In addition, both the Adjutant General (AG) Corps, which is responsible for accurate administrative and personnel records and the Corps of Engineers (CE), which is responsible for military and civil engineering tasks, allow officers to gain additional training in computer related functional areas. A more detailed description of each of these three branches and their related functional areas follows. Because of the nature of the specific jobs within the Signal Corps, a description is also given of each area of concentration. Related functional area details are given after the AG and CE descriptions.

3.1 Signal Corps

The Signal Corps provides rapid and reliable information systems in support of Army combat forces during both peace and war. This includes planning, design, engineering, acquisition, installation, operation, supply, maintenance and evaluation of automation, communications, and visual information systems at all levels within the Department of the Army and the Department of Defense.

Entrance to the SC is open to all disciplines, and requires no particular background, although some assignments may require engineering, or physical science knowledge. Once commissioned into the SC, all new Signal Officers attend the Signal Officer Basic Course (SOBC) at Fort Gordon, GA, where each officer is designated as a Communications-Electronics Operations Officer (25C).

After two assignments, but before specialization, most officers then attend the Signal Officer Advanced Course (SOAC), also at Ft. Gordon. After 4-6 years of experience, additional training or education in another area of concentration may be conducted when specialization is needed, depending on the career goals of each officer and the needs of the Army. This other area of concentration may then become an officer's primary specialty, and may or may not involve learning another skill. The officer may also opt to receive training in a functional area related to his work in the SC. The computer related functional areas most often recommended for the SC Officer include Operations Research/Systems Analysis, Research and Development, Systems Automation, and Contracting and Industrial Management.

From this point on, the officer's assignments will be in one of the six areas of concentration, as described below or a related functional area within the SC for which he is trained. Leaving the SC to move to another branch is extremely difficult and allowed only in special cases. Any cross training is done within the SC, typically through functional area training, and is highly encouraged.

The classification of 25A, General Signal Officer, is given to those positions in the Signal Corps not directly related to one of the other five Areas of Concentration. It is normally used to classify positions requiring general signal knowledge, but is not used to classify an officer's skills. Such positions include: serving as an aide-de-camp, Professor or Assistant Professor of Military Science, Commander of a Signal Training Unit and others.

Classification as a Communications - Electronics (C-E) Automation Officer (25B) requires an undergraduate degree in math, physics, computer science, engineering or a related discipline. Designation as such is given upon completion of the Teleprocessing Operations Officer Course (TOOC) conducted at the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base (AFB), OH. 25B duties include: managing or supervising specific automated systems or nodes in a data or communication network; providing technical guidance to commanders and staff concerning a given network; and operation and maintenance of distributed data base systems, teleprocessing systems and data communications supporting battlefield automated systems. The officer may also be involved in the practical application of automation theory in the design, implementation, and successful integration of hardware and software for telecommunications and teleprocessing. This AOC is often paired with the Systems Automation field (FA 53).

The C-E Operations (25C) designation is given to all new officers upon entering the SC. Standard training consists of the Signal Officer Basic Course, followed by Signal Officer Advanced Course, and any additional assignment oriented training (AOT) as required. As an Operations Officer responsibilities include: commanding Signal units engaged in the installation, operation and maintenance of automation and communication systems; planning, coordinating and supervising the training, administration, operation, supply, maintenance, transportation, security and allocation of the resources of Signal units and facilities; and advising commanders and staff regarding capabilities, limitations and employment of available Signal assets. The majority of Signal Officers will have an additional area of concentration besides this one.

Classification as a C-E Engineering Officer (25D) requires a background in electrical/electronics engineering or a related discipline. The designation is given after completion of the C-E Engineering Course conducted at AFIT. This area of concentration is often paired with Research and Development (FA 51), and graduate work is encouraged in electrical/electronics or communications engineering. 25D duties involve: planning and supervising the design, development, installation, modification, test and acceptance of automation and communication-electronics equipment; developing standards for equipment performance, and hardware and software test and evaluation; and using the direct application of electrical, electronic and automation theory and principles in the design, test and acceptance, and installation of hardware and software for Signal systems.

