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U.S. Air Force Engineering and Services Hardware Requirements

Prepared for

Logistics Information Management
Support System Program Office
Electronics System Division - AVS-2
Air Force Systems Command
Hanscom AFB, MA 01731-5000

U.S. Department of Transportation
Research and Special Programs Administration

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EXECUTIVE SUMMARY

The mission of the communications-computer systems (C-CS) used by Air Force Engineering & Services (E&S) has shifted from peacetime support to wartime support, dictating the need for deployable hardware and a multiprocessing environment. This document describes the need for and benefits of a competitive C-CS procurement for E&S, and it proposes a path to meet the E&S C-CS requirements in the mid-to-late 1990s. It also reflects the philosophies that guide E&S management as it carries out the missions assigned by the Air Force.

The requirements specified are consistent with the Air Force C-CS policies and guidelines in the 700-series Air Force Regulations (AFR). Specifically, AFR 700-3, Information Systems Requirements, establishes the policies and procedures for identifying, documenting, and validating C-CS requirements so they can compete effectively for the limited resources allocated by the Department of Defense's (DoD) Planning, Programming, and Budgeting System (PPBS).

A C-CS procurement will enable each of the two organizations within E&S - Civil Engineering (CE) and Services (SV) - to carry out its assigned mission using fewer people and spending less money. The CE mission is to acquire, construct, maintain, and operate real property facilities and utility systems, and to provide related management, engineering, environmental, and other support work and services. The SV mission is to provide food service, troop billeting, linen exchange, and mortuary affairs support.

This document identifies a mission-critical problem and outlines its solution in the following steps:

- States the assigned missions, outlines the diverse and information-intensive functions performed by CE and SV personnel to accomplish the missions, and discusses how information systems help them perform those functions.

- Describes the existing E&S information-processing capabilities from the perspective of E&S customers, end-users, and technologists.

- Identifies the existing and projected capability shortfalls for the E&S customers, end-users, and technologists.

- Outlines the requirements for a cost-effective and open technical solution that will satisfy E&S C-CS requirements into the next century and will support Air Force C-CS architecture and mission directions.

The E&S Information Management System (ESIMS), an umbrella concept that encompasses several information systems used by CE and SV, comprises the C-CS used by E&S. ESIMS has evolved over the past 10 years with equipment procured through the Air Force Minicomputer Multiuser System (AMMUS) contract. Through AMMUS ESIMS, the information needed to support decision making in some of the CE and SV functions is readily available and centrally stored. Where available, this information helps CE personnel expend funds efficiently, conserve and plan best use of resources, and track all project resources. ESIMS provides SV personnel some of the information resources that support food management, billeting activities, squadron administration, and force management. Currently, ESIMS is saving a minimum of $500,000 per base per year in labor, reporting, planning, control, and resource management costs. This efficiency has turned the information system into a mission-critical segment of each E&S function, making ESIMS a force multiplier.

Many E&S mission-support functions involve the typical services that most residents and visitors on a base see, but do not readily associate with information management (e.g., building runways and residences, fighting fires, and providing food service). However, many E&S functions involve preparing, maintaining, and disseminating massive amounts of information. For example, when engineers build a structure or a pavement, they need blueprints for plans and designs, and they need to track materials and expenditures. When firefighters respond to a fire, they need to know the location and disposition of hazardous materials, a gas main, electrical service, and rescue access. Food Service personnel need to know the number and location of meals to prepare and serve and must keep track of items purchased and amounts expended. Additionally, many of the CE shops and the SV sections routinely process workorders and job orders to support their daily tasks, and managers in all of the E&S branches and sections rely on current, detailed information to make their daily decisions. Information work, therefore, has become a critical part of the functional work performed by each CE and SV organization as it carries out its assigned mission.

The very system that has enabled E&S personnel to perform more efficiently has, however, highlighted deficiencies such as the need for enhanced information system performance, interoperability, and capacity. The equipment that supported acceptable systems in 1984 has led to a level of user acceptance that has outstripped its computing capabilities. The success of AMMUS ESIMS and the need for increased efficiency resulting from the reductions in E&S personnel have generated a large demand for ESIMS, which cannot be met by the AMMUS contract. In both CE and SV, most functional areas require additional automated support and integration of information resources in order to approximate the efficiency provided by automation in private industry. A business is considered automated only when every desk is equipped with a workstation and operating decisions are based on on-line information. Essential ingredients include the equipment (workstations, network, etc.), useful and complete application software, data transparency, technical support, and end-user training. Furthermore, AMMUS ESIMS is only a peacetime system. It cannot be used during combat because it lacks the following features: deployability, "peel-down" architecture, and "graceful degradation " capability.

Completing the integration of ESIMS will enable E&S to provide its customers with the quality and extent of products and services they need to support their missions within the constraints of the reduced budgets and personnel quotas projected for the balance of the decade. The technical solution specifies a cost-effective system that will not be obsolete upon award; that meets the capacity, performance, and functional requirements of E&S; and that is sufficiently flexible and adaptable.

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1 INTRODUCTION

This document proposes a path to meet the communications-computer systems (C-CS) requirements of Air Force Engineering & Services (E&S) in the mid-to-late 1990s. It reflects the philosophies that guide E&S upper-level management as it carries out the missions assigned by the Air Force.

Air Force C-CS are planned, developed, and managed under the policies and guidelines of the 700-series Air Force Regulations (AFR). Specifically, AFR 700-3, Communications-Computer Systems Requirements Processing, establishes the policies and procedures for identifying, documenting, and validating C-CS requirements so they can compete effectively for the limited resources allocated by the Department of Defense's (DoD) Planning, Programming, and Budgeting System (PPBS).

1.1 PURPOSE OF DOCUMENT

The purpose of this document is to help the E&S communities, as represented by the Air Force Engineering & Services Center Computer Applications and Development Directorate (HQ AFESC/SC), shape the future of E&S C-CS. The E&S Information Management System (ESIMS) comprises the C-CS used by E&S. ESIMS is an umbrella concept that encompasses several information systems used by the base-level Civil Engineering (CE) and Services (SV) units.

ESIMS can also mean the plural aggregate of systems. For example, when used in the singular ("ESIMS is..."), ESIMS refers to the umbrella concept. When used in the plural ("ESIMS are..."), however, ESIMS refers to the collection of operational systems. Current ESIMS include the Work Information Management System (WIMS), Services Information Management System (SIMS), Integrated Graphics System (IGS), RED HORSE Information Management System (RHIMS), Site Automation System (SAS), and NAF PHONES. Future ESIMS will extend the current capabilities of these systems and will support changing requirements as they are identified through the turn of the century.

The primary goal of ESIMS is to provide E&S end-users with the automated information management tools they need to be more productive and wartime-ready, to provide wartime decision support capability, and to improve the services they render to E&S customers. ESIMS helps the end-users perform and document their daily routine tasks.

In addition to making the routine recordkeeping more accurate, complete, and efficient for the functional user, ESIMS provides management with a powerful set of analysis and reporting tools. By capturing information from the daily operation without interrupting routine work and then consolidating it into a single resource, ESIMS gives users immediate access to a wealth of information from diverse sources, permitting sophisticated analyses across functional areas and disciplines.

Ready availability of reliable information permits better-informed, timely, economical, and effective decisions. In summary, ESIMS enables E&S managers to perform the following functions:

- Obtain a quick view of tasks in progress and pending.
- Highlight problem areas.
- Establish plans and budgets.
- Address goals and meaningful measures of merit.
- Manage resources.

An Air Force base is considered a weapon system because it is the platform from which aircraft sorties are generated. E&S ensures availability of the base infrastructure, including land, facilities, and utilities, and provides life-sustaining support, including food, water, and shelter. In wartime, CE and SV are responsible for keeping the base in crisis-ready condition, for repairing damage, and for accommodating changes in base capacity or mission. The base and its component facilities must support the missions of the squadrons assigned to the base.

Both the Base Civil Engineer (BCE) and the Chief of Services report to the Base Commander (also known as the Combat Support Group Commander or Air Base Group/Wing Commander), who defines goals and objectives and delegates authority to define tasks. Customers, which include all resident and tenant organizations on a base, generate requirements and requests. To make effective and timely decisions and to provide the Base Commander with appropriate information, the BCE and the Chief of Services need complete, accurate, and timely data from their functional components. CE and SV functions are located throughout the base, and each activity depends on a variety of materials, facilities, and personnel. Assessing status and capacity is information intensive and can be best monitored by using an automated system. Constant status (including resource availability and capacity) is the basis for informed decisions, which are critical to the success of any mission.

This document is intended to help ESIMS transition in an orderly manner to full compliance with all of the C-CS standards adopted by the Air Force. It will provide the information needed to complete the appropriate form, specified in AFR 700-3, for the Future ESIMS requirements: either AF Form 3215, C-CS Requirements Document (CSRD), or the Statement of Operational Need (SON). This document may also be used in the Future ESIMS acquisition process as the basis for a Request for Information (RFI) and a Request for Proposal (RFP). As other logistics information systems are developed or upgraded to become parts of the Air Force distributed open systems architecture of the future, ESIMS will lead the way toward effective data sharing through interfaces that are consistent with Air Force C-CS architectural standards.

To achieve its purpose, this document begins with statements of assigned mission for both CE and SV. Then, it identifies the functions performed by the various branches of CE and SV to carry out the missions, and describes how automation helps E&S personnel perform those functions. Next, it describes the existing ESIMS computing environment and compares it with the needs projected for the mid-to-late 1990s (and possibly beyond) to determine the deficiencies of the current systems. These deficiencies are then used to specify the requirements for Future ESIMS.

1.2 GUIDING PRECEPTS

Certain overarching precepts guided development of this proposed path toward Future ESIMS. These precepts should also serve as the foundation for follow-on requirements and acquisition documents. Specific rules for the effort are described in the following subsections.

1.2.1 Support Deployment and Crisis Operation

In addition to use of a fully functioning system, ESIMS must perform reliably under crisis conditions. Three methods of coping with failures in parts of the system are peel-down architecture, graceful degradation, and redundancy. Graceful degradation and peel-down architecture are complementary concepts. Graceful degradation responds to loss of hardware by redistributing the functions to other available equipment, without loss of functionality. Peel-down architecture provides for prioritized loss of functionality to match the available processing capacity. Redundancy is handled in two ways: replicated data with a means of determining validity and methods of recovery; and the availability of other equipment that can be substituted for the failed or lost unit. For this purpose, redundancy does not mean multiprocessing within a single box as in fault tolerant systems; instead, it means separate systems and communication channels, preferably located beyond blast distance of each other. The Future ESIMS architecture requires all three of these methods (peel-down architecture, graceful degradation, and redundancy).

1.2.2 Increase System Survivability

System survivability requirements include reliability and maintainability (R&M). All C-CS equipment shall have interchangeable parts to permit easier servicing and upgrades, more in-house maintenance, and higher-quality and lower-cost commodity parts. The workstation requirements define a single generic workstation (with options) to meet minimum specified performance. All special-purpose workstations shall be reversible expansions of the generic workstation. This specification will minimize maintenance requirements, maximize use of standard components, and allow interchange of workstations and components during emergencies and shortages.

1.2.3 Promote Orderly System Evolution

The Future ESIMS requirements are written to use an open system architecture that will also accept existing software to ease the transition effort. Additionally, the open system concept, with its defined interfaces, allows third-party software access to operating system and communication components. Third-party access encourages competitive bidding, thereby reducing overall cost.

1.2.4 Constrain the Impact of Transition

Each implementation shall be planned and designed such that the transition to Future ESIMS will not compromise the mission-effectiveness of the unit or otherwise impair its war-fighting capability. The current and new environments shall operate in parallel at each location long enough to demonstrate the integrity and reliability of the enhancement.

1.2.5 Enhance Current Capabilities

ESIMS enhancements must provide the benefits and economies of the technologies that will be available at the time of installation. In all cases, the functionality, performance, and compliance requirements specified for the mid-to-late 1990s shall meet, as a minimum, the Air Force hardware, software, and communications standards in force at that time. All additional functionality, performance, and compliance that can be economically provided by commercially available products will be required for delivery with all system installations.

1.2.6 Maintain Current ESIMS Effectiveness

The functionality and performance of the Future ESIMS shall be equal to, or preferably greater than, that of the existing systems, which were procured through the Air Force Minicomputer Multiuser System (AMMUS) contract. The end-users of AMMUS ESIMS must be able to transition to the new environment with little, if any, retraining.

In AMMUS ESIMS, the development and maintenance of applications and systems have relied heavily on the end-user's capability to identify opportunities for automation. Through the use of end-user programming tools provided under the AMMUS contract, the end-user's capability to produce those applications and systems without the use of scarce professional programming talent has resulted in systems that work effectively, meet the end-user's needs, and are delivered in only a fraction of the time normally required for software development. End-user programming is thus the cornerstone of the success of ESIMS, and is a requirement for Future ESIMS.

Another factor in the success of the AMMUS systems has been the consistency of the platform at all level of command in the Air Force. The same platform used at base level is used at the major command (MAJCOM) and headquarters (HQ) levels, thus allowing E&S personnel at all levels the opportunity to see the capabilities and features (and most importantly, shortfalls) provided by AMMUS ESIMS.

1.3 RELEVANT SOURCE DOCUMENTS

Several Air Force regulations, Government and military standards, and guides were consulted in preparing this document.

1.3.1 Air Force Regulations

The following Air Force regulations pertain to E&S and its C-CS requirements:

- AFR 85-2, Operations Management
- AFR 86-1, Programming Civil Engineering Resources
- AFR 93-3, Air Force Civil Engineering Prime Base Engineer Emergency Force (Prime BEEF) Program
- AFR 93-9, Civil Engineering RED HORSE Squadrons

- AFR 140- series, Services
- AFR 143- series, Mortuary Affairs
- AFR 146- series, Food Service
- AFR 148- series, Laundry and Dry Cleaning
- AFR 700-2, Communications-Computer Systems Planning and Architectures
- AFR 700-3, Communications-Computer Systems Requirements Processing
- AFR 700-4, Volume I: Information Systems Program Management, and Volume II: Information Systems Acquisition and Major Automated Information Systems Review Requirements
- AFR 700-19, Computer Systems Authorization Directory (CSAD)
- AFR 700-20, Air Force Data Element Dictionary
- AFP 700-50, Deployable Communications-Computer Systems Architecture
- AFR 700-53, Management of Standard Systems

1.3.2 Standards

Air Force C-CS must comply with various Government and military standards. Applicable Government standards include the following Federal Information Processing Standards (FIPS):

- FIPS-PUB-120, Graphical Kernel System (GKS)
- FIPS-PUB-127, Database Language SQL
- FIPS-PUB-128, Computer Graphics Metafile (CGM)
- FIPS-PUB-146, Government Open Systems Interconnection Profile (GOSIP)

- FIPS-PUB-151, Portable Operating System Interface (POSIX) for Computer Environments

- FIPS-PUB-156, Information Resource Dictionary System (IRDS)

Source code programming language standards for Ada, BASIC, C, COBOL, and FORTRAN, as well as other applicable Government standards, are discussed in Section 5.2.1.2.

1.3.3 Guides

The following sources are also applicable to C-CS:

- Air Force GOSIP Action Plan

- FOUNDATIONS: Building on Success

- Functional Review of Civil Engineering, two volumes

- Future Vision: Taking Charge of Our Future

- GOSIP Users Guide

- MIL-HDBK-59, CALS Program Implementation Guide

- Organizational Impact of WIMS and SIMS on Base-Level Units (Air Force Management Engineering Agency [AFMEA] study), two volumes

- Point Paper: Project Future Vision for E&S

1.4 ORGANIZATION OF DOCUMENT

Section 1 - Introduction - describes the purpose and approach of this document, and cites the source documents that were consulted.

Section 2 - Missions, Functions, and Systems Support - defines the missions of the CE and SV organizations, describes the functions performed by these organizations, and explains how ESIMS helps E&S personnel perform their functions more efficiently and effectively than the previous manual methods.

Section 3 - Baseline Environment - surveys and documents the current level of C-CS support for each CE and SV function, and describes the existing ESIMS computing environment.

Section 4 - Capability Shortfalls - evaluates the C-CS capabilities required to meet the current E&S functional needs and those projected for the mid-to-late 1990s, and compares these needs to the existing capabilities to determine the deficiencies in the existing systems.

Section 5 - Target Environment - specifies the Future ESIMS requirements, which include all features of the existing systems and the additional features needed to correct current and projected deficiencies.

Section 2

Missions, Functions, and Systems Support

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2 MISSIONS, FUNCTIONS, AND SYSTEMS SUPPORT

Each of the two organizations within E&S--Civil Engineering (CE) and Services (SV)--has its own unique mission. CE and SV organizations maintain and improve the base infrastructure and facilities to enable the base's primary mission and tenant organizations to work effectively. Within each of the diverse CE and SV functions is a significant information management task. Effective management of and ready access to the information resources that describe the personnel, material, assets, and tasks enables each organization to meet its objectives more quickly and economically with higher quality.

The current level of automated information management support, which is provided by the E&S Information System (ESIMS) components listed in Section 1, is saving a minimum of $500,000 per base per year in labor, reporting, planning, control, and resource management costs. The current ESIMS hardware is at the end of its procurement cycle, and the successor system requires definition. The payback for the successor system will come from integration of the "stovepipe" applications and use of information as a resource. This document seeks to specify a cost-effective system that is not obsolete upon award; that meets the capacity, performance, and functional requirements of E&S; and that is sufficiently flexible and adaptable to be used effectively until its retirement.

This section establishes the basis of need for the ESIMS replacement targeted for the mid-to-late 1990s. It begins with the missions assigned by the Air Force to the CE and SV organizations and the response of E&S upper-level management to those missions. It then describes the functions currently performed by the various branches of CE and SV to carry out the missions. These descriptions are informal; they are based upon field interviews and review of regulations; they are to be considered descriptive only. Finally, it explains how ESIMS helps E&S perform these functions.

2.1 MISSIONS

CE and SV organizations are multifunctional units deployed at 200 locations around the world - 130 main bases and 70 lesser sites. These organizations vary in size and structure depending on the size and the mission of the installation they support. The basic E&S mission is to support the various local operations, including developing and implementing programs designed to improve living conditions for the base community.

2.1.1 Civil Engineering (CE) Mission

The CE mission is to acquire, construct, maintain, and operate real property facilities and utility systems, and to provide related management, engineering, environmental, and other support work and services.

This mission includes the following directives:

- Plan, program, design, and construct new facilities, including buildings, airfields, and utility systems.

- Acquire and dispose of real property facilities.

- Regulate the environmental impact of base activities.

- Maintain and repair real property facilities.

- Operate and maintain utility systems and equipment.

- Provide base services such as fire protection, custodial support, snow removal, and refuse collection.