The fifth area of concentration is Information Systems and Networking (25E), which requires experience in C-E Operations, and completion of the SOAC. Additionally, a strong math and analytical background is recommended. Designation as a 25E is given either upon completion of the Information Systems Staff Officer Course (ISSOC) at Keesler AFB, MS, through equivalent graduate work, or through Training with Industry (TWI) in telecommunications or information systems management. Jobs in this area are comprised of: planning and managing the integration and interconnection of diverse types of automation and communication systems into local area and long haul information networks; determining overall architecture requirements to support battlefield users, exercising network control and conducting network analysis; developing network standards for performance and interconnectivity requirements; and the practical application of systems engineering principles to plan, design and install tactical and non-tactical information networks.

The C-E Materiel Management (25F) area requires experience in C-E Operations and completion of the SOAC. An undergraduate degree in business is desirable but not required. Officers must complete either the Army Logistics Management Course (LMC) or

the Army Maintenance Management Course (MMC), both conducted at the US Army Logistics Management Center (ALMC), Fort Lee, VA, or qualify either through graduate work or TWI in logistics or material acquisition management. Officers in this field will: command or serve as a staff officer or manager in a unit engaged in the supply, maintenance, and life cycle management of information systems materiel; implement organization maintenance procedures, standards and quality control techniques; conduct reviews and develop plans for overhaul or replacement of information systems, facilities and equipment; and plan and direct all logistical matters concerning the acquisition, fielding and sustainment of information systems materiel.

3.2 Adjutant General Corps

The Adjutant General Corps' primary responsibility is for the Army's administrative functions. The officers in this branch formulate policies and manage the Army's personnel and administrative systems. This includes planning, developing and directing personnel systems which support the personnel life cycle, from enlistment through retirement, as well as providing support for administrative management activities and services, especially the application of techniques such as word processing. There are no entry restrictions for the AG Corps.

Upon commissioning into the AG Corps, each new officer attends the Adjutant General Officer Basic Course (AGOBC), where he is prepared for an initial assignment in a personnel and/or administrative management position. After two assignments stressing various aspects of the personnel and administrative field, the officer will attend the Advanced Course (AGOAC). At this time, provided an AG branch assignment has been completed successfully, the officer is considered branch qualified.

After branch qualification, an officer may choose to single track in the AG branch, or may choose additional training in a related functional area. The key functional areas for AG officers include Comptroller, Operation Research/Systems Analysis, and Systems Automation. Civilian and military schooling may be combined to give each officer opportunity to become fully qualified in their Functional Area. In addition, many AG officers receive the 4H skill designation, Branch Automation Officer. This skill focuses on personal computer applications and automation techniques.

From now on, the officer's assignments will be either in his branch, functional area, or branch immaterial areas. Additional military or civilian training may be included when necessary to perform job duties.

3.3 Corps of Engineers

The Army's Corps of Engineers has both combat support and combat service support roles. Officers are responsible for training and leading troops in combat along with construction engineering operations, facilities maintenance, and civil works programs. The support role may include facilities and housing support at military installations, mapping, charting, geodesy and geographic responsibilities as part of the Department of Defense (DoD) mapping team, and special tasks such as exporting engineering technology to friendly nations. A college background in engineering or physical science is required for admission to the Corps of Engineers, but may be waived for equivalent training or experience.

As in the Signal and Adjutant General Corps, the new Engineer Officer attends OBC, before being assigned as a Combat Engineer. After two assignments and selection to captain, the officer will attend OAC. At this point, the officer will be given the opportunity to specify a functional area as an additional field of expertise. The computer related functional areas suggested most often include Comptroller, Operations Research/Systems Analysis and Research and Development. Graduate or additional military study may be encouraged in this area, to provide ample training for related assignments. The officer will continue to serve in assignments requiring either AOC or FA knowledge throughout his career.