- Provide family housing and off-base housing referral services.

2.1.2 Services (SV) Mission

The SV mission (as described in Air Force Pamphlet 140-5, Services Manager's Handbook) is to provide food service, troop billeting, linen exchange, and mortuary affairs support. This mission includes the following directives:

- Feed personnel in dining halls or via fast-food flight kitchens (Food Service).

- House transient or unaccompanied permanent party personnel in hotel or dormitory quarters on and off base (Billeting).

- Issue and maintain housing support furnishings for transient family and unaccompanied personnel, and for families at overseas locations (Furnishings Management).

- Clean and exchange organizational clothing and dormitory linens (Linen Exchange).
- Maintain records on deceased personnel and retirees, and assist in locating and identifying remains (Mortuary Affairs).

2.1.3 E&S Response to Assigned Missions

In response to the assigned missions, E&S has published its principles, measure of merit, and future operating environment in FOUNDATIONS, Building on Success. Appropriate sections are paraphrased here.

2.1.3.1 Principles

E&S will apply the following principles to all of its programs and policies:

(1) **Quality** - Fulfill the customer's expectations. Listen to the customers and understand what they need.

(2) **Accountability** - Decentralize. Push authority, responsibility, and resources to specific individuals located as deep in the units as demonstrated competence allows. Provide the training and the resources to get the job done. Require the responsible individuals to account for their programs' progress, schedule, and resources.

(3) **Teambuilding** - Focus on the team, not the individuals. Integrate the right people with the right skills at the right time.

(4) **Technology** - Actively search for solutions to hone skills and capabilities, increase productivity, and improve the quality of work.

(5) **The Future** - Keep an eye on the future. Seek out and study projected trends. Build for tomorrow when planning, designing, and developing air bases today: our decisions today may stand 100 years.

2.1.3.2 Measure of Merit

Deliver Results - Focus on results, not on process. Understand and satisfy the customers' needs and expectations.

2.1.3.3 Future Operating Environment

Look forward to meet the needs and expectations of the changing E&S missions and personnel. Insights into the future are not predictions, but are reasonable extensions of current trends. Everyone on the E&S team must plan, program, and posture to meet the needs of tomorrow. The focus of E&S planning should be in the following areas:

(1) **World Power** - E&S must be prepared to respond across the spectrum of war, although the most likely use of the U.S. military

will be in low intensity conflict in response to terrorism. There will be greater military emphasis on mobility. Basing and airspace rights will become major military issues.

(2) **Customers** - Information technology will reduce the need for middle managers, who will have to be retrained as their skills become obsolete. There will be greater use of team decision making as problem complexity increases. Customers will become more concerned about quality and timely delivery of products and services.

(3) **The Environment and Energy** - Environmental and energy concerns will receive increasing public and statutory attention.

(4) **Science and Technology** - Advanced computer technology will be pervasive. Technological revolution will occur frequently. The critical question is when and how to invest in the technology.

2.2 E&S ORGANIZATIONS AND FUNCTIONS

Base-level CE and SV units are multifunctional organizations which vary in size and structure depending on the size and mission of the base or site they support. Most units are squadrons. However, some larger installations have CE groups composed of at least two squadrons, while smaller sites may have only CE and SV flights. CE and SV units come under the operational control of and report to their parent groups and wings. CE and SV units are required to provide administrative reports to the Deputy Chief of Staff for E&S at their respective major command (MAJCOM) headquarters, which forwards summary reports to the Directorate for Engineering and Services (HQ CE) at the Pentagon and/or the Air Force Engineering and Services Center (HQ AFESC) at Tyndall Air Force Base, Florida.

2.2.1 Base Level

This section presents the organizational structures of the base-level CE and SV squadrons, and describes the functions performed by each branch of these squadrons. These functions are based on current Air Force regulations, published analyses of organization functions, and observations of E&S operations at several bases. Each of these functions is required for other Air Force organizations to achieve their respective missions. Note that many of these functions involve preparing, maintaining, and disseminating the information needed to support and supplement the functions typically associated with engineers and support personnel. (Section 3.2.3 discusses these functions in terms of the automation that currently supports them.)

2.2.1.1 Civil Engineering (CE)

The Base Civil Engineer (BCE), who reports directly to the Base Commander, serves as the CE Squadron Commander, as well as the fire marshal. As Squadron Commander, the BCE is responsible for directing and overseeing the following activities of the squadron:

- Program planning and budgeting
- Status and resource reporting
- Response to contingencies
- Policy and programs
- Identification and correction of problem areas concerning base facilities and CE projects

Because CE support requirements vary among the CE organizations, the BCE must tailor the organizational structure to the needs of the particular installation. However, some CE components are common to each installation. Using these common components, Figure 2-1 shows a "typical" base-level CE organizational structure. The base-level CE squadron consists of the eight major areas described below: (Although they are not consistently used throughout the Air Force, the office symbols have been included for illustration purposes.)

(1) **CCQ/CCF/DEA - Squadron Section/First Sergeant/ Administration** - directly supports the BCE by providing the following:

- Command and administration, including the following tasks:
  - Ensuring personnel actions, discipline, training, morale, and welfare
  - Tracking Enlisted Performance Reports (EPR) and Officer Performance Reports (OPR)) for the assigned/attached personnel

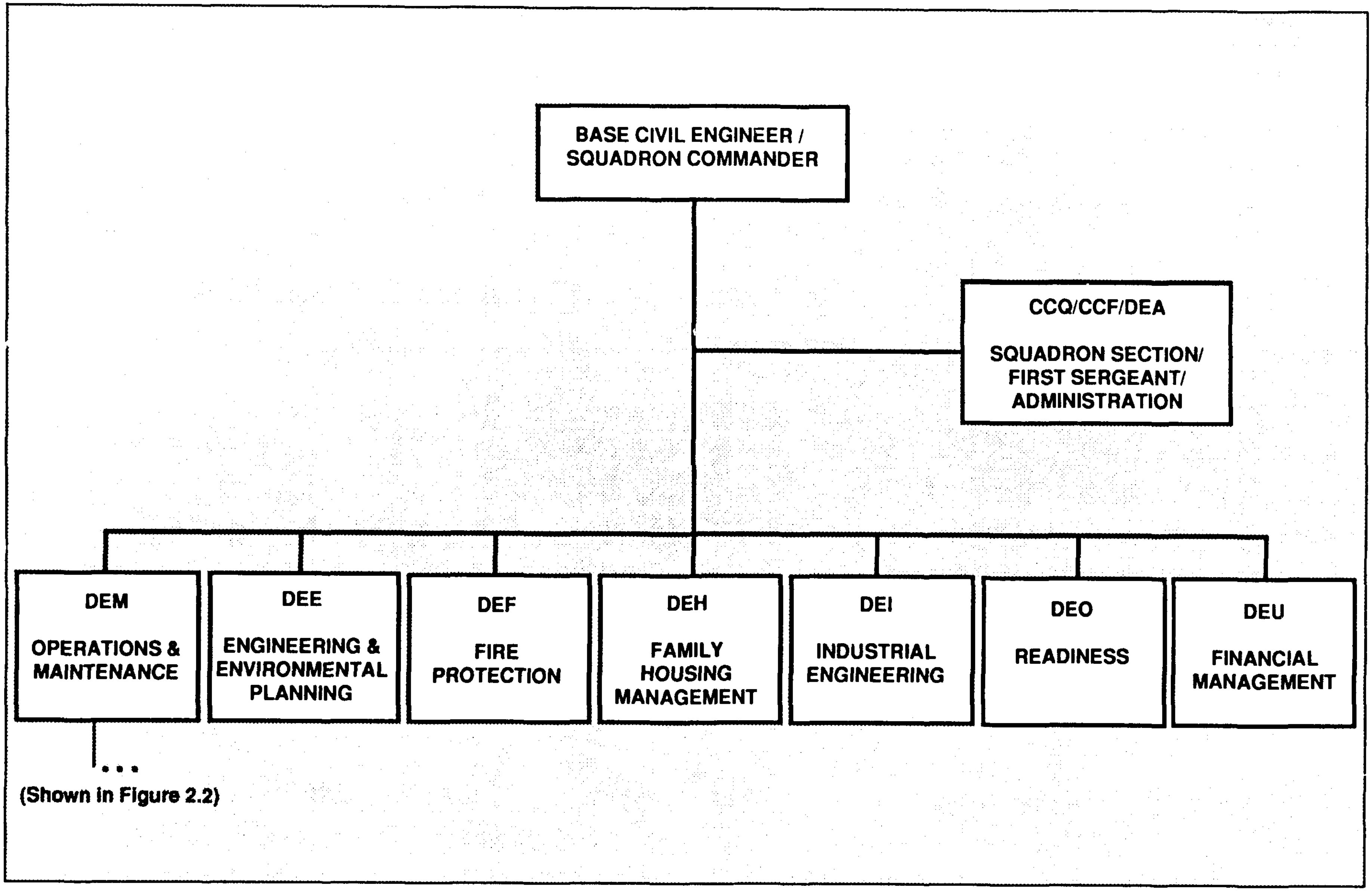

FIGURE 2-1 CIVIL ENGINEERING (CE) SQUADRON

- Management and administrative support, including the following tasks:

    - Maintaining associated personnel records, correspondence suspenses, document logs, and organizational mail services
    - Receiving and transferring records to and from other organizations
    - Typing, filing, and scheduling appointments

(2) **DEM - Operations & Maintenance** - has the following general responsibilities:

- Reports labor charges, use of work materials, personnel scheduling, and chemical use.
- Locates tools, equipment, materials, and other resources.
- Maintains facility inspection records.
- Recommends maintenance and repairs.

This branch, usually the largest component of the base-level CE unit, consists of skilled military and civilian technicians and craftsmen, and as shown in Figure 2-2, is organized in the following eight sections:

(a) **DEMP - Pavements** - provides the following services:

- Construction, repair, and maintenance of all types of pavements
- Snow removal

In providing these services, Pavements personnel maintain special-purpose vehicle records and records of runway operations.

(b) **DEMG - Grounds** - provides the following services:

- Maintenance and rehabilitation of grounds
- Pest management

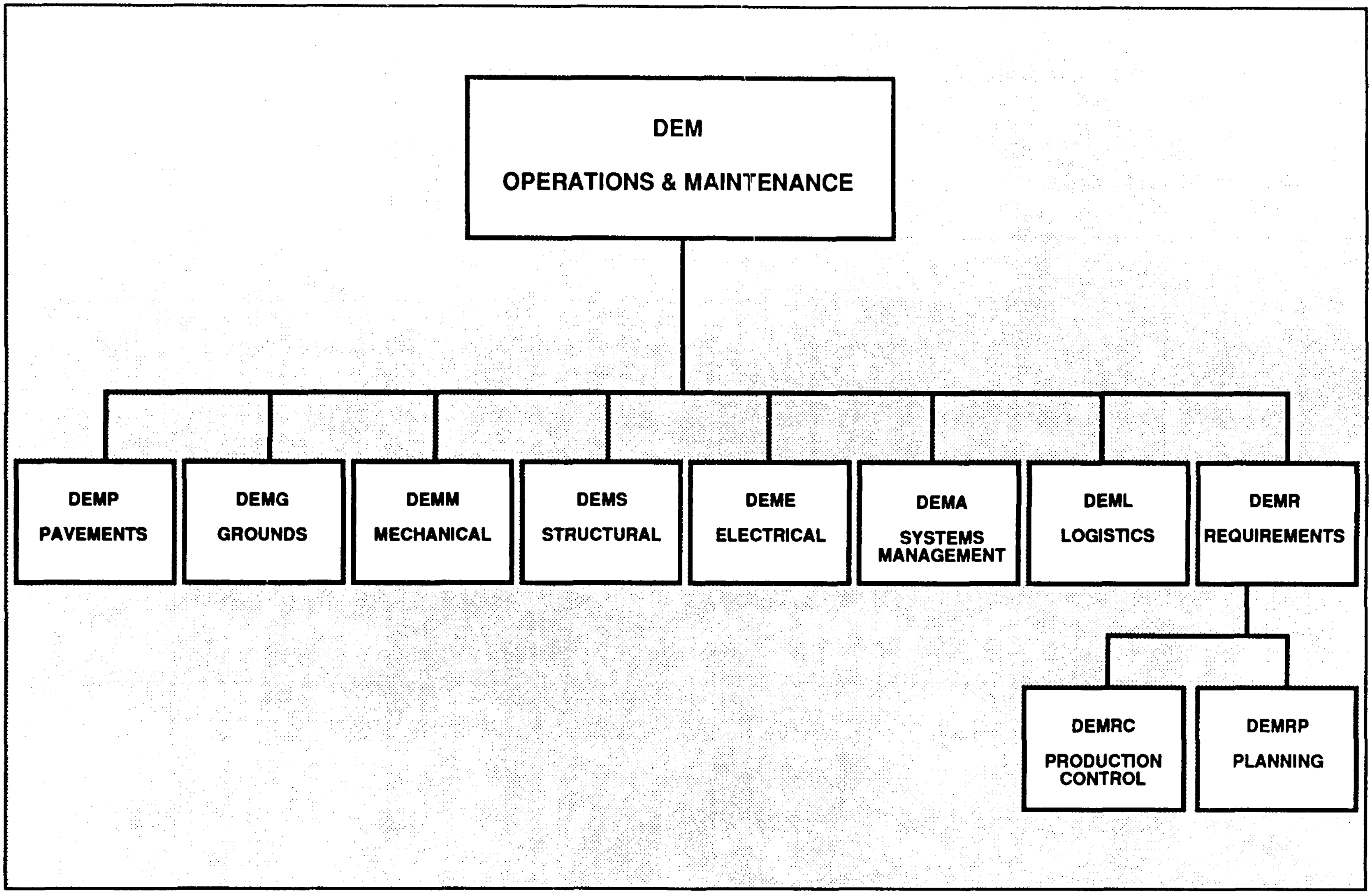

FIGURE 2-2 CE OPERATIONS & MAINTENANCE BRANCH

To provide these services, Grounds personnel maintain records of drainage maintenance, inventory of landscaping resources, and the ice house inventory.

(c) **DEMM - Mechanical -** Operates, maintains, and repairs the following facilities systems:

- Central heating and air conditioning plant
- Steam and chilled water distribution systems
- Individual heating, refrigeration, and air conditioning systems
- Air compressors
- Liquid fuels storage and dispensing systems

In performing these functions, Mechanical personnel maintain records of boiler maintenance, use, and safety; fuel consumption; and flue and stack contents.

(d) **DEMS - Structural**

- Provides all carpentry, painting, plumbing, metal work, masonry, and locksmith services.
- Performs minor maintenance of high-use facilities.
- Maintains and repairs Military Family Housing (MFH) structures.
- Repairs and maintains water supply and waste collection, processing, and treatment systems.
- Maintains records of water use, sewage treatment use, and water and sewage sampling.

(e) **DEME - Electrical -** installs, maintains, and repairs the following facilities:

- Interior and exterior electrical systems, including exterior lighting, base power distribution grid, building entrance pads, and building interior power distribution

- Air Force owned appliances
- Emergency backup power systems
- Diesel and gasoline engines for power production
- Electric motors
- Lighting, control, and distribution systems
- Power substations

In performing these functions, Electrical personnel maintain records of power consumption and production, fuel consumption, and engine maintenance.

(f) **DEMA - Systems Management**

- Operates and maintains the Energy Monitoring Control System (EMCS), including software and hardware.
- Maintains, repairs, and calibrates electronic or pneumatic control systems, traffic control lights, fire detection systems, and intrusion alarms.
- Maintains alarm records and EMCS reports.

(g) **DEML - Logistics** - includes the Plans Officer, who maintains and updates base war and disaster plans. The other Logistics personnel perform the following functions:

- Manage all material acquisition and distribution through the Standard Base Supply System (SBSS), the Contractor Operated Civil Engineering Supply Store (COCESS), and/or the Government Operated Civil Engineering Supply Store (GOCESS).
- Control vehicle support for the squadron.
- Operate the Civil Engineering Material Acquisition System (CEMAS).
- Maintain base civil engineering vehicle records, and resolve task-related problems.

(h) **DEMR - Requirements** - directs all activities involved in managing work requirements and assigning tasks to the workcenters. The personnel are organized in two units:

- **DEMRC - Production Control** - is responsible for all in-service work activities, such as the following:

  - Developing the in-service work plan (IWP), the BCE daily work schedule, and the BCE weekly work schedule

  - Managing the customer-service unit, service-call function, and DO-IT-NOW (DIN) crews

  - Operating CE emergency response force

  These activities require Production Control personnel to receive work requests, originate workorders, provide job status, and maintain real property facility folders, suspense records of the personnel working on each workorder, and logs of all emergency response calls.

- **DEMRP - Planning**

  - Obtains data for and prepares the Commander's Update Briefing.

  - Determines facility maintenance and repair requirements.

  - Determines layout, measurement, material, equipment, and other essential data required for proposed work.

  - Plans labor and material requirements, and estimates costs.

  - Prepares bills of materials, and the facility sketches that accompany workorders.

  - Provides detailed instructions to the craftspeople.

(3) **DEE - Engineering & Environmental Planning** - ensures compliance with environmental regulations and standards on base. One of the primary tasks of this unit is land-use and community planning. Accordingly, the staff includes mechanical, electrical, environmental, civil, and architectural engineers; contract construction and services inspectors; and engineering technicians. The personnel are organized in the following four sections:

(a) **DEEE - Engineering Technical Design**

- Prepares, coordinates, and designs projects, including plans, specifications, and cost estimates for contract or USAF in-house accomplishment.
- Develops special architectural and engineering reports and related drawings.
- Provides continuing technical surveillance of all real property facilities and systems.
- Prepares architect/engineer (A/E) statements of work, participates in A/E selection, assists Contracting Officer in A/E negotiations, and monitors/reviews the design work produced by the A/E contractors.
- Plans maintenance of pavements for runways and roads.
- Maintains the Base Comprehensive Plan and facility blueprints.
- Categorizes costs of reimbursable utilities.
- Prepares facility contracts, and maintenance and repair recommendations.
- Monitors changes in regulations and technical standards.

(b) **DEEC - Contract Management**

- Ensures contractor compliance with plans and specifications for base maintenance, repair, construction, and service contracts.

- Assists the Contracting Officer in negotiating contract changes, e.g., prepares contract change orders and recommends contract payments, penalties, and other adverse actions.

- Manages projects on a daily basis by either approving or rejecting work and authorizing progress payments.

- Maintains inspection records of active contracts.

(c) **DEEV - Environmental & Contract Planning**

- Manages community, natural resources, and environmental protection planning functions.

- Ensures compliance with the Federal Environmental Policy Act and all related legislation, policies, and regulations.

- Prepares environmental assessments and reviews utility plant operation records.

- Manages work requirements accomplished by contract and is responsible for natural resource planning.

- Prepares environmental and hazardous material reports required by higher headquarters for forwarding to the EPA and Congress.

- Maintains the CE contract budget and contract priority list.

(d) **DEER - Real Estate**

- Accomplishes real estate acquisition, retention, and disposal actions.

- Maintains an accurate record of all real property assets.

- Identifies capitalization requirements from completed workorders and job orders.

- Manages use of real property space.

(4) **DEF - Fire Protection** - provides fire protection for weapon systems and facilities. The personnel assigned to this branch are trained in firefighting and crash/rescue procedures. It consists of the following three sections:

(a) **DEFA - Administration**

- Maintains daily station and fire reports, firefighting operation procedures and policy files, suspense records, training records, and correspondence.
- Receives, stores, and distributes instructional material.
- Establishes requirements for, provides, and monitors special training aids and devices.

(b) **DEFT - Technical Services**

- Prepares fire regulations for the supported installation.
- Periodically inspects fire protection equipment for all base facilities.
- Investigates, evaluates, and prepares reports on fire incidents.
- Prepares and directs area and unit fire marshal programs.
- Coordinates public relations matters, including mutual fire protection and prevention agreements.
- Coordinates and assists in preventive maintenance.
- Services and maintains ground-type portable fire extinguishers.
- Maintains records of equipment maintenance, facility inspections, and training.

(c) **DEFO - Operations**

- Performs speedy crash/rescue procedures for wing organizations with flying missions.
- Operates the fire alarm communications center.
- Operates and maintains firefighting and rescue facilities and equipment.
- Monitors the movement and storage of hazardous materials.
- Trains for and responds to hazardous material incidents.
- Maintains firefighter schedules, and records about the following activities: emergency response, fire communications, references and uses of hazardous material (HAZMAT) recommendations, and physical fitness.

(5) **DEH - Family Housing Management** - manages the Military Family Housing (MFH) program, consisting primarily of the following functions:

- Controls the assignment of MFH dwellings for permanent party families, including maintaining and publishing housing waiting lists, maintaining government-owned housing occupancy records, preparing housing reports, and conducting family housing requirements surveys.
- Prepares and maintains the housing budget.
- Provides off-base housing referral assistance for all personnel and maintains the off-base housing referral list.
- Advocates family housing maintenance, repair, and improvement projects, and develops MFH inspection and self-help programs.
- Maintains public relations and communicates with appropriate government agencies, public utilities, civic organizations, and community leaders.

- Mediates housing-related issues or complaints involving tenants and their landlords, public utility and other companies, law enforcement organizations, and government and civil agencies.

- Promotes and encourages the Equal Opportunity in Off-Base Housing Program, and processes complaints of housing discrimination.

(6) **DEI - Industrial Engineering (IE)** - has the following responsibilities:

- Evaluates the quality of work performed by CE personnel, including quality control reviews.

- Evaluates equipment and procedures for adequacy and effectiveness.

- Develops systems for ensuring optimum use of CE resources.

- Monitors operation of data automation control systems and reporting procedures.

- Develops, administers, and maintains the Work Information Management System (WIMS) on Wang minicomputers.

(7) **DEO - Readiness** - has the following responsibilities:

- Organizes, trains, and equips CE forces to support Air Force combat operations.

- Oversees and manages Prime Base Engineer Emergency Forces (Prime BEEF). Per AFR 93-3, this program develops and maintains a highly skilled, mobile combat support engineering force capable of rapid response in support of worldwide contingency operations. (Prime BEEF also operates at the MAJCOM level and at HQ CE and HQ AFESC.) Prime BEEF has the following responsibilities:

    - Provides all training (e.g., self-aid, chemical weapons, and periodic training) for all team members.

    - Manages, postures, and equips the Prime BEEF teams and maintains their readiness.

- Maintains inventory and tracks all items in the mobility bags.

- Maintains readiness materiel status, readiness training records, and individual deployment records.

- Upwardly reports the readiness status of the organization.

- Manages the disaster preparedness program, including response to accidents during peacetime.

• Administers the Unit Disaster Preparedness Program, which ensures that Air Force resources are protected from enemy attacks, accidents, and natural disasters.

(8) **DEU - Financial Management** - serves as financial advisor to the BCE and, in that role, performs the following functions:

• Performs the BCE's responsibilities for cost accounting.

• Provides financial planning and budget estimates.

• Maintains CE financial records.

• Maintains the CE budget.

• Prepares and processes all data required for the BCE Automated Cost System.

2.2.1.2 Services (SV)

SV organizations provide essential human services such as food, lodging, and mortuary affairs/honor guard responsibilities, managing and overseeing the entire Installation Services Program. In addition, SV represents the base population as a consumer advocate as part of the consumer affairs responsibilities for the Air Force Commissary Services (AFCOMS) and Army-Air Force Exchange Service (AAFES).

The Chief of Services, who also serves as the SV Squadron Commander, reports directly to the Base Commander, and is responsible for planning, directing, and overseeing SV activities.

The base-level SV squadron (see Figure 2-3) consists of four major areas (i.e., the administrative area and three branches): (Although the office symbols are not consistently used throughout the Air Force, they are included for illustration purposes.)

(1) **SVA - Squadron Section/First Sergeant/Administration** - performs the following functions:

- Provides command and control and administrative support for the SV squadron, including responsibility for the administering the following activities:
  - Weight management program
  - Suspense system
  - Ancillary training
  - Publications and forms
- Oversees the Dormitory Management program, which performs the duties of a building manager for permanently assigned unaccompanied personnel. Examples of these duties are as follows:
  - Room assignments
  - Inspections
  - Minor maintenance
  - Budget estimates
  - Cleaning
  - Supervision

(2) **SVF - Food Service** - provides nutritious food to authorized patrons at the following locations:

- Central dining halls, including carryout service
- Fire stations and command posts (catered food)

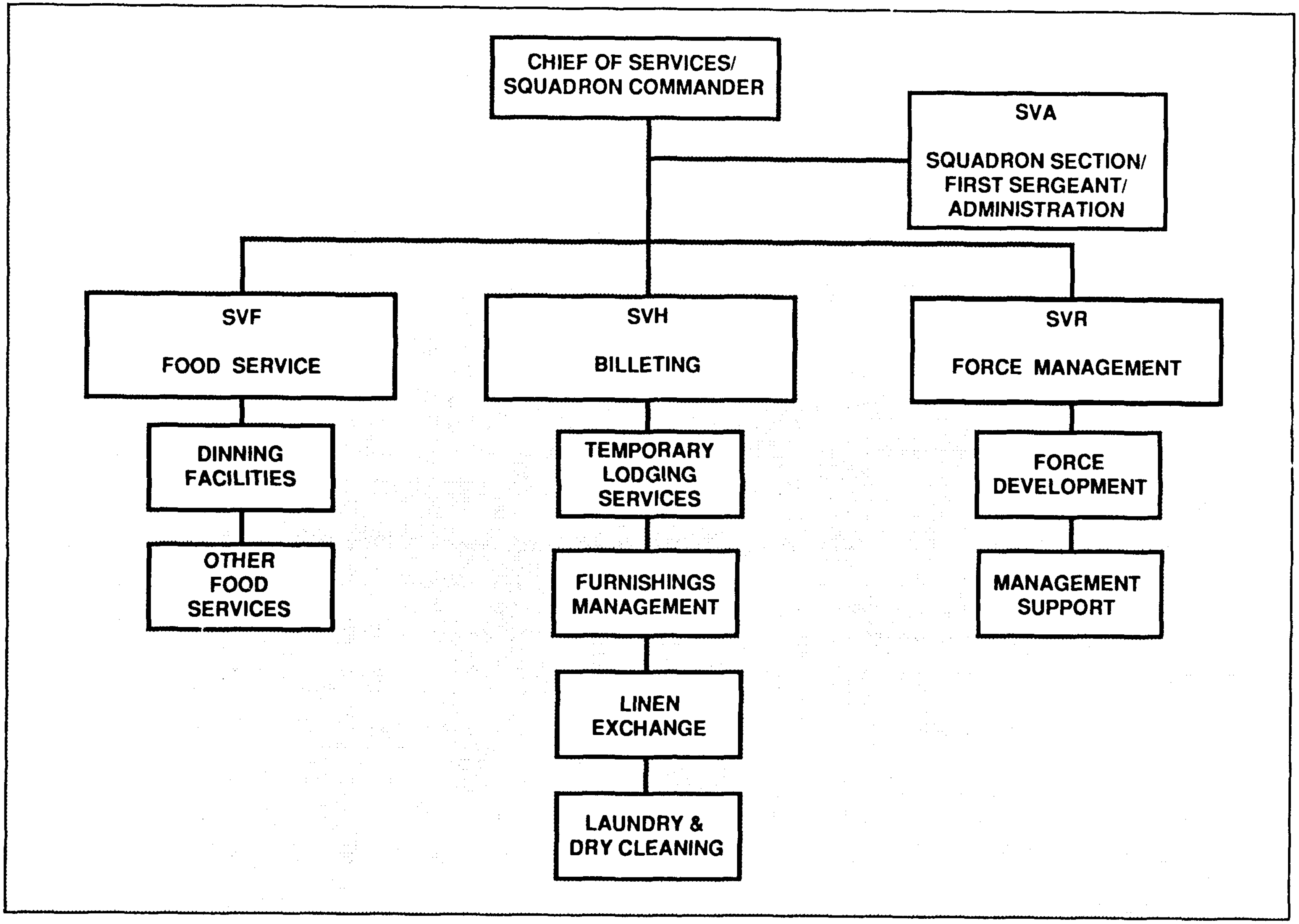

FIGURE 2-3 SERVICES (SV) SQUADRON

- Flight kitchens (meals for consumption aloft, as well as pre-flight and post-flight meals on the ground, and box lunches for personnel working shifts when the dining halls are closed)

- Missile launch control sites, and bomber and fighter alert facilities

- Field locations under deployed and combat conditions

To ensure that food is provided at these locations, Food Service performs the following functions:

- Plans for feeding an allocated number of personnel to meet base-specific requirements.

- Plans and implements menus, including supply, logistics, quantities, and inventory control.

- Operates and staffs kitchen and dining facilities.

- Transports, preserves, and stores various foodstuffs.

- Maintains sanitary conditions in all food-handling and storage facilities.

- Monitors quality of food, service, and facilities.

- Conducts quality assurance inspections (periodically, randomly, and in response to customer complaints) to evaluate and document services performed by the contractor.

- Receives subsistence payments for meals, and maintains accountable records.
- Maintains accountable records for stores received and issued per meal.

Food Service personnel are organized in two sections, according to the type of service and the location:

(a) **Dining Facilities** - performs the following functions at central dining halls:

  - Provides and maintains facilities for feeding personnel in central dining halls.

- Verifies meal entitlement.

- Prepares and serves regularly scheduled meals, night meals, and carryout meals.

(b) **Other Food Services** - manages the miscellaneous-site food preparation program (i.e., prepares food at all locations other than dining halls, including pastry kitchens, and serves and delivers it as appropriate).

(3) **SVH - Billeting** - manages and oversees all installation lodging functions other than MFH (which is a function of the base-level CE squadron), furnishings management, linen exchange, and laundry and dry cleaning. The Billeting branch also determines entitlements and basic allowances and provides base locator services. It consists of the following four sections:

(a) **Temporary Lodging Services** - houses transient personnel and their families and permanently assigned unaccompanied personnel in apartments or hotel-type quarters. In fulfilling this responsibility, personnel in this section manage the following operations:

- Reservations and room assignments

- Guest and base locator and messages services

- Contract quarters and nonavailability authorizations

- Budget development

- Maintain accountable records of funds received and dispersed

(b) **Furnishings Management** - centrally manages and controls military quarters furnishings and appliances, including responsibility for inventory, availability determinations, and deliveries. (In overseas areas, Furnishings Management also provides furniture and appliances for MFH and for private rental quarters.)

(c) **Linen Exchange** - exchanges soiled laundry items for clean items for unaccompanied and transient personnel residing on base. Specifically, this workcenter performs the following functions:

- Prepares and transports linen and organizational (i.e., industrial and safety) clothing items to a laundry or dry cleaning facility.
- Maintains a stock of linen items for exchange.
- Orders new linen.
- Disposes of worn-out linen.
- Conducts linen inventories.
- Helps with developing and monitoring contracts between the Air Force and the laundry and dry cleaning facilities.

(d) **Laundry & Dry Cleaning** - where applicable, operates physical plants and establishes pickup and distribution points for cleaning organizational clothing.

(4) **SVR - Force Management** - is responsible for readiness and overall business management of the squadron. This branch, the newest in SV, comprises the previously independent Prime Readiness in Base Services (Prime RIBS) (SVX) and Mortuary Affairs (SVM) programs. Its personnel are organized in two sections:

(a) **Force Development** - ensures that SV personnel and functions can be mobilized in response to military or other emergency in a timely and effective manner. To carry out this responsibility, Force Development oversees and manages Prime RIBS: a mobility program that organizes and trains SV military forces for wartime and peacetime contingency combat service support roles. Prime RIBS performs the following functions:

- Identifies military authorizations and skill levels, and postures them on mobile teams for deployment.
- Defines CONUS sustaining and in-theater services force requirements.

- Ensures that civilian SV personnel are ready and available for support roles during combat, natural disasters, and major accidents.

- Schedules and provides readiness training to SV troops.

- Maintains accountable records of monies received and dispersed.

- Tracks war reserve materiel (WRM) equipment and manages WRM inventory and maintenance. (Outside CONUS, WRM includes items needed to support surges in personnel during deployments such as refrigerators, chairs, tents, cots, etc.)

(Prime RIBS also operates at the MAJCOM level and at HQ CE and HQ AFESC.)

(b) **Management Support** - performs miscellaneous, but essential, functions in support of the SV activities:

- Administers the Mortuary Affairs program, which includes retirees as well as active members. Mortuary Affairs performs the following functions:

  - Recovers and positively identifies remains, including search and removal.

  - Notifies next-of-kin.

  - Prepares remains (i.e., embalming).

  - Provides uniform, awards, and decorations for remains.

  - Provides caskets and shipping cases.

  - Transports remains and an escort to the location designated by next-of-kin.

  - Arranges round-trip travel for immediate next-of-kin to the memorial service.

  - Provides military honors.

- Oversees and administers the Honor Guard organization.

- Trains and supervises teams for search, rescue, and recovery.

- Maintains current information on Government cemetery requirements for eligible persons, including procedures for use and maintenance of the cemeteries.

• Develops and maintains mortuary affairs support within the Services Information Management System (SIMS).

• Controls the acquisition, maintenance, and disposition of physical installations required by the SV mission.

• Ensures that supplies and equipment required by the SV mission are available when needed.

• Oversees and manages training, manpower and personnel, strategic and operational planning, budgeting, contract review, and workorder control.

2.2.2 Major Command (MAJCOM) Level

CE and SV are combined under the Directorate for Engineering & Services at the MAJCOM level. Thus, at HQ MAJCOM, there will normally be a staff function labeled Deputy Chief of Staff (DCS) for Engineering & Services. Otherwise, the section names and hierarchy of each MAJCOM are different, making it impossible to generate a standard organization chart. Responsibilities at the MAJCOM level are, however, uniform throughout the Air Force and parallel those performed at the base level. Each MAJCOM usually has a section for each of the following responsibilities:

• Readiness

• Housing and food service

• Minor construction and maintenance

• Real property

• Organizational issues

- Environmental issues
- Computer operation and maintenance

2.2.3 Directorate of Engineering & Services (HQ CE)

HQ CE establishes Air Force policies and procedures for E&S activities worldwide. It provides policy guidance and technical direction to HQ AFESC.

In peacetime, CE plans, programs, acquires or constructs, operates, and maintains real property facilities, and provides related management, engineering, and other support services (e.g., food, housing, and laundry). It also ensures the personnel training and equipment maintenance necessary to maintain constant readiness and facilitate a rapid shift to wartime operations.

In wartime, CE is responsible for food service, billeting, housing, laundry and linen services, and mortuary affairs.

This directorate, formerly HQ LEE, was recently redesignated as HQ CE. Figure 2-4 and the following functional descriptions reflect the internal organization and functions of HQ LEE, which contained six divisions:

(1) **LEED - Installation Development -** This division contains two branches: Program Management and Policy. It performs the following functions:

- Develops and issues policy and procedures for the planning and acquisition of facilities and infrastructure for all Air Force construction programs except housing.
- Provides consulting services to the Director of International Programs for planning, design, and construction of facilities in support of defense security assistance.
- Is responsible for the following Military Construction Program (MILCON) functions:
    - Allocates the MILCON design and construction funds appropriated by Congress.

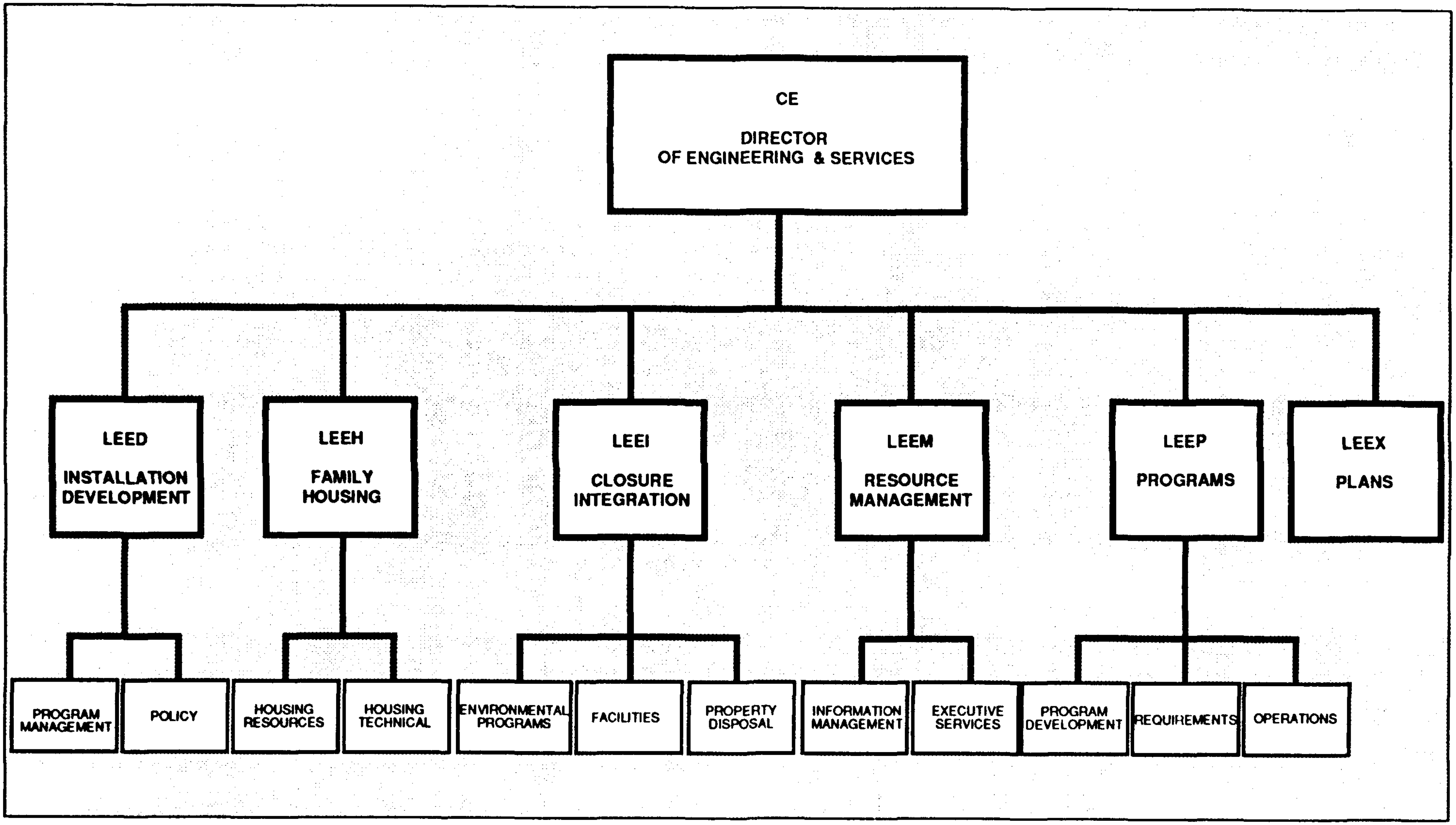

FIGURE 2-4 DIRECTORATE OF ENGINEERING & SERVICES (HQ CE)

- Develops, presents, and defends the annual MILCON design budget before Air Staff, the Office of the Secretary of Defense (OSD), and Congressional committees, and provides these organizations with design and construction program status information.