3.4 Comptroller (FA 45)

The Army Comptroller Officer serves as a resource manager and provides advice and guidance concerning resources to commanders and chiefs. The primary duties include: developing and monitoring program plans and budgets, determining performance criteria, analyzing capabilities based on available funding, conducting cost and economic analysis, coordinating program reviews to ensure planned accomplishments are met, and administering internal budgetary controls.

Designation as a Comptroller is given at the seven year point to branch qualified officers only. These officers must have sufficient college training or experience in resource management, managerial/cost accounting, business administration, operations research, information systems, or systems management, before serving as a comptroller. Attendance at Individual Entry Training Courses, such as the Resource Management Introductory Course, or the Planning, Programming, Budgeting and Execution Course is required. The specific course depends on assignment requirements and the officer's background.

3.5 Operations Research / Systems Analysis (FA 49)

Operations Research/Systems Analysis (OR/SA) specialists focus on the application of analytic methods, supported by mathematical, statistical, and economic research tools, to the solution of varied and complex strategic, operational and managerial Defense issues. Job responsibilities involve: applying objective, analytical and orderly thinking to the conduct of qualitative and quantitative analysis of complex military problems, formulating problems, designs, research and study methods and developing, applying and interpreting appropriate models in conducting such studies, and preparing reports and briefings detailing analytical findings for senior decision makers.

The background required to request designation as an OR/SA officer includes a bachelor's degree in a discipline supporting advanced study in Operations Research. These fields include most engineering fields, mathematics, business, economics, computer science, physical sciences, or applied science. In order to perform well in an analytical capacity, an OR/SA officer must have an in-depth knowledge of Army weapon systems, force design, combat developments, and the operations of other armies. Therefore, before being assigned to this functional area, an officer must be branch qualified, have experience working with troops, and have or be eligible to obtain a graduate degree in Operations Research, Industrial Engineering, or a related area of study. The officer may also choose to attend the OR/SA Military Application Course I (MAC I), in addition to obtaining a less related graduate degree.

3.6 Research and Development (FA 51)

A Research and Development officer participates in the development of materiel, programs, and systems from concept through product validation, including the development of prototype operational programs and systems. Job assignments involve: coordinating management decisions to ensure the proper interface between system design and support programs, while maintaining requirements at the lowest life cycle cost, initiating, participating and analyzing studies to determine future Army needs, coordinating and scheduling resources to test systems both under controlled and realistic operational conditions, and participating in all phases of the Life Cycle Systems Management Model, i.e., research and exploratory development, concept exploration, demonstration and validation, full scale development, and production and deployment.

Participation in the research, development, testing and evaluation of Army systems requires a bachelor's degree in engineering, business, or physical sciences. The Research and Development Officer should also be fully branch qualified, and have previous field experience with troops. This functional area provides many opportunities to pursue advanced degrees as well as participate in the TWI program.

3.7 Systems Automation (FA 53)

Systems Automation Officers manage the development of software systems, the integration of software, hardware and data communications, automated systems and related services, and serve as staff officers and consultants. Officers command and manage automation support activities, advise commanders and staffs on the employment of automation and related technologies and systems security; serve in information management staff positions; supervise and perform systems analysis, design, development, testing, prototyping, training, and system installation; acquire and integrate system components, and manage systems implementation.

Officers requesting Systems Automation as a functional area should possess an undergraduate or graduate degree or equivalent experience in computer science or a related major (math, engineering, physics, and statistics) with a minor in computer science. Study in information systems management, computer engineering, or a related scientific discipline is also acceptable. Course work should provide a solid technical background with a strong emphasis on structured problem solving, logic and automation technology.

Officers in the Systems Automation functional area may serve as a Software or Hardware Engineering Officer, or Automation Management Officer. Each of these areas of concentration requires completion of the Systems Automation course at the Computer Science School at Fort Gordon, GA. This course covers all aspects of automation, including hardware selection, networks, integrated systems, software design and development and management of automated systems. Once in this area, the officer is expected to maintain currency through membership in professional societies, self-study, or independent research.