- Coordinates special programs related to MILCON requiring interagency approval.

- Compiles and analyzes construction data for management purposes on costs, bidding trends, obligation rates, schedules, and other performance factors.

- Oversees design and construction projects of Air Force Regional Civil Engineers (AFRCEs) and MAJCOMs.

- Prepares OSD and Congressionally directed execution reports.

- Coordinates efforts with other services and Government agencies on correspondence and publications involving collateral responsibilities.

- Coordinates efforts with AFESC (Construction Cost Management Directorate) on historical pricing data, methods, and computer model use.

(2) **LEEH - Family Housing** - This division contains two branches: Housing Resources and Housing Technical. It performs the following functions:

- Develops, presents, and defends the family housing program before OSD and Congressional committees.

- Monitors and manages the total family housing inventory.

- Establishes or reviews and approves architectural and engineering design policies, criteria, and standards for construction or improvement of family housing.

- Prepares implementing instructions, guidance, and criteria for domestic and foreign leased housing programs.

- Manages all family housing funds and coordinates their allocation to the field to ensure timely and proper use, and furnishes information to Air Staff and OSD.

- Develops management techniques and procedures to implement existing laws affecting family housing programs; reviews contractor claims; prepares litigation reports and summary briefs for the Office of the Air Force Advocate General; and drafts and reviews proposed legislation and private relief bills for contractor claims affecting family housing matters.
- Develops and disseminates Air Force policy concerning assignment to military family housing, military controlled housing, and Government mobile home park spaces, and policy concerning off-base housing referral services, the Equal Opportunity in Off-Base Housing Program, the Fair Housing Enforcement Program, and the Homeowner's Assistance Program.

- Maintains a database of housing construction costs in various geographic areas (both private sector and military family housing) for use in estimating residential construction costs.

(3) **LEEI - Closure Integration -** This division contains three branches: Environmental Programs, Facilities, and Property Disposal. It performs the following functions:

- Supports the Air Force's Program Management Office for Base Closure (AF/PRPJ),and provides a central clearing house and single point of contact for E&S closure-related activities.

- Assigns E&S responsibilities for closing Air Force bases, realigning missions, and disposing of the real property of the closed bases.

- Provides design and construction program status information to Air Staff, OSD, and Congress for MILCON funded from the Base Closure Account.

- Ensures that environmental cleanup actions are consistent with scheduled closure and disposal programs.

(4) **LEEM - Resource Management** - This division contains two branches: Information Management and Executive Services. It is responsible for planning, developing, and managing administrative, logistics, personnel, computer, and graphic presentation support for HQ CE. Specifically, it performs the following functions:

- Serves as equipment custodian and supply representative for all accounts, and prepares supply documents.
- Manages the directorate's office-space program, and processes all move requests.
- Develops and implements the directorate's policy for administrative electrical communications and administrative orders.
- Manages and administers the military and civilian manpower and personnel function, including counseling, training, preparation of reports, classification actions, reserve activities, assignments, and career progression..
- Approves TDY travel orders, manages and controls the TDY travel budget.
- Develops and manages the overall security program for the directorate.
- Operates a worldwide communications headquarters for Programming, Design, and Construction (PDC) system.
- Serves as HQ CE program manager for the DoD Excellent Installations Program, including the Model Installation Program and Command Modal Installation Program.
- Manages the directorate's records, and serves as liaison with the Federal Records Center.
- Monitors receipt of monies for reproduction and research costs.
- Approves the directorate's printing and duplicating requests, serves as liaison with the Pentagon Duplicating Center, and prepares the printing budget.

(5) **LEEP - Programs** - This division contains three branches: Program Development, Requirements, and Operations. It performs the following functions:

- Validates all Air Force facility and installation real property maintenance activity (RPMA), MILCON, and privatization (i.e., private-sector financed) requirements, and programs the requirements to effectively and efficiently support current and planned missions.

- Ensures that Air Force facility programs, including RPMA, MILCON, MFH, Environmental Quality (EQ), and privatization, comply with the operational plans of the Air Force and the Joint Chiefs of Staff (JCS).

- Develops the annual Air Force MILCON, RPMA, MFH, EQ, and privatization programs, and all natural disaster, emergency MILCON, and contingency reprogramming actions; and presents and justifies them to the Air Force Board Structure and Secretariat, OSD, and Congressional committees.

- Provides MILCON, RPMA, MFH, EQ, and privatization budget inputs to Air Force exercises pertaining to development of the Program Objective Memorandum (POM), the Air Force budget, the Force and Financial Plan, and the Six Year Defense Plan.

- Prepares the Air Staff position on program review proposals and program budget decisions concerning MILCON and RPMA.

- Monitors programming of facility projects in the NATO Infrastructure Program.

- Records and maintains current project authorizations and appropriations as approved by Congress.

- Prepares testimony and witness statements in support of E&S positions at Congressional hearings.

- Processes approvals and disapprovals of requests for waivers to Congressional facility disposal commitments.

- Develops and recommends investment strategies and programs to operate, maintain, and develop the installations and facilities required to effectively and economically support Air Force missions and people.

(6) **LEEX - Plans** - This division performs the following functions:

- Staffs all actions related to E&S strategic (long-range) planning.

- Formulates short-, mid-, and long-range planning processes to meet the E&S objectives for readiness and direct combat support through technical, programmatic, and managerial initiatives.

- Develops plans which advance Air Force mission capabilities through an in-depth understanding of E&S and the role of air base performance in warfare systems.

- Develops and maintains E&S doctrine to provide the foundation for educating, training, organizing, and equipping E&S forces.

- Assesses the direction and impact of Air Force force structure plans and programs to ensure that functional requests are consistent with the directorate's missions, goals, and objectives.

- Evaluates new policies, legislation, directives, and regulations for force structure implications; negotiates changes where necessary; and translates and disseminates the policies for field implementation.

2.2.4 Air Force Engineering & Services Center (HQ AFESC)

HQ AFESC is located at Tyndall AFB and has two staff organizations and nine directorates (see Figure 2-5). The staff organizations are:

- Administration

- Special Staff

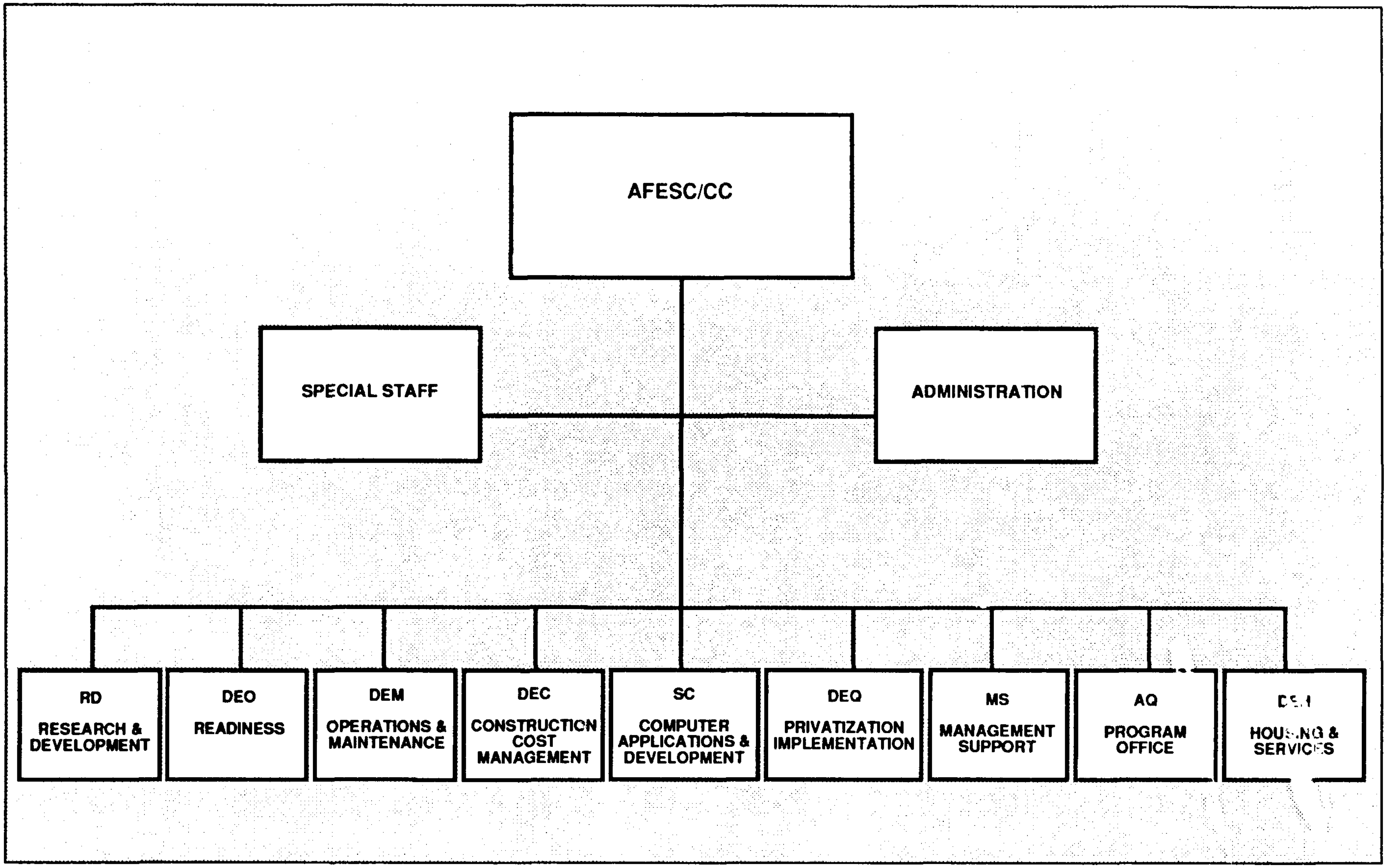

FIGURE 2-5 HQ AFESC ORGANIZATION

The directorates and their responsibilities follow:

(1) **RD - Research & Development** - studies and develops products and concepts that can be applied to CE and SV functions.

(2) **DEO - Readiness** - is responsible for combat readiness of CE and SV forces, entailing the following functions:

- Manages and oversees Prime BEEF and Prime RIBS training at Eglin AFB.
- Acquires and maintains the equipment needed to support Prime BEEF and Prime RIBS personnel during combat.
- Plans readiness strategies and recommends policies.

(3) **DEM - Operations and Maintenance** - performs the following functions:

- Recommends maintenance policies for the life of the various E&S facilities.
- Ensures that E&S maintenance organizations operate economically and are responsive to the needs of their customers.
- Operates the Civil Engineering Maintenance Inspection and Repair Team (CEMIRT) that repairs the major Air Force electrical generation facilities around the world.

(4) **DEC - Construction Cost Management** - consists of the independent cost estimators for the Air Force. They estimate construction costs based on the data supplied on Air Force Form 1391C to validate the figures provided to Congress.

(5) **SC - Computer Applications & Development** - is responsible for the hardware and software used by base-level units, entailing the following functions:

- Acquires, in cooperation with other Air Force agencies, suitable hardware and commercial software.
- Develops custom software for unique E&S applications or delegates the development to the Standard Systems Center (SSC).

(6) **DEQ - Privatization Implementation** - investigates the desirabiltiy and feasibility of using private enterprises (such as Burger Kings and commercial hotels) to supplement the services normally rendered by SV units, and manages and oversees those enterprises.

(7) **MS - Management Support** - includes the E&S support functions: the HQ squadron, accounting, personnel, MAJCOM security, and public affairs.

(8) **AQ - Program Office** - applies the products and concepts developed by Research & Development personnel.

(9) **DEH - Housing Services** - performs the following functions:

- Operates and manages the laundry and dry cleaning plants.
- Recommends policies for Billeting, Furnishings Management, and Food Service.
- Oversees Food Service menu planning throughout the Air Force.

2.3 INFORMATION SYSTEMS SUPPORT FOR E&S FUNCTIONS

Many of the functions outlined in Section 2.2.1 represent the typical services that most residents and visitors on a base see and do not readily associate with information management (e.g., building runways and residences, fighting fires, and providing food service). However, many E&S functions, which either support or augment the traditional CE and SV services, involve preparing, maintaining, and disseminating massive amounts of information. For example, when engineers build a structure or a pavement, they need blueprints for plans and designs, and they need to track materials and expenditures. When firefighters receive notice of a fire, they need to know the location and disposition of HAZMATs, a gas main, electrical service, and rescue access. Food Service personnel need to know the number and location of meals to prepare and serve and must keep track of items purchased and amounts expended. Additionally, many of the CE shops and the SV sections routinely process workorders and job orders to support their daily tasks, and managers in all of the E&S branches and sections rely on current, detailed information to make their daily decisions, some of which are critical and must be made on short notice. Information work, therefore, has become a critical part of the functional work performed by each CE and SV organization as it carries out its assigned mission.

Most base-level CE and SV organizations use a combination of manual and automated processes to manage the information associated with their functions. The automated processes have evolved over the past 10 years with the ESIMS equipment procured through the Air Force Minicomputer Multiuser System (AMMUS) contract. Through AMMUS ESIMS, the information needed to support decision making in some of the CE and SV functions is readily available and centrally stored. Where available, this information helps CE personnel to expend funds efficiently, to conserve and plan best use of resources, and to track work requests, details of contracting, job costing, multiple inventories, regulatory compliance, engineering activities, and location of people. ESIMS provides SV personnel some of the information resources that support food management, billeting activities, squadron administration, and force management. In fact, because of the efficiency afforded by ESIMS, the information system has evolved into a mission-critical segment of each E&S function. An effective information system is a force multiplier.

The very system that has enabled E&S personnel to perform more efficiently has, however, highlighted deficiencies such as the need for enhanced information system performance, interoperability, and capacity. The Wang equipment that permitted installation of acceptable systems in 1984 has led to a level of user acceptance that has outstripped its computing capabilities. The success of AMMUS ESIMS and the need for increased efficiency resulting from the reductions in E&S personnel have generated a large demand for ESIMS. In both CE and SV, most functional areas require additional automated support and integration of information resources in order to satisfy this demand and approximate the efficiency provided by automation in private industry.

In industry, automated information systems have reduced manpower requirements, costs, duplication of effort, paper, management staffing levels, processing time, clerical errors, and inconsistencies. Moreover, automation has enabled industry to increase throughput, more effectively manage its resources, and fundamentally improve the way it conducts business. These benefits are maximized, allowing the greatest savings of money and manpower, only when information systems fully automate the business.

What constitutes an automated business? The automated system provides the following types of benefits:

- Strategic information to managers and other workers

- Improved access to functional data (In the past, a 2-second response time was considered acceptable but slow. Response times shorter than 1 second are now the norm, with response time at screen refresh rate the desired goal.)

- Tools necessary to allow workers to develop automated access to functional data
- Accountability and identification of responsibility
- Viewpoint from which each end-user can better understand the organization's overall mission, goals, objectives, functions, and tasks (i.e., "the big picture") and the end-user's optimum role in that system
- Opportunity to apply metrics to functional activities, thereby providing a cost history, a basis for budgeting and planning, and a basis for estimating similar projects.

It must not be assumed that a business is automated merely because it uses a computer system. The underlying difference between a manual system and an automated system is the system's prime mover: the instrument that authorizes use of resources, i.e., the "first cause of all movement." A system that moves on manual forms (even if the information is later entered into a computer system for reporting purposes) is a manual system. An automated system, on the other hand, relies on online initiation, authorization, communication, and distribution to move the organization; that is, the prime mover is the computer record. For example, in a system where the workorder is approved by a signature on a hardcopy form, carried to the shop, and later key-entered into a computer system, the hard-copy form is the prime mover and the computer record is merely the archive--a storage repository for records--and, as such, can be used only for automated reporting and after-the-fact analysis. In contrast, when the workorder is processed on-line, the database documents the planning, review, and approval process, and the hard-copy workorder merely reports the transaction for later reference.

Thus, any system of information (workorder tracking in this example) can be considered automated only when the prime mover is the computer record, and the paper report serves only as an archive. Accordingly, a business is considered automated only when every desk (the presumed site of all paperwork) is equipped with a workstation. Essential ingredients include the equipment (workstations, network, etc.), useful and complete application software, data transparency, technical support, and end-user training.

The E&S information system will not be truly automated until the ESIMS evolution is complete and ESIMS becomes the prime mover for all of the functions described in Section 2.2. (Section 3.2.3 describes the functions currently supported by ESIMS, and Section 4.2.3 discusses the functions that must be driven by ESIMS before E&S can be considered an automated business.)

Where ESIMS is the prime mover, the end-user can, for example, generate a workorder on-line by entering only a minimal amount of information. The computer's database then supplies the detailed information needed to complete the workorder, and ESIMS transmits the workorder to the appropriate functional areas within CE. They, in turn, check budgeting, allocate resources, establish priorities, schedule the job, and notify the customer. Additionally, these activities can be performed sequentially or in parallel among the various organizations. Using the manual method, on the other hand, E&S personnel must process a multipart form serially. The initiator of the workorder must look up the detailed information from a card file, correctly enter it on the form, and transfer the paper to the next desk. Any errors on that form force the form be transferred back to the appropriate function.

Given the information-intensive nature of the E&S functional, administrative, and information duties and the current and predicted reductions in the number of E&S personnel to perform those functions, the automated system, not the manual system, is the only practical way to do business. The primary objective of ESIMS is to help E&S personnel work faster and smarter so they can handle more work at a greater level of detail. The bottom-line benefit is to turn the paperwork burden into a useful information resource.

The following examples illustrate the functional benefits (i.e., support for coordinating and managing related E&S functions) that are and can be derived from automation:

(1) **Wartime Support** - Rapid repair of runways to establish minimum airstrips during combat and minimization of physical damage to key facilities (such as the tower, radar equipment, communications equipment, and repair shops) are essential to sortie generation and base recovery after attack. ESIMS must provide immediate access to the information needed to assess damage and prioritize repairs under battlefield conditions. By having ready access to information on available supplies, workforce, and equipment, E&S personnel will more quickly identify repairs that must be done, set priorities in accordance with guidance from the Base Commander, and assign tasks to the appropriate recovery teams.

(2) **"Beddown" of Permanent Party and In-Transit Units** - CE and SV personnel use ESIMS resources to coordinate the following activities and related information with the Base Commander, higher levels of command, and the in-transit unit commander: "beddown", feeding, facilities support for the unit's operations, temporary and permanent storage, and parking facilities.

(3) **Major Change in Base Status** - Major actions that E&S must coordinate include changes in mission, transition from active to reserve duty, and closing a facility or base. These operations require proper planning and informed decisions (including responses to questions such as "should work in progress be completed or stopped?"), requiring ready access to all pertinent information. Decisions require information about the disposition of current inventory, equipment, personnel, contracts, or contractor support.

Voice, data, and graphics support, to be provided by Future ESIMS, will expedite the planning and decision-making processes. Work in progress (WIP) will continue to be on-line. Planning will continue to be documented and performed on-line, but will also include on-line development of, responses to, modification of, and execution of plans to support the transition. Information needed to support decisions will be available on-line, allowing managers to expeditiously resolve difficulties in the transitions. Furthermore, communications will be easier to propagate and track because they will be completely in electronic form.

In each of these examples, to satisfy the customers' needs, the various end-users need a ready source of information (i.e., inventories for their shops, base supply, and local commercial establishments) regarding availability of material, equipment, staff, and other resources. Ready data on these availabilities require a database of locations, quantities, items, etc. Such a database also allows personnel to record as part of the recording process their ideas and results of their experiences so they can be readily available to others. This type of information sharing eliminates the time- and resource-consuming rediscovery process that impedes production of measurable results. Furthermore, immediate access to complete, accurate, and timely information allows every E&S organization to improve response time, quality, resource management, and decision time.

Section 3

Baseline Environment

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3 BASELINE ENVIRONMENT

As stated in Section 2, the E&S Information Management System (ESIMS) umbrella concept was developed to help E&S personnel perform the functions listed in Section 2.2 as they carry out the missions stated in Section 2.1. Section 3 describes the existing ESIMS computing environment and functional capabilities. Section 4 then identifies the deficiencies in the environment described in Section 3 in terms of the current workload and that projected for the mid-to-late 1990s, and summarizes the perceived direction of E&S over the next 20 years. These deficiencies combined with the future direction of E&S are the basis for the Future ESIMS requirements specified in Section 5.

Section 3 serves as the minimum capability baseline for Future ESIMS. This baseline environment (which will exist until the end of fiscal year 1995) is presented in terms of the perspectives of the three groups of people who influence the direction of ESIMS: the customers who receive services and ESIMS outputs from E&S, the E&S end-users who use ESIMS to help them satisfy the customers' demands and perform their mission-directed functions, and the technologists who design the applications and select the hardware and software that support the ESIMS end-users.

3.1 CUSTOMER PERSPECTIVE

This perspective focuses on the demand for support services placed on E&S by its customers: Air Force Headquarters (HQ USAF); the tenant organizations (i.e., the Wing Commander, et al.); the other Logistics functions (i.e., Supply, Munitions, Maintenance, and Transportation) at the base, major command (MAJCOM), and HQ levels; and all of the permanent and transitory personnel and visitors on a base.

The general demands for E&S support derive from the missions assigned to E&S by the Air Force. E&S satisfies these mission-driven demands through the various functions described in Section 2.2. Although the customers, except in rare instances, neither use nor receive tangible outputs from ESIMS, the E&S personnel, as described in Section 2.3, perform their customer-support functions most efficiently and effectively with the assistance of the information resources and tools provided by ESIMS. Thus, the quality and timeliness of the customers' services depend on the level of ESIMS support. Accordingly, the customers' demands for E&S services shape the ESIMS needs of the end-users.

Because Air Force missions differ from base to base, the support demanded of E&S, and ultimately from ESIMS, also varies. To accommodate this range of functional needs, E&S management has adopted a philosophy of decentralizing authority and pushing responsibility to the appropriate people. As a result, the E&S bases differ in management style and organizational structure. Additionally, individuals at the different levels of management perform their duties differently. Even managers at the same level have different styles; that is, they may deal with the same day-to-day issues in different ways. Thus, to satisfy its customers at each site, E&S had to develop a flexible system from model software that would meet unique needs on a timely basis, not an inflexible system that constrains the end-user to an unresponsive regimen, meeting yesterday's needs tomorrow.

3.2 END-USER PERSPECTIVE

Because of their intimate involvement with E&S functional issues, the E&S end-users have been the primary developers of ESIMS. Adaptable software tools enable the end-users to produce the customized programs needed to meet particular management styles and unique site and functional needs. Using these programs, the end-users can meet changing management requirements and customer demands without waiting for updates from a central code production source. This flexibility has contributed significantly to the success of the ESIMS concept. The successful implementation of ESIMS is evidence of the essential role of the end-users in developing the E&S C-CS.

The end-users' role in the ESIMS application-development-and-refinement process is illustrated in Figure 3-1. HQ AFESC serves as the central application-development source for ESIMS. Its professional developers obtain or produce the necessary development tools and produce the ESIMS model software. HQ AFESC then releases the tools and software to the end-users. It also provides the training and technical support that the end-users need to tailor the model software to meet their particular needs. The end-users then send the adapted software back to HQ AFESC for review. Where applicable, HQ AFESC then generalizes and standardizes the software and incorporates it as ESIMS applications. This process produces many additional developers, each of whom has a vested interest in producing needed applications, with the required features, as they are needed.

This perspective focuses on the interfaces and applications that help these end-users perform their functions and satisfy their customers. As the customers' demands shape the needs of the end-users, the end-users' demands for ESIMS support, in turn, shape the demand for the hardware and system software provided by the technologists.

The following subsections discuss the interfaces to ESIMS designed to facilitate its use, the component application systems of ESIMS (WIMS, SIMS, etc.), and the various application programs, within those systems, currently available to the end-users. Section 4.2 identifies the areas where the current ESIMS, despite the relative success of the concept, does not adequately support the end-users.

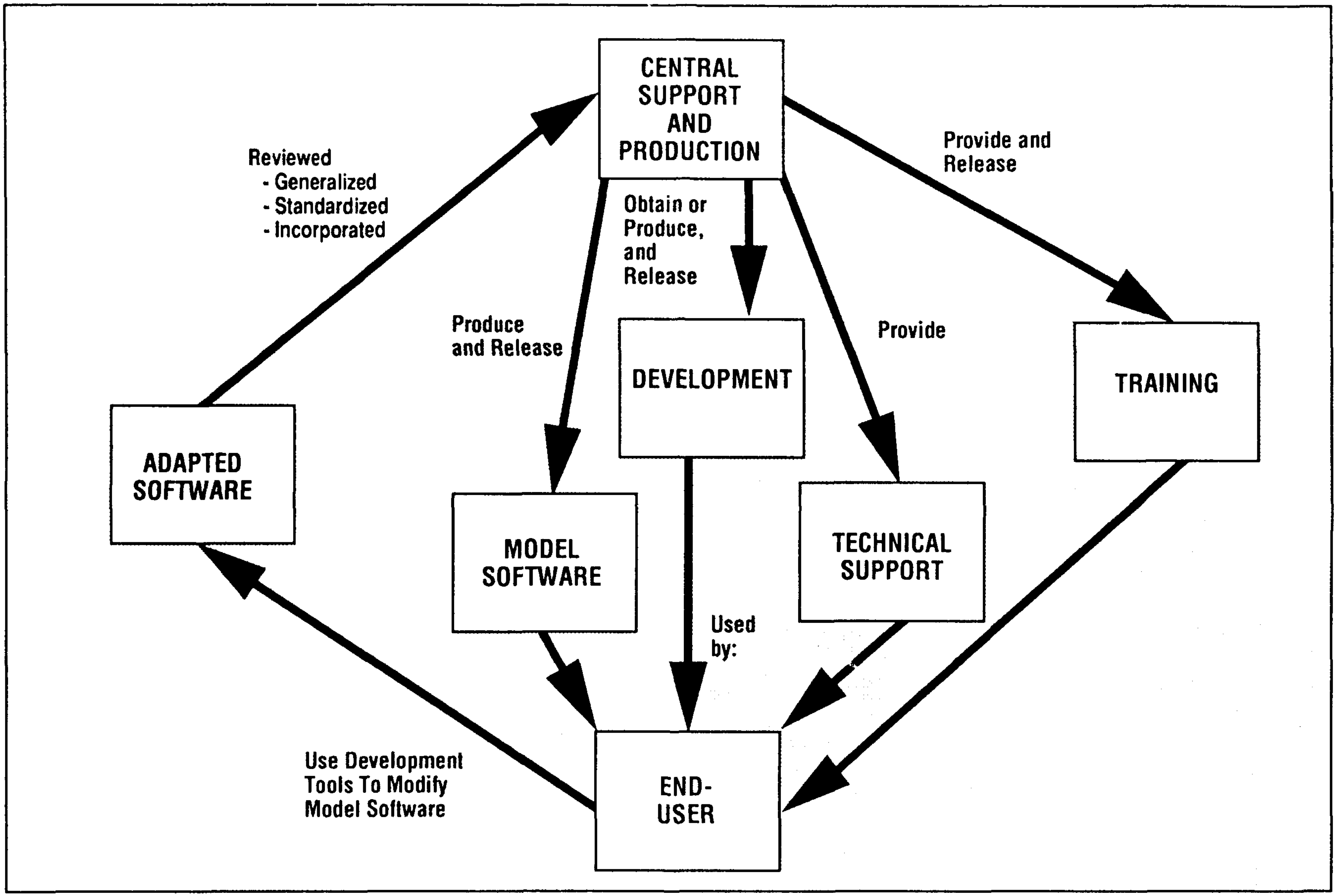


FIGURE 3-1 ESIMS END-USER-DEVELOPMENT PROCESS

3.2.1 Human-Machine Interface

The flexibility of the ESIMS concept has produced a well developed structure, within ESIMS, for application generation and maintenance by the end-users. Under other circumstances, this structure could create the potential for duplication and difficulty in communicating across sites. Because of proper planning and effective management, however, ESIMS has followed uniform application development standards and maintains standard user interfaces across the sites.

All of the existing ESIMS application systems offer an integrated working environment that is convenient, easy to learn and use, and tailored to accommodate both experienced and inexperienced users.

Every user has access to a full suite of office automation application products such as word processing, spreadsheets, officecalendars, and electronic mail (E-mail). The user/machine interfaces (i.e., the keyboards and PF functions, terminals, workstations, and user consoles) for using these products are simple and consistent for all aspects. Interface standards have been defined and adhered to throughout ESIMS, allowing any user to work with the system worldwide without concern for user/machine interface issues. All ESIMS features use full-screen, fill-in-the-blanks displays for both operating system and application functions. The user interface is consistently mediated by menus, prompts, and "HELP" procedures. Interrupt messages are displayed on the system user's console to indicate hardware and software errors and to help the users resolve such errors.

At each installation, ESIMS has been customized to meet the needs of that particular organization. ESIMS provides program-generation tools which allow the end-user to produce the customized programs needed to meet unique site and functional needs. These capabilities allow end-users to produce data entry screens and reports with no programming assistance. Using these programs, end-users can meet changing management requirements without waiting for updates from a central code production source. End-user-developed solutions are forwarded to the Air Force Engineering and Services Center (HQ AFESC), where they are screened for possible inclusion in a future release of the standardized application programs.

3.2.2 ESIMS Application Systems

The various E&S organizations, selected schools, technical development centers, and Air Force Regional Civil Engineers (AFRCE) have received computer systems under the Air Force Minicomputer Multiuser System (AMMUS) contract. These systems use the ESIMS umbrella concept of application systems, which are configured in a worldwide information network of nodes at 200 locations.

The ESIMS application systems provide the Civil Engineering (CE) and Services (SV) squadrons with the following automated tools to help them perform their functional responsibilities:

- **Data Processing** - is used by all of the functional areas within CE and SV.

- **Office Automation** - consists of word processing, E-mail, messages, calendars, spreadsheets, and scheduling.

- **Decision Support** - comprises graphics, information processing, and analysis.

Wang utilities available for all E&S end-users include Office, Word Processing, Report, Inquiry, Control Data Entry, 2020, VSGF, Editor, and Spreadsheet.

Under the ESIMS conceptual umbrella are two principal application systems: the Work Information Management System (WIMS), which supports the CE mission, and the Services Information Management System (SIMS), which supports the SV mission. These systems use a multitude of application programs and software modules (summarized in Section 3.2.3), which support the personnel functions outlined in Section 2.2.1. The software used to generate these programs and modules includes standard software developed by the Standard Systems Center (SSC), model software developed by HQ AFESC, and base-unique software.

3.2.2.1 Civil Engineering (CE)

WIMS helps base-level CE personnel manage the resources, functions, and operations of their organizations. It has a subsystem, the Civil Engineering Material Acquisition System (CEMAS), and a companion system, the Integrated Graphics System (IGS), that support selected CE functions. Currently under development is a fully deployable wartime equivalent of WIMS: the RED HORSE Information Management System (RHIMS).

WIMS, supplemented in some areas by CEMAS and IGS, supports the BCE and the functions performed in each branch, section, and unit of the CE squadron (i.e., those functions outlined in Section 2.2.1.1). A representative sample of the various applications supported by the CE systems appears in Section 3.2.3.1.

3.2.2.1.1 WIMS - This principal CE system allows users to produce and manage job orders, workorders, engineering projects, labor reporting, work and training scheduling, real property records, Prime Base Engineer Emergency Force (Prime BEEF) training and requirements, personnel files, financial planning, housing, and material control. Users can monitor virtually all aspects of squadron operations on a real-time basis, enabling them to determine the status of job orders, workorders, the in-service work plan (IWP), and contract projects. WIMS provides immediate status of more than 3,000 workorders per year and 3,000 job orders per month, TDY and leave status, readiness, and training requirements. Additionally, WIMS electronically tracks workorders, job orders, and materials, including the date an order is sent to a section and the total number of days it remains there, eliminating the need for manual logs.

WIMS automates the job order/workorder process. When job orders are received via telephone, WIMS enters the customers' requirements directly into the computer. Workorders are approved and authorized electronically, rather than through the paperwork exercise. WIMS electronically calculates and tracks internal suspenses. The approving authority's name is assigned directly to the workorder, and estimated data (start dates, completion dates, etc.) cannot change once work has begun.

WIMS produces reports that list job orders and workorders in the various offices and automatically post suspenses based on predetermined criteria. These reports give a very precise overview of the amount of effort being expended for various categories of work for any period specified by the user. These data serve as a basis for analysis on how to improve resource allocation. Base productivity can be easily compared command-wide, enabling managers to focus on the areas where the different bases excel and lag.

Additionally, WIMS consolidates facility requirements. The consolidated facility report combines the various requirements for a facility into a single workorder or project. A planning report sorts all workorders and job orders by facility number, enabling planning of several jobs at once. Facility surveys for adjacent facilities can also be easily identified even if the inspection cycle is quite different. Shops can daily print their list of work requirements by facility number and consolidate trips to the work sites. The recurring work plan allows several different shops to perform recurring maintenance on the same piece of equipment at the same time using one vehicle. The Facility Manager report provides managers with a list of all the work in their facilities. This report allows customers to see that CE understands their total requirements and commitments, thereby reducing communication errors, building customer confidence in CE, and enhancing CE's professional image.

Furthermore, WIMS has automated the Commander's Update Briefing, which is prepared by the Planning unit of the Operations and Maintenance branch. The briefing is now conducted by automated reports that dynamically access on-line data, ensuring that the information is current. Previously, personnel collected the data manually. Because the process typically took 4 to 8 hours, it was conducted during the previous afternoon, rendering the briefing obsolete when it was given.

It is also not uncommon for a Commander to postpone a briefing, requiring repetition of the 4-to-8 hour process under the manual method.

Finally, the WIMS E-mail system allows users to send labor and scheduling information. In fact, some shops at some bases order material, issue material-complete status, and open and close job orders and workorders using E-mail.

3.2.2.1.2 CEMAS - This WIMS subsystem is used by various shops in the Engineering and Environmental Planning branch and in the Operations and Maintenance branch to send purchased-material information (including purchase requests, job order numbers, workorder numbers, and organizational codes) to the Base Contracting Accounting System (BCAS), thereby eliminating preparation of manual material requests and reducing the number of telephone calls. Personnel in the Logistics section of the Operations and Maintenance branch use CEMAS to ascertain material status and to update job orders and workorders upon receipt of materials, making the status available to the shops and customers. Additionally, CEMAS automatically informs Material Control when the delivery date of materials has passed.

3.2.2.1.3 IGS - This recently implemented system is designed to be used in combination with WIMS and, eventually, with RHIMS. IGS is a three-dimensional computer-aided design and drafting (CADD) application for designing, analyzing, drawing, mapping, charting, and illustrating tasks previously prepared manually. It currently operates in stand-alone mode on the non-AMMUS engineering graphics workstation (described in Section 3.3.1.2.5) and on a few of the AMMUS programmable workstations (described in Section 3.3.1.2.4). This system offers rapid, accurate creation and manipulation of information, both graphical and textual, and facilitates quick reviews and updates of information essential to senior-level management.

When application programs are developed and when IGS is fully integrated and interactive, it will be a valuable asset for civil engineers in daily construction, planning, operation, and maintenance of base facilities and the supporting infrastructure. It will be particularly useful in the Engineering and Environmental Planning branch: it will enable personnel in the Engineering Technical Design section to automate and easily update the Base Comprehensive Plan.