3.8 Contracting and Industrial Management (FA 97)

The Contracting and Industrial Management Officer is responsible for bridging the gap between the military and civilian industry in order to facilitate the procurement process.

These officers must ensure that the weapon systems, supplies and services necessary to support and sustain Army troops are acquired within contract cost and specifications. Specific duties include: procurement program planning, and cost/budget forecasting; selection, formulation and review of contract type; evaluation of work in process reviews; preparing formal contracts and ensuring that all government terms, specifications and requirements are met; awarding, managing and terminating government contracts; conducting technical analysis of contractor facilities, cost proposals, quality assurance and quality control programs; and ensuring contract is on time and in proper condition.

The Contracting and Industrial Management functional area is not aligned with any single branch of the Army, and is not usually awarded until an officer has been branch qualified. Many officers combine Contracting and Industrial Management training with the Materiel Acquisition Management (MAM) Program. The Management of Defense Acquisition Contracts Course (Basic) is required for all Contracting and Industrial Management officers, and is the general procurement course at the ALMC . In addition, other courses in the areas of Production Management, Defense Cost and Price Analysis, Defense Specification Management Course, Logistics Executives Development Course, Integrated Logistics Support and Materiel Acquisition Course and Contract Law may be taken through ALMC, the Defense Systems Management College (DSMC) at Ft. Belvoir, VA, AFIT, the U.S. Army Management Engineering College (AMEC), Rock Island, Il., and the Naval Materiel Command (NAVMAT), Washington, D.C. These courses may be combined with the TWI program and include certification leading to the Professional Designation in Contract Management. This certification can be valuable in obtaining a contracting officer's warrant allowing the officer to act on behalf of the government.

4.0 RESEARCH AND DEVELOPMENT ARMY

A major portion of the Army's development work is done by civilian employees or government contractors. The civilians work primarily for one of two Major Commands (MACOM), which are further broken down into Major Subordinate Commands (MSC). The principle MACOMs are the Army Materiel Command (AMC), which is responsible for embedded, battlefield weapon systems, and the Information Systems Command (ISC), which concentrates on management information systems and business applications. Because of the nature of its work, AMC is further divided into MSCs which include, among others: Avionic Systems Command (AVSCOM), Armaments, Munitions and Chemical Command (AMCCOM), Missile Command (MICOM), and the Communications and Electronics Command (CECOM). All four of these MSCs coordinate and validate their work through AMC's Laboratory Command (LABCOM). On the other side, ISCs only MSC is the Information Systems Engineering Command (ISEC), which focuses on personnel, administrative, financial and logistics systems.

Within AMC and ISC, eleven Life Cycle Software Engineering Center (LCSEC) locations are divided among the MSCs, with each of the LCSEC focusing on a different Battlefield Area. (Refer to Figure D-4) In AMC, each of the nine centers is connected with the command's Research and Development center, while the two ISC centers stand alone. Each of the centers provides technical assistance to the individual program offices on all aspects of software development. In addition to this internal Department of the Army support, technology is also exchanged with several Office of the Secretary of Defense (OSD) projects or groups, such as the Ada Joint Program Office (AJPO), Software Technology for Advanced, Reliable Systems (STARS) and the Software Engineering Institute (SEI) located at Carnegie-Mellon University in Pittsburgh, PA. LABCOM also