3.2.2.1.4 RHIMS - By managing manpower, equipment, and material resources, this wartime equivalent of WIMS will support the Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineer (RED HORSE) mission: to provide a highly mobile, rapidly deployable CE response force that is self-sufficient for limited periods of time. In peacetime, RED HORSE squadrons support special operations such as aircraft crash or contingency airfields or operating locations required by JCS missions, often at austere bare-base sites. In wartime, these squadrons provide heavy engineering support for "beddown" of weapon systems and installation of critical utility and support systems needed to initiate and sustain operations in remote hostile locations. They perform heavy damage repair needed to restore critical Air Force facilities following an enemy attack or natural disaster. In addition to civil engineers, each squadron has services, supply, vehicle maintenance, medical, financial management, and disaster preparedness personnel.

To support a mobile, self-sustaining squadron, RHIMS must be fully deployable and will automate the critical CE functions supported by WIMS and IGS and some of the SV functions (most notably food service) supported by SIMS. It will also provide summary data for identifying problems. RHIMS will automate integrated RED HORSE requirements that span four functional areas with a subsystem to support each of those areas:

- **Personnel** - will provide the database for managing the squadron, including manning and all individual, contingency, and special capability training, and will track personnel for mobility team assignments and TDYs.

- **Material** - will provide material availability, description, location, quantity, and cost; will allow review of notices on parts levels and will track war-readiness spares kit (WRSK) parts; and will provide material requirements for various structures and will track equipment readiness.

- **Workforce** - will track project labor and material cost, schedule projects and track their progress, and track project stock levels.

- **Mobility** - will track mobility equipment status, personnel mobility status, exercise support records, medical status, medical supplies, drugs, and food service.

RHIMS software will be similar to that of WIMS and SIMS, but tailored to RED HORSE requirements. RHIMS will interface with both WIMS and SIMS, allowing RED HORSE squadrons to access all the information and systems available to WIMS and SIMS. It will also report directly to the MAJCOMs.

3.2.2.2 Services (SV)

SIMS helps base-level SV personnel manage the resources, functions, and operations of their organizations. It supports the Chief of Services and the functions performed in each branch and section of SV (i.e., those functions outlined in Section 2.2.1.1). Small E&S sites that do not have sufficient workload to require a minicomputer and all of the SIMS applications use a microcomputer-based version of selected portions (primarily the food service and billeting applications) of SIMS: the Site Automation System (SAS), which is fully compatible with SIMS. Additionally, ESIMS includes a hotel-style system, NAF PHONES, which is accessed by SIMS and SAS for telephone-call accounting purposes. NAF PHONES is used by the Billeting branch's Temporary Lodging Services section to collect and report room availability status and maintenance information.

SIMS provides the real-time information required for day-to-day decision making at all levels of management within the SV organization. Using SIMS, managers can monitor virtually all aspects of the operation and, thus, determine the real-time status of transient quarters, food service operations, and various personnel issues. Furthermore, managers can track personnel status (i.e., training, immunizations, leave, etc.), equipment availability for the Prime Readiness in Base Services (Prime RIBS) teams, and location-unique concerns.

SIMS enables SV personnel in all sections to track and update financial information and to project budget information. It also provides timely consolidation of budget estimates for the upcoming year.

SIMS offers all squadron personnel access to real-time data concerning administrative, financial, and services information under the SV General Information Menu, which displays the current status of funds, CE workorders, and various administrative reports. Using real-time data coupled with word processing and briefing-slide capabilities, SIMS automates various types of Commander's briefings, which can be reviewed under the SV General Information Menu.

SIMS includes three major subsystem modules of the standard software developed by SSC. Each of these modules contain several submodules:

(1) Billeting

- Worldwide reservations system
- Real-time guest folios
- Contract quarters availability
- Guest and base locator services
- Comprehensive accounting data

(2) Food Service

- Real-time storeroom accounting
- Meal planning
- Subsistence-in-kind (SIK) tracking
- Basic daily food allocation calculations
- Master recipe files
- Comprehensive bookkeeping functions

(3) Information

- Prime RIBS
- Personnel training
- Unit orderly room functions
- Mortuary management
- Industrial fund laundry and dry cleaning
- Billeting
- Food service

These submodules support many of the SV applications, which are described in Section 3.2.3.2.

3.2.2.3 ESIMS Interoperability

Telecommunication networks link ESIMS at base level to the MAJCOM level and at the MAJCOM level to Headquarters. (These interconnections are shown in Figure 3-2.) Base-Level and MAJCOM-level E&S organizations send cost accounting information, project estimates, real property reports, housing reports, meal cost information, and pesticide reports to the Directorate for Engineering & Services (HQ CE) and HQ AFESC.

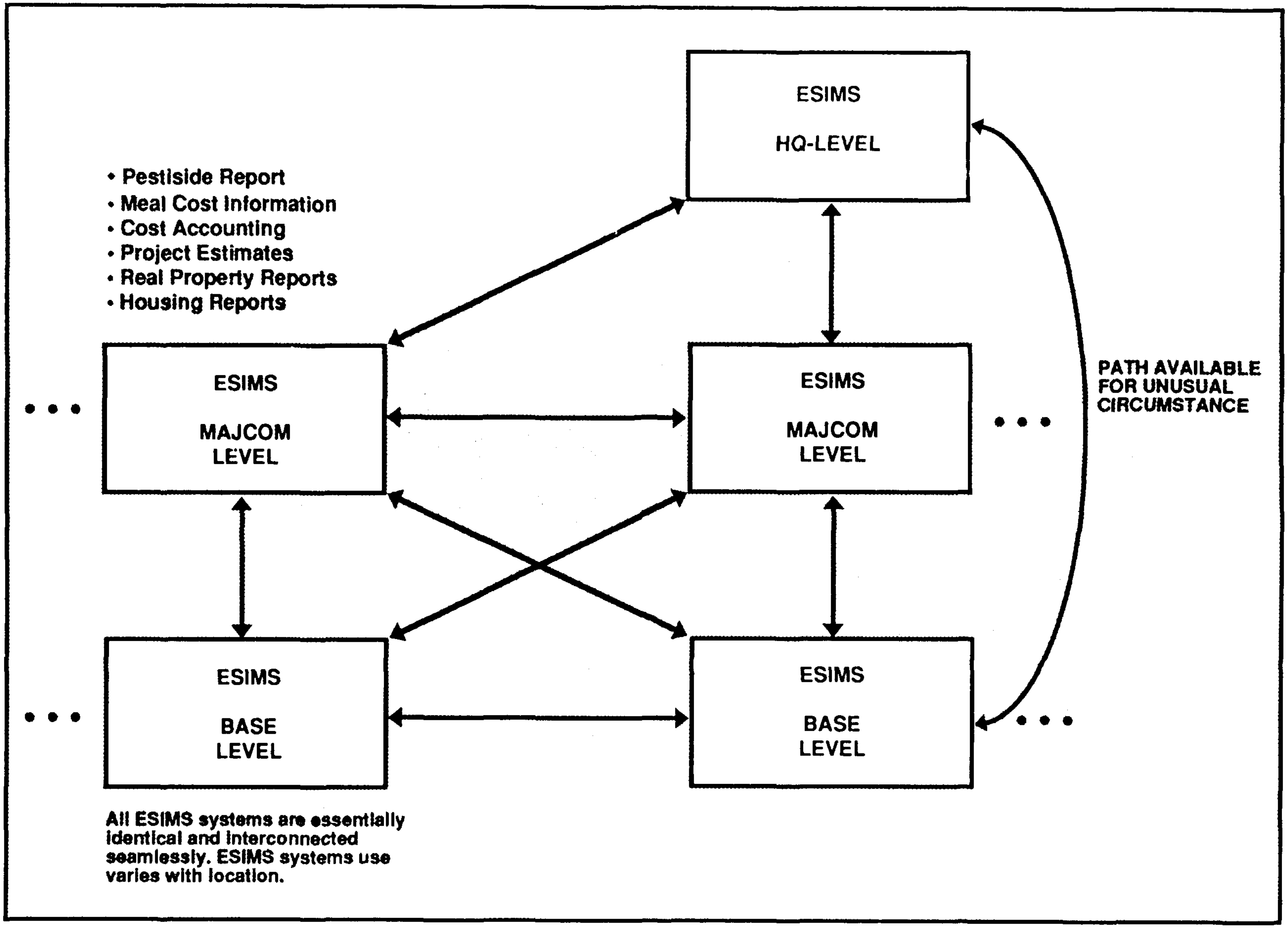


FIGURE 3-2 ESIMS INTERCONNECTIONS

The baseline configuration of the ESIMS component systems and their interfaces to other systems are shown in Figure 3-3. By the end of fiscal year 1991, the Base Engineer Automated Management System (BEAMS), the precursor to WIMS, will be phased out, and all interactive queries to systems in other functional areas will be supported directly through interface databases. Interfaces to the following Air Force functions and systems outside of E&S have already been identified:

- Contracting: Base Contracting Accounting System (BCAS)
- Supply: Standard Base Supply System (SBSS)
- Transportation: On-Line Vehicle Interactive Management System (OLVIMS)
- Accounting and Finance: Base Quarters (BQ) system
- Personnel: The Base Level Military Personnel System (BLMPS)
- Commissary: Automated Commissary Ordering System (ACOS)
- Non-Appropriated Funds Financial Management Office (NAFFMO): Non-Appropriated Funds Management Information System (NAFMIS)

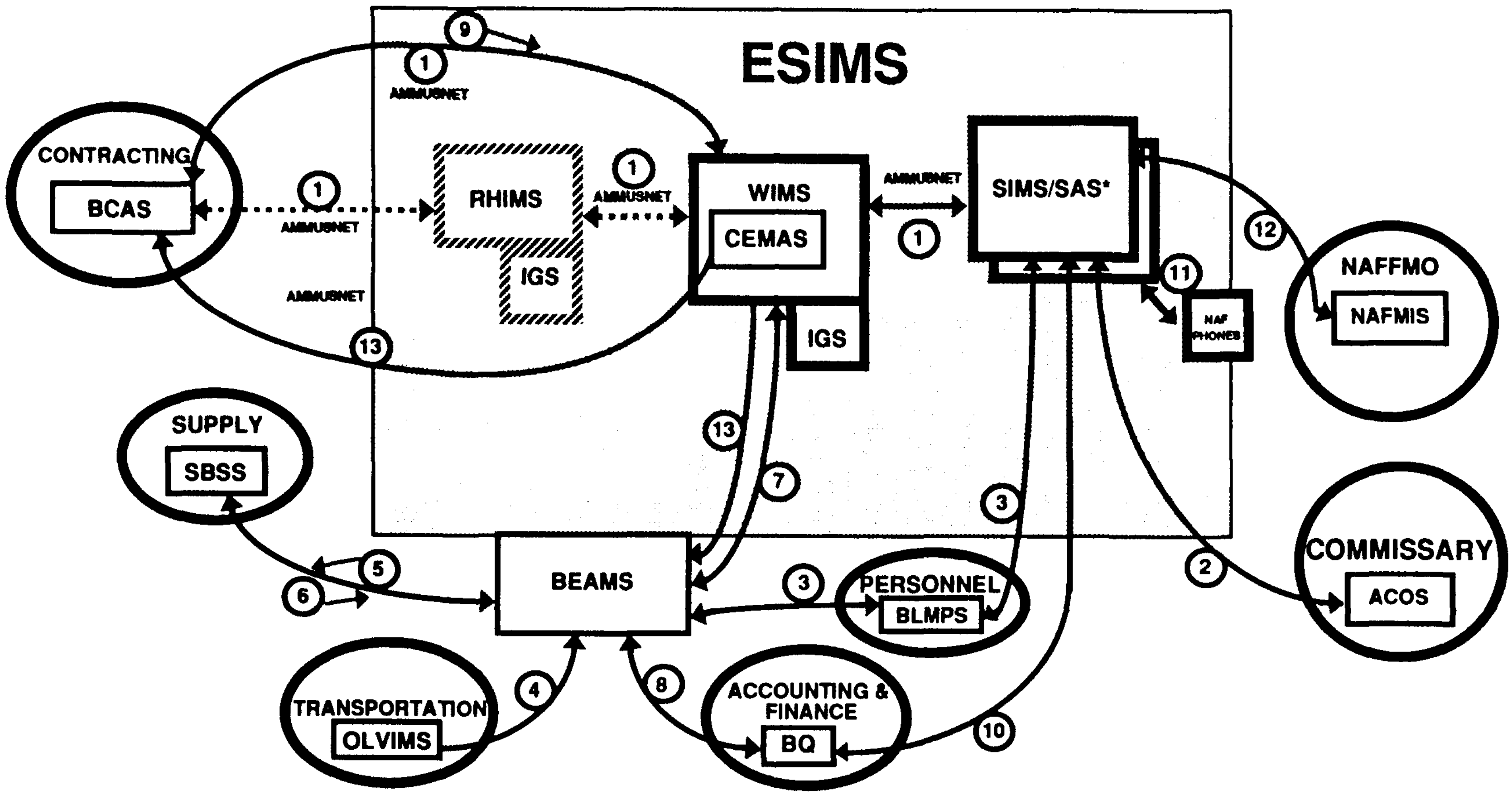
The links between WIMS and SIMS and the outside systems shown in Figure 3-3 are described in the following subsections.

3.2.2.3.1 WIMS Information Flows - WIMS interfaces with RHIMS, SIMS or SAS, and the systems used by Contracting (BCAS), Supply (SBSS), Transportation (OLVIMS), Accounting and Finance (BQ), and Personnel (BLMPS).

As shown in Figure 3-3, WIMS interfaces directly with BCAS and SIMS or SAS, and uses BEAMS to interface with SBSS, OLVIMS, BQ, and BLMPS. Examples of data sent through BEAMS are costing information, real property reporting, and pesticide reports. Work is under way to phase out BEAMS, which resides on the base-level Unisys mainframe computer, by using interface databases which contain information similar to that contained in BEAMS.

CEMAS sends purchased-material information to BEAMS on the Unisys Phase IV computer and to BCAS on a Wang VS100 computer. BCAS, in return, sends receiving reports and contractor invoices to WIMS.

The information flow with Transportation is a one-way flow, from OLVIMS to the WIMS through BEAMS. WIMS receives vehicle-related information from OLVIMS, including vehicle registration numbers, amounts of fuel issued for vehicle use, and amounts expended on vehicles.



1. MIS Updates/Actions; E-Mail Memos; E-Mail Packages of Files
2. Food Service Cost Data
3. Personnel Actions Data
4. Vehicle Registration Numbers; Vehicle-Fuel Use and Cost Data
5. Requisition Numbers; Workorders; Accounting IDs; Needed-Parts Info
6. Material Cost, Status, and Requisition Information
7. Two-Way Interface from BEAMS to WIMS for All Data Visible to the BCE
8. Billable Costs Associated with Material, Construction Contracts and Service Contracts
9. Receiving Reports; Contractor Invoices
10. Budget Status Information; Meal Card Entitlement
11. Hotel Telephone Accounting Information
12. Accounting Operations; Property Management Information; Daily Activity Reports
13. Purchased-Material Information

* SAS is a microcomputer-based version of selected parts of SIMS used at smaller sites.

FIGURE 3-3 ESIMS INTERFACES TO OTHER SYSTEMS

Through BEAMS, WIMS sends information to the BQ system concerning reimbursable cost distribution. Again through BEAMS, the BQ system returns personnel cost, inventory cost, and project cost information.

WIMS sends requisition numbers, workorders, accounting ID numbers, job order numbers, and information on parts needed to SBSS via hard copy, through BEAMS. SBSS, in return, sends information on issued items, item cost, item status, and requisitions through BEAMS to WIMS.

By using tape, PC III, or direct terminal logon, WIMS transmits losses/gains of personnel and Base Enlisted Quarters (BEQ)/Base Officers' Quarters (BOQ) allowance verification messages through BEAMS to BLMPS and back.

<u>3.2.2.3.2 SIMS Information Flows</u> - As shown in the right-hand portion of Figure 3-3, SIMS interfaces with NAF PHONES, WIMS, and the systems used by NAFFMO (NAFMIS), the Commissary (ACOS), Accounting and Finance (BQ), and Personnel (BLMPS). Because SAS is a scaled-down version of SIMS used where a full SIMS is not needed, SAS has the same information flows and interfaces as SIMS with the systems on the particular SAS site.

SIMS is electronically interfaced with the NAFMIS. Although NAFFMO is outside of E&S, the SV Billeting branch uses NAFMIS to process accounting operations, daily activity reports, and property management information.

The Commissary E-mail system, CAMNET, uses Wang PCs and functions as a management information system providing mail message service through SIMS. SIMS places orders to the Commissary through a phone-line hookup to ACOS on the NCR computer system. SIMS receives pricing information from ACOS for troop support and local purchase food items. This interface has eliminated the labor-intensive tape transfer of the order and cost information normally performed on a monthly basis. ACOS also provides inventory management and costing information for access through SIMS. In addition, SIMS receives pricing information from Defense Personnel Services Center (DPSC), local contractors, and vendors.

SIMS receives budget status information electronically from the operations budget ledger via magnetic tape transfer. From the BQ system, SIMS receives meal-card entitlement information. Having this information within SIMS eliminates the need for meal cards by allowing Food Service to verify eligibility from the Airman's Military Identification Card.

The base-level SV organization requests, by letter, an update tape from Personnel containing an annotated list of military personnel stationed at the base. This information is used by the base locator service. This interface is currently not standardized and is implemented only where deemed necessary.

SIMS finds status of work requests for transients, status of permanent party quarters, and status of food service buildings, as requested by CE. WIMS returns status information on work requests to SIMS.

Requests for supplies, furnishings, and equipment are sent to Supply via hard copy. Supply, in return, sends hard copy information on the status of the supplies or equipment, as requested.

SAS has a two-way interface which can be used for download/upload from a Wang system at a large base or MAJCOM, as appropriate, and interfaces with WIMS, SIMS, and ACOS.

3.2.3 Functional Application Programs

There are approximately 5,000 application software modules under WIMS and SIMS used by CE and SV personnel, respectively, to perform the functions listed in Section 2.2. The following subsections describe the automated functions and list a representative sample of the major software modules and information outputs available in each squadron and branch. (For a detailed list and description of CE applications, see the Air Force Management Engineering Agency (AFMEA) study, <u>The Organizational Impact of WIMS and SIMS on Base-Level Services Units</u>. For a detailed list of SV applications, see the SIMS menu of screens, which is documented in the Chief of Services User Guide for SIMS, June 1988.)

<u>3.2.3.1 Civil Engineering (CE)</u>

The BCE's functions are supported by the Executive Management Summary module. This WIMS model software provides access to every functional area of the system, enabling the BCE to monitor all aspects of squadron performance. The BCE can obtain real-time status of job orders and workorders, review progress on design projects, and develop unique summary reports of any data for use as management indicators of key areas of concern.

Additionally, WIMS supports many programs in each of its eight functional areas:

(1) **CCQ/CCF/DEA - Squadron Section/First Sergeant/ Administration** - WIMS functional applications have automated the manual processes of recording and retaining unit administrative data that are accessed by other functional area software, thereby eliminating duplication and disparity. Wang's word processing merge capabilities eliminate the need for fill-in-the-blank duty rosters and appointment letters. The CE personnel data file provides real-time personnel information access. These applications reduce the administrative burden by providing accurate up-to-date information for common use.

There are applications that provide the BCE and the Branch Chiefs with ready access to reports and lists that identify specific vacancies and deficiencies in the organization, permitting quick and responsive decisions. Application programs provide the following reports and lists on personnel and vacancies:

- List of all CE personnel (military and civilian)
- Vacant military overage positions
- Vacant civilian overhire positions
- Unit leave control log
- Military appointment report
- Shop rosters
- Personnel TDY by departure date
- List of essential emergency positions by Commander
- List of all vacant authorized positions (military and civilian)
- CE personnel history report (military and civilian)
- Additional duty list

The following reports are also furnished by application programs:

- Suggestion report
- Monthly forms report
- CE awards report
- Military meal card report

This functional area uses computer applications in fulfilling its responsibility to provide training to CE personnel in the various branches of the squadron. Menus serve as the training outline, while the programs provide the details needed to teach the personnel how to perform their duties. The programs contain "HELP" text to minimize the training time. These programs ensure that training is uniform from user to user within the particular functional area. There is also an application to manage the weight control program.

(2) **DEM - Operations and Maintenance -** WIMS model software offers operations officers a means to monitor shop and staff performance through their access to every major functional area of the system. In accordance with the WIMS philosophy of decentralized control, an operations officer can develop unique summary reports of any data in the system to use as management indicators for key areas of concern, and can electronically calculate and track internal suspenses within the Operations and Maintenance sections, as well as an estimated completion date (ECD). The report of workorders sorted by ECD and shop is used to build the weekly work schedule, prioritize the workload, and determine when ECDs must be changed.

There are many software modules that support job order and workorder management and various other functions throughout all of the seven sections within this branch; they include the following (Note - The bulleted items are not necessarily exact titles of individual modules. For brevity, related modules have been combined into a single item.):

- User access rights for the job order system and for the workorder system
- All active job orders and workorders by order number, by commitment dates, by type of service, by shop, and by special indicator

- Job orders and workorders awaiting planning
- Job orders and workorders in planning by suspense date, by planner, and by work class
- Job orders and workorders awaiting accomplishment and awaiting completion, by type and by shop
- Job orders and workorders in progress
- Completed job orders and workorders by shop and by type
- Delinquent job orders by shop and by type
- Closed job orders and workorders
- Job order/workorder quality control inspections, including pre-inspections, interim inspections, and follow-up inspections
- Open job orders by categories, e.g., emergencies over one day old
- Typc of job order and commitment days to complete, by shop
- Job orders in upload file
- Job orders written on facilities required
- Job orders requiring materials during a specified period
- Job orders completed within 30 days
- Job orders completed by estimated completion date (ECD)
- Job orders about to exceed their ECD, by type and by shop
- Job orders that have exceeded their ECD, by type and by shop
- Average time spent on emergency job orders, on routine job orders, and on urgent job orders
- Completed emergency job orders, by shop
- Work requests/workorders by location

- In-house and contract workorders by facility
- Workorders by reimbursement, by special indicator code, and by work class
- Workorder status and name description
- Workorder status by selected organization
- Workorders awaiting materials
- Workorders tracked to materials
- Utility workorders
- Minor construction workorders
- Workorders on job stoppage
- Collection workorder check
- Estimated manhours by shop
- Problems reports
- Requirements planning by items/functions

This branch also maintains an automated master vehicle file (authorized vs. assigned) to monitor and control CE vehicles. The reports generated include the following:

- Assigned vehicles by shop and by type
- Authorized vehicles by shop and by type
- Vehicle discrepancies
- Vehicles out of commission
- Vehicles with radios

Examples of other general types of reports generated by this branch follow:

- List of all Precision Measurements Electronics Laboratory (PMEL) equipment sorted by calibration due date and by type
- Reliability and maintainability (R&M) design checklist

In addition to the many branch-level applications, there are applications that are unique to each of the eight sections within this branch:

(a) **DEMP - Pavements** - The only program that is unique to this section reduces raw data into a more usable form.

(b) **DEMG - Grounds** - This section has a pesticide management program that allows entomologists to quickly display a history of pesticide applications. This history enables them to avoid using the same chemicals in successive applications, thereby preventing pests from developing a tolerance to pesticides.

(c) **DEMM - Mechanical** - This section uses software modules that identify storage tanks by age and by contents.

It also uses a program, ASBESTOS, that manages asbestos removal and abatement efforts. Currently in use at HQ TAC, Robins AFB, and Eglin AFB, ASBESTOS is a series of related application packages. Efforts are under way to consolidate functional requirements into a single program to be integrated into ESIMS as part of WIMS. When fully implemented, ASBESTOS will help personnel manage asbestos removal from Air Force base facilities worldwide. It will support a database of locations where asbestos was installed and where its removal is planned. This database will include an updater, reports, procedures, report change subroutines, report menus, application and release documentation, and data conversion.

(d) **DEMS - Structural** - Personnel in this section have two unique applications to help them perform their functions:

- **ROOFER** - This minicomputer-based application performs calculations that support roof- maintenance management. It is a non-sophisticated base-level expert program designed to provide a practical decision-making procedure to identify cost-effective roofing repairs.

- **APUDAS** - The Automated Post-attack Utilities Damage Assessment System (APUDAS) consists of pressure and flow transducers installed in water pipelines and of fault identification relay switches on electrical circuits. APUDAS detects pipeline breaks and downstream electrical system damage, enabling the BCE to prioritize pipeline repair options. This application, which is based on stand-alone survivable technology, calls for installation of system-specific software on the SBCS computer, not for incorporation into WIMS.

This section also has applications that support water and waste management.

(e) **DEME - Electrical** - This section has applications for power outage reporting and for generator refueling and replacement.

(f) **DEMA - Systems Management** - This section has an energy monitoring system that supports management and reporting of use and requirements for heating oil, electricity, natural gas, butane, propane, anthracite, coke, bituminous coal, and wood. Reports generated at base level are sent via E-mail to the MAJCOM level, where the reports are consolidated and sent to HQ AFESC for further consolidation and reporting to the Defense Logistics Agency (DLA).

(g) **DEML - Logistics** - Personnel in this section use CEMAS, an application within WIMS, to ascertain material status and to update job orders and workorders upon receipt of materials, making the status available to shops and customers. Additionally, CEMAS automatically informs Material Control when the delivery date of materials has passed.

(h) **DEMR - Requirements** - This section uses a "consolidated facility report" to report all work in a facility. This report consolidates several different requirements into a single workorder or project. The Requirements section has two units:

- **DEMRC - Production Control** - WIMS automates the principal labor scheduling forms: AF Form 1734, BCE Daily Work Schedule, and AF Form 561, BCE Weekly

Work Schedule. AF Form 1734 calculates the total hours for each worker, job order, and workorder and reconciles the variances. Previously, the schedulers in this unit typically spent 3 hours per day calculating these totals; now, they merely enter the data into WIMS and let it total the figures, consolidate the information, and produce the reports. AF Form 561 extracts data from AF Form 1734 and consolidates it on a weekly basis.

- **DEMRP - Planning -** Planners use WIMS applications to perform the following functions that are unique to their unit:

  - Obtain data for and prepare the Commander's Update Briefing.

  - Transfer Air Force Engineering Performance Standards (EPS) data while estimating job orders and workorders.

  - Update carpet certification and exterior protective coating data.

  - Prepare bills of material, and monitor material-complete status.

(3) **DEE - Engineering and Environmental Planning -** Applications provide automation of the Critical Path Method (CPM) design scheduling and real property management, a consolidated projects file, and capability for technical design programs. There are many software modules at the branch level; they include the following:

- Engineering projects overview and file

- Current status of current fiscal year O&M programs

- Projects funded and authorized

- Projects under construction

- Projects behind schedule

- Projects with warranties expiring

- Minor construction program
- Project design overview
- Design schedule
- Engineering rights
- Base verification listing
- Current service contracts

In addition to these applications, there are many applications that are unique to each of the four sections within this branch:

(a) **DEEE - Engineering Technical Design** - This section has a resource allocation program that calculates the most efficient design using the least amount of time. This program automatically identifies a critical path for working critical projects. It consists of the following software modules:

- Contract work required
- In-house repairs identified
- Design resources
- Design schedule by resource, by resource type, by project number, and by priority
- Roof inventory by category, by facility number, and by roof type
- Roof inspections due and scheduled
- Roof warranty expiration dates

This section also has a microcomputer program (MicroPAVER) for planning pavement maintenance. Personnel use MicroPAVER to describe and determine the relative condition of pavements at a specific time, to evaluate various pavement maintenance strategies to determine which one will produce the greatest improvement for the least life-cycle cost, and to establish priorities for pavement maintenance to ensure efficient and economical use of funds.

(b) **DEEC - Contract Management** - The primary application used by this section is the projects program. It displays project milestones that are available to each engineer and all users, enabling all section personnel to work toward the same goal. The other major programs used by this section are as follows:

- Update and review of project data
- Items under warranty/guarantee
- Engineering labor
- Reliability and maintainability

Project reports include awarded projects, projects under construction, and completed projects. Labor discrepancy and family housing reports are also produced and are available to all workcenter personnel. Additionally, Contract Management inspectors can produce several reports.

(c) **DEEV - Environmental and Contract Planning** - Each specialist in this section also has specific programs, which include the following:

- Facility survey program (used by facility energy conservation officers)
- Programs and reports for project data, storage tank information, data on use of pesticides, and airfield waiver data (used by environmental engineers)
- Sampling analysis and sonic boom analysis applications (used by environmental engineers)
- Programs for updating and reviewing project data (used by community planners)
- Exterior protective coating applications
- Cost-limitation projections program

Additionally, this section uses NOISEMAP, a group of programs developed by the Air Force, to predict noise exposures in the vicinity of an air base caused by aircraft flight, maintenance, and ground run-up operations. These programs can also be used to predict noise levels at civilian or joint-use (military-civilian) airfields, providing the necessary reference files are added to the database used by NOISEMAP.

(d) **DEER - Real Estate -** WIMS model software acts as a front-end processor for primary real estate applications in BEAMS. In addition to BEAMS-similar real property records applications, WIMS has building managers, in-grant/out-grant, and support agreement applications. The primary benefit of WIMS for this section is its ability to interface real property data with other applications. For example, shop supervisors use facility manager information files to schedule work with facility managers. Real property facility files are then used in other areas to write job orders and workorders. This section has nearly 50 software modules. Examples are as follows:

- Real property category codes
- Real property support agreements
- Leased facilities file report
- Real property projected moves
- Portable building record by building number and by organization number
- In-grant monthly and annual rental payments and term payments
- Building inventory schedule
- Real property inventory summary
- Building utility availability

(4) **DEF - Fire Protection** - Using WIMS applications, the Supply Custodian can maintain the annual budget for the Fire Protection branch and PMEL data. The PMEL file is then shared with the other offices that use PMEL. Additionally, there are applications that perform the following functions:

- Provide critical pre-fire plan data at the finger tips of the alarm center operator.
- Forecast training requirements.
- Reduce alarm reaction time, and provide increased fire protection by improving planning.
- Monitor status of fire protection systems that are down.
- Improve scheduling of inspections and life-support equipment maintenance.
- Reduce burden in updating information which may involve life safety.

Many applications are available to each of the three sections within this branch:

(a) **DEFA - Administration** - There is an application that accurately projects and schedules training for Fire Protection and provides course sign-in sheets. There is also a records management application that documents the training that personnel receive; it has reduced the time required for this process from 8 hours (using the manual method) to 15 minutes.

(b) **DEFT - Technical Services** - This section has applications for fire prevention inspections and for fire technical reports. Fire prevention data, facility pre-fire plans, fire safety data, and fire extinguisher data are all available through WIMS. Comments on design and pre-construction costs can also be entered. Furthermore, personnel can track the status of fire systems.

(c) **DEFO - Operations** - This section uses the following applications:

- Fire hydrant flow tests
- Hazardous materials (HAZMAT) locations and types
- Equipment availability
- Alarm dispatching

These applications enable Operations personnel to record and track all tests on breathing apparatus, hoses, vehicle pumps, ladders, and any other equipment required by local conditions. They can also record hydrant flow test information and track vehicle in-commission rate information by vehicle-registration number, type of vehicle, and month.

There is another application, the Firefighter Trans-attack Assessment System (FTAS), for use by this section that is currently in research and development (R&D). Currently FTAS is used only for concept testing and proving. It consists of existing fire detection systems and fixed "smart" infrared sensors that identify fire initiation. It interprets the data transmitted and determines the optimum selection of response options available to the Fire Chief. Connectivity and data sharing with WIMS will be established prior to release. Additionally, the graphics standards of interchange used in IGS will be used to facilitate the proper interchange of data.

(5) **DEH - Family Housing Management** - Existing applications perform the following functions:

- Automate the on-base waiting lists.
- Produce Multiple Listing Service data on available housing.
- Assign housing, and manage inventory data on appliances.
- Forecast renovations and maintenance.
- Automate report preparation, such as Department of Defense (DoD) Forms 1410 and 1411. (WIMS has reduced the time required to perform this function from 3 weeks to 1 minute.)

This branch uses four major programs:

- Housing waiting list
- MFH temporary assignments
- MFH facilities and occupant file
- Appliances/equipment files

Specific software modules include the following:

- Housing facility occupant history
- Occupant listing by street address, by facility, by name, and by Social Security Administration Number (SSAN)
- Emergency information by street address
- Total number of dependents
- Spouse listing by SSAN
- Report of unaccompanied families
- Adequate family housing
- Inadequate family housing
- Housing waiting list
- Adequate ineligible waiting list
- Housing refusal report
- Off-base housing suspense file
- Inactive off-base listings

(6) **DEI - Industrial Engineering** - In fulfilling their responsibility to develop and maintain WIMS, industrial engineers use Wang utilities to modify application software and to create base-unique application software. They also obtain data from WIMS to prepare the Commander's Update Briefing. To perform these functions and the

others listed in Section 2.2.1.1, industrial engineers have numerous application programs, including the following:

- Security user history
- WIMS configuration list
- WIMS equipment by office symbol, by ownership (leased or purchased), and by type
- Formal school attendance by course ID
- Labor utilization codes
- System software files and functions
- Disk volume management
- History of service calls and open service calls for CE information systems
- Current cost centers by cost center and by office symbol
- Tape log and tapes sent out and not returned
- Industrial Engineering work plan

(7) **DEO - Readiness** - Existing applications perform the following functions:

- Provide resource management information for personnel/team assignments.
- Automate recall and sign-in roster, training, vehicles, driver's licenses, and shots.
- Forecast training requirements and schedule training for Prime BEEF, and provide course sign-in sheets.
- Manage training documentation and scheduling for Prime BEEF. (WIMS has reduced the time expended for this function, which previously required a full-time person, to 4 labor hours per week.)

- Provide information to control tool boxes/support gear.

Specific application modules for the Prime BEEF program include the following:

- Personnel address report
- Vacant position report
- Vehicle listing
- Personal data - Privacy Act of 1974
- Minikit classes for a training item
- Personnel needing training (17 categories of training)
- Chemical warfare training
- Readiness test report by HQ AFESC and by cost center
- Readiness report (civilian and military) by recall code
- CONUS sustaining force (civilian and military)
- Mobilization augmentee strength report
- Readiness special team breakout
- Skill level deficiency report
- Composite team listing
- Reference file team configuration

There is a microcomputer-based expert system, Post-Attack Damage Assessment of Facilities (POST-DAM), that is currently in R&D as a concept testing effort for use by this branch. POST-DAM can assess damage to mission critical facilities in a post-attack environment and can recommend appropriate expedient repair strategies for the damaged structures. This application will have WIMS connectivity established prior to fielding and will have SBCS connectivity as soon as SBCS is a reality.

(8) **DEU - Financial Management -** Personnel in this branch have WIMS applications that automate the following functions:

- Obtain contract action data, budget reports, financial planning, facility cost, and financial management information reports.
- Review and update budget distributions and requirements, project data, and workorders.
- Obtain obligation data charts, total obligation authority, and housing data.
- Produce purchase request reports.
- Acquire data to prepare the Commander's Update Briefing slides.

Specific applications include the following:

- Initial distribution and changes and current total distribution and changes for P-721, P-722, P-724, P-728, and O&M
- Current reimbursement distribution/changes
- Quarterly targets
- Funded and unfunded budget requirements by EEIC and by date required
- Unfunded requirements by CE priority
- Equipment inventory
- 3080 equipment projected replace dates
- Purchase request log
- Purchase requests at commercial service, at budget office, and at Contracting
- Purchase requests by EEIC, by fiscal year, and by workorder
- MFH quantities

- Operating budget ledger charts
- Allotment ledger - O&M
- Fund status quick reference for each of the CE branches and shops

3.2.3.2 Services (SV)

SIMS model software enables the Chief of Services to monitor virtually every aspect of the SV operation. The three SIMS subsystem modules and their submodules (listed in Section 3.2.2.2), SIMS model software, and base-unique software support several programs in the four SV functional areas:

(1) **SVA - Squadron Section/First Sergeant/Administration** - SIMS applications allow personnel in this area to perform the following functions:

- Automatically update the Unit Administration database with input via the squadron personnel file.
- Electronically interface with the Prime RIBS personnel database, automatically revising files as the Unit Administration database is updated.
- Track the weight management program.
- Monitor the suspense system.
- Control ancillary training.
- Maintain publication and form ordering.
- Perform several dormitory management functions, using two application modules:
  - Manage furnishings
  - Manage repairs

SIMS also provides an automated leave program, which allows administrative personnel to project leave requests and automatically identify conflicting appointments.

(2) **SVF - Food Service** - The functions performed in this section are supported by the SIMS Food Service subsystem module, which contains the A La Carte Food Management System (ALACS) and interfaces with ACOS for all provisions. However, the Food Service interface with ACOS is currently automated as batch data transfer only. Food Service personnel use applications that provide the following automated functions:

- Real-time storeroom accounting
- Meal planning
- SIK tracking
- Basic daily food allocation calculations
- Master recipe files
- Comprehensive bookkeeping
- Quality Assurance Evaluation (QAE)

The Food Service module automates all of the forms used by Food Service's accounting, food production, and storeroom operations:

- **AF Form 129: Tally In/Out** - is used to turn in subsistence to the Commissary, to transfer subsistence between dining facilities, for medically condemned subsistence, and for issues to dining halls from central preparation facilities
- **AF Form 147: Dining Hall Stock Record** - posts all subsistence items from the Commissary, the meat processing facility, the pastry kitchen, and vendors.
- **AF Form 148: Senior Cook's Requisition** - lists the items and amounts requested from the storeroom; the amounts drawn, returned, and used; the unit price; and the total price for each meal.