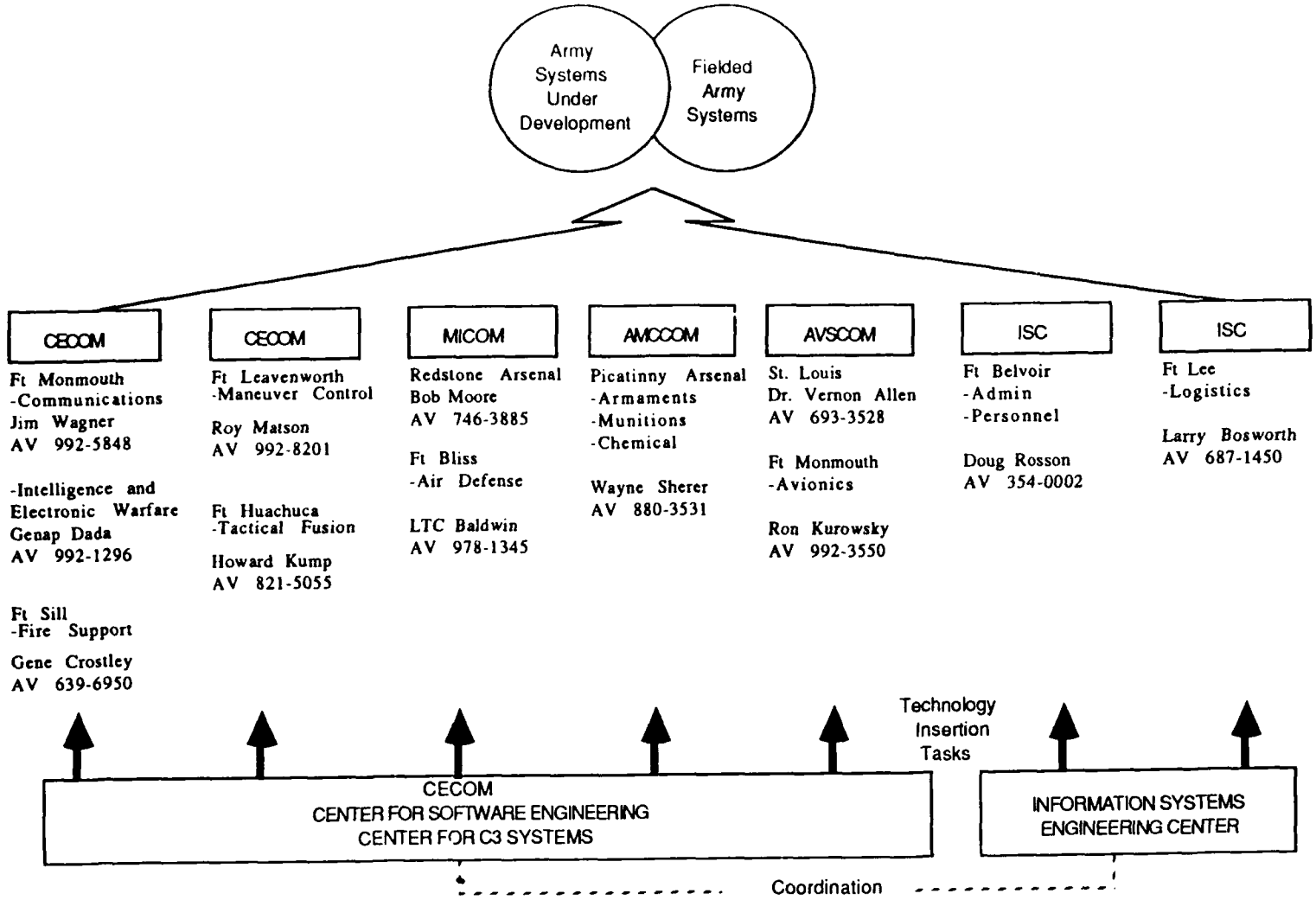

Figure D-4
MAJOR ARMY LIFE-CYCLE SOFTWARE ENGINEERING CENTERS *

* Data provided by Dennis Turner, US Army, CECOM

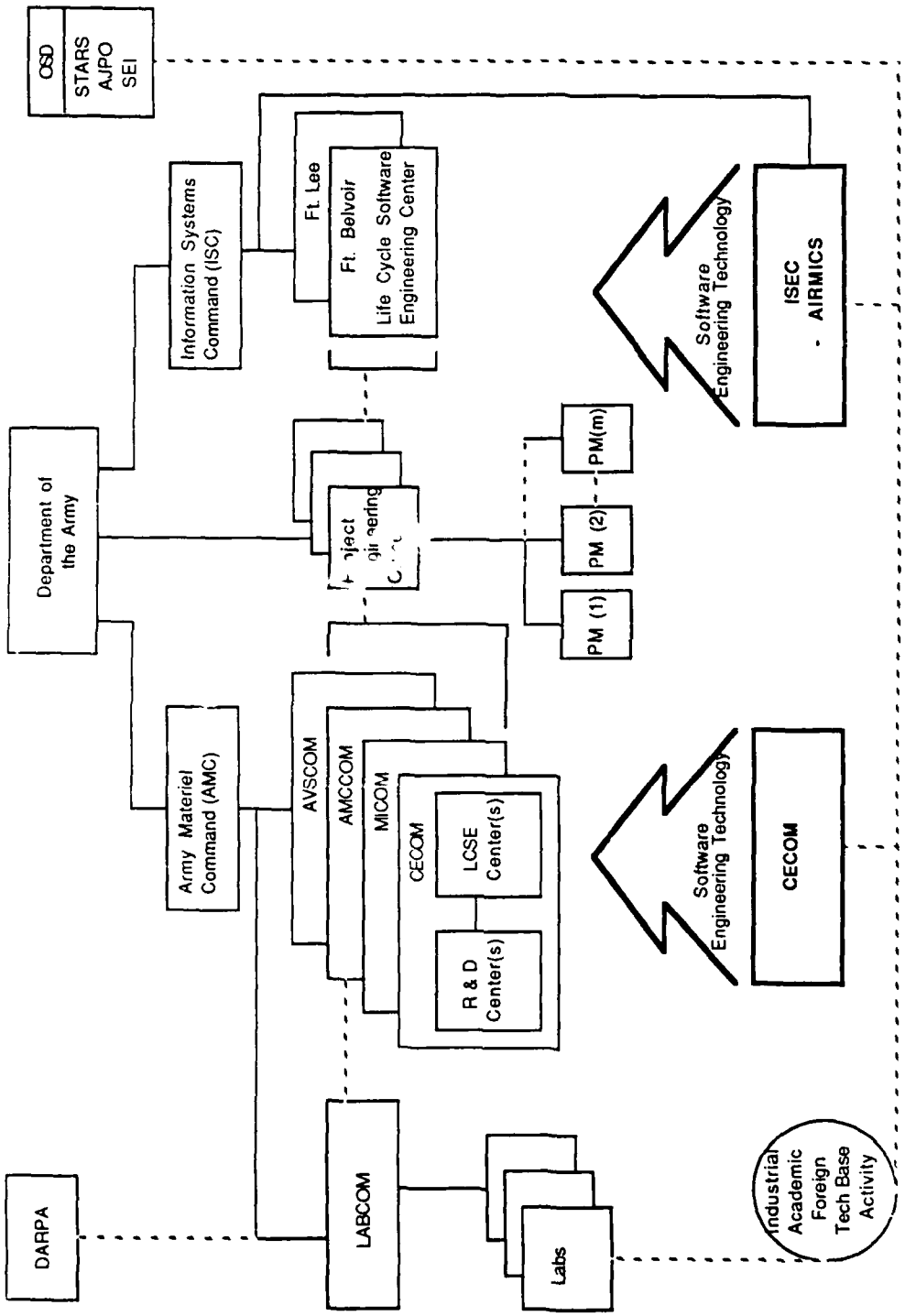

Figure D-5

Organization of Army Software Development for Mission Critical Defense Systems

* Diagram provided by Dennis Turner, US Army, CECOM

coordinates informally with the Defense Advanced Research Projects Agency (DARPA) in furthering software engineering technology insertion. The continuity from the program office through the senior levels of the Department of the Army helps keep the programs running and is an essential component of the Army's software development structure. (See Figure D-5)

In addition to the two development commands, the Army also has the Training and Doctrine Command (TRADOC). It is here that system requirements and standards are defined and refined. Once they are finalized, the requirements are sent to the coordinating development command. From that point on, TRADOC acts as middleman between the users and the Army development commands. Any changes to the initial system requirements are tested for feasibility before being approved and added to the design. Once the system enters maintenance, TRADOC also monitors the requirements for upkeep.

5.0 CIVILIAN PERSONNEL STRUCTURE

Civilian personnel are managed through the Office of Personnel Management which maintains a civilian personnel office on each installation. Each office coordinates new hires, promotions into higher ranking jobs, and any complaints or problems between civilians and their military superiors or subordinates. The offices also assist civilians with any career plans, changes, or questions the employee may have.

According to the General Schedule (GS) classification system, new employees are given a grade (GS-x) dependent upon their previous experience and formal education and training. GS-2 can be assigned with a little as 6 months general experience, and a High School diploma, while a GS-5 position requires a bachelor's degree including courses related to the position. Some of the lower grades (GS-2 through GS-4) may also require applicants to pass a written test before being appointed to theses positions. At the higher levels, such as GS-12 and GS-13, a PhD may be required for advanced research positions although some positions only require related experience.

Promotion to the next grade is considered after a minimum of one year in the present grade. Candidates for promotion must have fulfilled all education and experience requirements for the next grade before being considered. In addition, selective qualification factors related to specific jobs may be used to determine eligibility for the next higher grade. Opportunities are also given to qualified applicants to pursue additional civilian education or to attend specialized military training.

The six civilian positions most active in the computer area can be broken into two main areas: support and technical staff. The support positions are the Computer Operator and Computer Specialist series. The technical positions include the Electrical/Electronics Engineering, Computer Engineering, and Computer Science series. Neither support position requires a college degree, while all the technical jobs require at least a bachelors degree. Each of these series is described in detail below, including any specific jobs within each series that are of interest.

The computer operator focuses on the operation of digital computer systems, and especially on the operation of peripheral equipment used in support of mainframe operations. These positions require basic knowledge of mainframe functions and the ability to interpret and react to system messages and errors. Depending on the location,

formal training systems or courses may be included as part of the job in order to prepare the operator for a specific computer mainframe.

The computer specialist position involves managing, supervising, or performing system design, implementation, maintenance or modification in the use of digital computers to solve complex problems. Within this series, there are six subspecialties which define the job requirements more precisely. These six are: computer systems analyst, computer programmer, computer programmer analyst, computer systems programmer, computer equipment analyst and computer specialist.

The computer systems analyst is primarily concerned with systems design for computer applications. This work could include feasibility studies, development of program specifications or analysis of existing systems. The computer programmer translates instructions and system designs into machine readable programs through knowledge of a particular programming language. On the other hand, the computer programmer analyst combines many aspects of both the systems analyst and the programmer. The main functions of the programmer analyst are to evaluate new or modified applications, assist in new systems design and participate in the programming effort.

The computer systems programmer is concerned with writing and maintaining software necessary to run the main system. Such packages include debuggers, editors, assemblers and compilers. Some work may also require the analysis or design of systems that require these major components to interact.The computer equipment analyst assists in the evaluation of various peripherals or additional equipment in order to select the best equipment for a given function. However, this position does not involve internal design or repair. Instead, the focus is on the equipment's merits in meeting an organization's needs.

The computer specialist position is used for jobs that do not fall directly under a single position and can combine one or more of the other positions. Thus, it requires a much more general knowledge of computers, their applications and equipment. Often, this position involves coordinating between the technical aspects of the computer work and administrative tasks such as budgeting and long range planning.

All three professional engineering positions, electrical, electronics, and computer engineering, require the same general knowledge of engineering principles and all require the same practical background for selection and promotion. Each candidate must successfully complete a four year engineering program, including courses in statics and dynamics, strengths of materials, fluid mechanics, hydraulics, electrical fields and circuits, nature and properties of materials, thermodynamics and other fundamental areas of engineering science or physics. Professional engineering certification is not required, but is helpful. In some research and development cases, a higher degree in engineering is required due to the nature of the work. In addition, all government engineers are expected to remain current in the advances of their field.

The electrical engineering classification is given to those positions which emphasize electrical circuits, equipment and systems concerned with electrical energy as a source of power for motion, heating and cooling, illumination, or the production of electronic or magnetic fields. On the other hand, electronics engineering positions concentrate on electronic circuits, equipment and systems which use electro-magnetic or acoustical wave energy for communication, sensing, navigation and measurement. In both cases, a GS-5

engineer begins as a trainee with controlled assignments and limited contacts outside the organization. As more experience is gained, the responsibilities increase to include more autonomy over projects and increased contact with contractors and others outside the organization. At each stage, less analysis work is done by the supervisor and gradually, the engineer becomes responsible for all aspects of a project. At senior levels, the work involves substantial amounts of design development and review.

The computer engineering position is still so new that it is difficult to say exactly what the responsibilities entail. Some of the more general functions include research into advanced component technologies, software tools and methods and digital theory; analysis of system requirements, both hardware and software; conceptual design and validation of integrated systems; and specification analysis and preparation. Because of the newness of this series, much of the hardware related work has been done previously by electronics engineers. With the introduction of the computer engineering series, some of these positions will be reclassified. Others may remain as they are, especially in the case of large computer-based electronic systems where the emphasis must be individually determined.

The final series for consideration is the computer science group. This series covers the application of advanced techniques in computer science as well as research and development work. Typical duties of the computer scientist include the following: development of software, computer graphics, high-speed, and integrated computer systems; research in artificial intelligence including discrete speech recognition models; research in analysis of algorithms and abstract complexity theory and research into other related areas of study and development. The computer scientist is distinguished from the computer specialist by the former's in-depth knowledge of the theoretical foundations of computer science and the understanding of advanced mathematics and statistics. The specialist does not need this degree of knowledge for his work.

6.0 TERMS AND ABBREVIATIONS

ADP	Automatic Data Processing
AFIT	Air Force Institute of Technology
AFB	Air Force Base
AG	Adjutant General Corps
AGOAC	Adjutant General Officer Advanced Course
AGOBC	Adjutant General Officer Basic Course
AIT	Advanced Individual Training
AJPO	Ada Joint Program Office
ALMC	Army Logistics Management Center
AMC	Army Materiel Command
AMCCOM	Armaments, Munitions and Chemical Command
AMEC	Army Management Engineering College
AOC	Area of Concentration
AOT	Assignment Oriented Training
AVSCOM	Avionic Systems Command
CAS3	Combined Arms and Services Staff School
C-E	Communications-Electronics
CE	Corps of Engineers
CECOM	Communications and Electronics Command

CMF	Career Management Field
DA	Department of the Army
DARPA	Defense Advanced Research Projects Agency
DISC4	Director of Information Systems for Command, Control, Communications, and Computers
DoD	Department of Defense
DSMC	Defense Systems Management College
FA	Functional Area
GS	General Schedule
IC	Information Clearinghouse
ISC	Information Systems Command
ISEC	Information Systems Engineering Command
ISSOC	Information Systems Staff Officer Course
LABCOM	Laboratory Command
LCSEC	Life Cycle Software Engineering Center
LMC	Logistics Management Course
MAC I	Military Application Course I
MACOM	Major Command
MAM	Materiel Acquisition Management Program
MICOM	Missile Command
MMC	Maintenance Management Course
MOS	Military Occupational Specialty
MSC	Major Subordinate Command
NAVMAT	Naval Materiel Command
NCO	Non-Commissioned Officer
OAC	Officer Advanced Course
OBC	Officer Basic Course
OR/SA	Operations Research/Systems Analysis
OSD	Office of the Secretary of Defense
RDA	Research, Development and Acquisition
ROTC	Reserve Officer Training Corps
SC	Signal Corps
SEI	Software Engineering Institute
STARS	Software Technology for Adaptable, Reliable Systems
SOAC	Signal Officer Advanced Course
SOBC	Signal Officer Basic Course
TOOC	Teleprocessing Operations Officer Course
TRADOC	Training and Doctrine Command
TWI	Training With Industry
USMA	United States Military Academy

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