- **AF Form 200: Basic Daily Food Allowance Computation** - computes the food cost index (i.e., the monetary value authorized for the subsistence of one enlisted person per day.

- **AF Form 249: Food Services Operations Report** - records the monthly transaction of the food service operation.

- **AF Form 287: Subsistence Request** - describes the type and amount of food by unit requisitioned from the Commissary.

- **AF Form 662: Food Service Production Log** - is used as a guide for planning, preparing, and serving meals.

- **AF Form 1119: Monthly Monetary Record** - records data that provide comparison of daily standing of earned income with subsistence expenditures.

- **AF Form 1650A: ALACS Daily Dining Facility Summary** - recaps the number of meals served to each category of personnel, computes the daily earned income, records miscellaneous data needed to complete other accounting records, and records cumulative summaries of the daily data.

- **DD Form 160: Inventory of Class Quarter Master Supply** - records the inventory of subsistence on hand.

- **DD Form 1131: Cash Collection Voucher** - serves as a receipt for the daily funds and cash collection sheets turned in by the dining hall to the proper control office and by the control office to the finance office.

- **DD Form 1150: Request for Issue or Turn-in** - is used to reimburse the base level when meals are furnished under cross-service procedures.

These automated functions and forms support the personnel functions of both of the Food Service sections: (a) Dining Facilities and (b) Other Food Services.

(3) **SVH - Billeting** - SIMS provides comprehensive accounting data and various specific applications to support the personnel in each of Billeting's four sections:

(a) **Temporary Lodging Services** - SIMS standard Billeting module software supports the personnel in this section with the following applications:

- Automated DD Form 2085: Unaccompanied Personnel Housing Inventory and Utilization Data, which records use of on-base quarters, including the number of bed-nights expended.
- Automated worldwide reservations system. (By automating the information previously maintained in the reservation control log [RCL], this system eliminates the need for a large cumbersome book that is difficult to accurately maintain and use. It also reduces customer time by 50 percent, and with "its frequent visitor file" it further reduces time for regular customers who routinely visit a particular base.)
- Real-time guest folios
- Contract quarters availability
- Guest and base locator and message services
- Housekeeping status and control
- Room-maintenance reporting
- Numerous accounting reports during "night audit", eliminating the position of Night Auditor

(b) **Furnishings Management** - SIMS provides automated control of furniture and supply assets. In CONUS, it tracks repair costs and repair allowances. OCONUS, it tracks MFH and O&M funds for delivery contracts, and controls repairs and salvage of assets.

(c) **Linen Exchange** - SIMS automates three basic operations for this section:

- Contract cost management
- Inventory management

- Resource management (performs five specific functions):

  - Monitors linen contract expenditures.

  - Tracks linen exchange transactions.

  - Tracks stock status.

  - Controls assets sent to the contractor.

  - Automates AF Forms 85, 115a, 904, 905, and 2009-1.

(d) **Laundry and Dry Cleaning** - SIMS applications automate the accounting and recordkeeping for the industrial fund laundry and dry cleaning operation.

(4) **SVR - Force Management** - Applications within the SIMS Information module support the information management needs of both the sections within this branch:

(a) **Force Development** - SIMS real-time data replace the large wall charts and manual recordkeeping previously used by this section. SIMS applications record data for, manage, and monitor the following concerns of the Prime RIBS program:

- Deployment history and authorizations

- Readiness requirements, including mobility bags, weapons, and ammunition

- Personnel and team assignments

- Personnel history and status

- Training status and needs, by AFSC and by skill level

- Immunization status (shot records for overseas travel)

- Equipment inventory of all accountable equipment, by part number and by serial number

- Licenses for 40-foot tractor-trailers, 10K forklifts, 2 1/2-ton trucks, front-end loaders, backhoes, the requirements for each of these licenses, and the license deficiencies of each unit

(b) **Management Support** - In fulfilling their responsibility to develop and maintain SIMS, Management Support personnel use Wang utilities to modify application software and to create base-unique application software.

The other major responsibility of this section is the Mortuary Affairs program. Only about 10 percent of its workload is automated, and because of the nature of these tasks, there are no immediate opportunities for further automation. The only automated items are fill-in-the-blanks checklist forms, which support the following operations:

- Case file management

- Preparation for search and recovery

- Honor guard personnel management and scheduling

The other functions performed by this section are supported by the standard SIMS Information module software.

3.3 TECHNOLOGIST PERSPECTIVE

This perspective focuses on the engineering aspects of developing and operating ESIMS to support the end-users. To that end, hardware, operating system, system applications, database, and communications experts select and implement technology to provide the appropriate quality of service, transparency mechanisms, information storage, application portability support, network structures, security mechanisms, and user-access facilities.

The subsections that follow survey and document the hardware and system software, selected by the technologists and purchased under the AMMUS contract, that currently support the ESIMS end-users and their applications. This perspective also describes the communications, security, and physical plant features that support the hardware and software. The descriptions are high level. Specific technical details can be found in the appropriate manufacturers' documentation. Section 4.3 identifies the areas where the current AMMUS technology does not adequately support the ESIMS end-users and customers.

3.3.1 Hardware and System Software

Each installation has an ESIMS node for each of its E&S functional communities: CE, SV, and MAJCOM. Each node has at least one super minicomputer. Each minicomputer within a node serves networked workstations in a local star configuration and is linked to the other functional communities (including the other ESIMS nodes) on base. As shown in Figure 3-4, all minicomputers within a single node are connected together via communications links, and the lead minicomputer has the option to connect with the Defense Data Network (DDN). End-users can access all workstations within a node. In multiminicomputer nodes, the end-users access the workstations attached to their node's other minicomputers by switching, via the communications suite, from their minicomputer to the others. The various workstations interact with the minicomputer via block-mode communications, which is similar to and contains most of the features of the CCITT Virtual Terminal Synchronous (VT-S) protocol. This configuration was selected to support the speed requirements of the ESIMS environment.

Most of the current ESIMS workstations are merely monochrome terminals that rely on the minicomputer for their processing capabilities. There are, however, some stand-alone workstations that can process locally and use the minicomputer for only additional storage and central management.

3.3.1.1 Super Minicomputer

AMMUS ESIMS uses Wang VS super minicomputers. Each minicomputer accommodates only one central processing unit (CPU), which is the minimal stand-alone central computing element to which workstations, storage devices, output devices, and communications elements are attached. Thus, as shown in Figure 3-4, when a node requires an additional CPU to handle its workload, it must add another minicomputer and network of workstations via a communications link.

Each minicomputer has at least one magnetic tape drive, line printer, user console, multipurpose printer, and multipurpose workstation, and varying amounts of immediate access (disk) storage. Selected installations also have an optical character reader (OCR).

The user consoles are on-line input/output video display devices with a keyboard for controlling the minicomputer. They have integrated control over all of the minicomputer's processing functions, including logoff control. The consoles can also be used as data processing workstations and can operate at any location which supports a workstation.

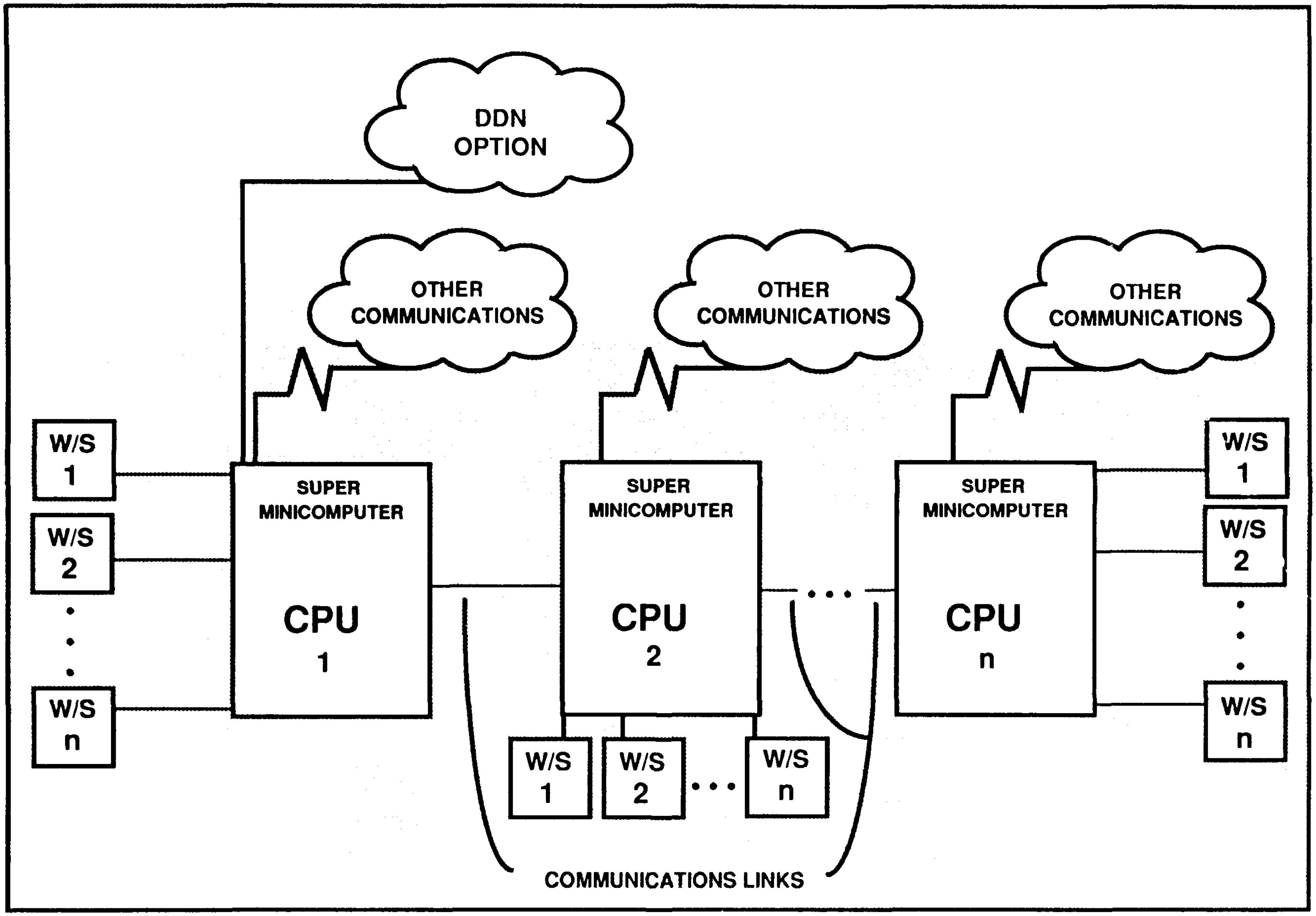


FIGURE 3-4 A REPRESENTATIVE AMMUS ESIMS MULTI-CPU NODE

The Wang VS operating system supports the following extensive set of software tools for data processing, word processing, and application development on all Wang VS computers:

(1) **Modes of Operation** - There are two modes of operation:

(a) **Interactive Processing** - Wang VS system software supports a menu system and interactive prompting. The users interact with the Wang VS operating system through the menu-driven command processor. In addition to menu choices, the operating system displays prompts and messages on the workstation screen to provide information or request clarification.

(b) **Noninteractive Background Processing** - The Wang VS offers noninteractive batch-type handling of tasks that do not require user input. The system runs these background jobs after the user submits them to the system's control, thereby freeing the workstation for interactive use.

(2) **Word Processing Modes** - There are two word processing modes:

(a) **Wang WP** - Wang VS multifunction workstations serve as both data processing and word processing devices. Wang word processing offers several types of editing and formatting features, such as copy, move, and search and replace.

(b) **WP Plus** - It supports all the features of Wang WP, as well as the integration of text and graphics, split-screen editing, an "undo" feature which reverses the effect of the most recent edits, an on-line training package, and an array of user aids such as spelling verification.

(3) **Virtual Storage** - Virtual storage, an integral part of the Wang VS operating system, is a virtual paged memory management scheme that allows an 8-MB program to run on 2 MB of RAM memory. Virtual paged memory uses disk storage as an extension of (main) physical memory. The Wang VS operating system ensures that only those sections of a program and the associated data used during program execution are kept in main memory, while the remaining unreferenced sections are kept on a virtual memory disk until needed. The Wang VS provides up to 16 MB of virtual address space with 3 or 8 MB of user address space. This memory management scheme minimizes operating system overhead and the quantity of data transported to and from the virtual memory disk, resulting in

enhanced throughput. Supporting ESIMS without virtual storage would have required about 128 MB of RAM, which at mid-1980s prices would have been cost prohibitive.

(4) **File Management System** - The Wang VS file management system provides comprehensive ability to organize files and control data access and I/O operations through features such as the Wang Data Management System (DMS), DMS/TX, PACE Relational Database Management System, and Wang VS TOTAL Database Management.

One of the essential features of the file management systems implemented on AMMUS ESIMS is transaction roll-back recovery. This feature maintains the consistency of files accessed during transactions, which can consist of opening and using one or more files. Transactions include creation, reads, updates, and deletions of files, records, or data items within a record. If a transaction is not completed, the system automatically rolls back the transaction and recovers to the state before the transaction was started. This feature provides rapid recovery from system failures. Another feature of the file management systems is serial resource management. The system allows multiple applications to share files during reads, but allows only one application to have control and access to files, records, or data items during creation, updates, or deletions.

(5) **Wang VS Utilities** - The Wang VS offers a variety of system utility programs. These utilities include a data entry, file maintenance, and report generation facility, as well as sort and copy routines.

(6) **Networking and Data Communications** - Wang Systems Networking (WSN) products link Wang systems for distributed processing and file transfer. Thus, from any suitably equipped workstation, users can run tasks on a remote Wang VS to which they have access rights.

(7) **Versatile Security System** - A multilevel security system provides security for the system and individual files.

(8) **Automatic Program Sharing** - This technique allows the user to share the same copy of a program's logic section in memory, minimizing system overhead and code duplication.

(9) **Automatic File Sharing** - The Wang VS permits concurrent update and/or inquiry operations on a file by several users.

(10) **Automatic Print Spooling** - This technique temporarily stores printer output on a disk rather than printing it, ensuring uninterrupted program execution. Also, the operating system controls and queues print requests to ensure efficient printing.

(11) **Automatic Data Compression** - Automatic data compression maximizes disk storage by a unique compression scheme that offers a potential storage savings of up to 30 percent.

3.3.1.2 Workstations

The existing system has seven classes of workstations with limited configurability. Each workstation class executes a specific and limited software function, as described in the following subsections. The first three classes are configurable by microcode, but the others are unique to their applications. Only the programmable, engineering graphics, and food service workstations operate as stand-alone systems, independent of the minicomputer. These workstations load and execute application programs locally, while the others are block-mode terminals that depend on the minicomputer for computing time and data storage.

3.3.1.2.1 Data Workstation - This workstation is a monochrome terminal that depends on the minicomputer for computing time, data storage, and access to peripherals such as printers. Its internal code is treated as microcode, not as programmer-accessible code. The data processing software supports the following capabilities:

(1) Letter quality documents

(2) Standard line drawings

(3) Plot requiring shaded or solid areas

(4) Smooth and curved lines

(5) Horizontal scrolling of up to 132 columns and vertical scrolling throughout the entire text under program and function key control

(6) Movement of rows and columns one at a time and in multiples

(7) Rows and columns scrolled off the screen to be stored in a display buffer with recall scrolling capability

(8) Programmable interrupt and system access functions based on an individual's logon

3.3.1.2.2 Word Processing (Text) Workstation - This workstation is a data terminal with word processing microcode loaded. Accordingly, it supports data processing and word processing functions, although only one mode is active at a time. The word processing software provides the following capabilities:

(1) A spelling dictionary with at least 40,000 words that is user-expandable to at least 80,000 words

(2) Ability to copy a data processing file (i.e., source program files, data files, and print files) into a word processing document, and to copy a word processing document into a data processing file

(3) Ability to create and delete user-specified document catalogs

(4) Ability to create and delete documents

(5) Ability to copy (non-destructive) portions of text from one document to any place within that document or to another document

(6) Ability to move (destructive) portions of text from one document to any place within that document or to another document

(7) Global search and replace for a portion of text

(8) Search for a specific page

(9) Individual search and replace for a portion of text

(10) Ability to print a document with or without footnotes

(11) Automatic pagination, which includes user-defined line length, header/footer generation, and page numbering with user-defined page number position and starting page number

(12) Identification of text for insert, delete, move, and copy via cursor movement

(13) Display of least 20 lines of text per screen load

(14) Horizontal scrolling of at least 132 characters and vertical scrolling throughout the entire text

(15) Page, line, and column position indicators

(16) Automatic centering

(17) Automatic underlining and highlighting

(18) Left, and left and right margin justification

(19) Automatic screen advance during text entering and display

(20) Programmable tabs with decimal alignment feature

(21) Cursor movement to include left, right, up, and down with automatic cursor wrap-around on left and right movement

(22) Automatic word wrap-around to next line and automatic word wrap-around to the previous tab

(23) Automatic word hyphenation

(24) Selective de-hyphenation

(25) Ability to type, store, and recall frequently used text

(26) Ability to archive documents to a removable diskette

(27) Ability to reformat a paragraph

(28) Ability to set print options to include number of copies, line spacing, software fonts, and printer number

(29) Special function keys to support indentation, stop printer, note, replace, merge, go-to-page, decimal tabbing, page formatting, find, screen scrolling, and cancel

3.3.1.2.3 Business Graphics Workstation - This workstation has the same software capability as the word processing workstation and supports a menu-driven interactive business graphics software package. The business graphics workstation is a color terminal and has video output capability to allow video projection systems to display the screen image for conferences and meetings. It performs the following functions:

(1) Provides a data selection or qualification interface to user files.

(2) Provides a data selection or qualification interface to user word processing documents.

(3) Selectively adds or deletes information from the graphics display.

(4) Stores and edits stored source instructions.

(5) Stores the object code instructions for later graph regeneration.

(6) Stores the final generated screen display for later regeneration.

(7) Develops point graphs, line charts, bar charts, and pie graphs.

(8) Specifies classifications, title, legend, axis labeling, and user comment text.

(9) Distinguishes between at least eight types of data from the same file by using at least eight different types of shading or hashing to identify point graph, line chart, bar chart, and pie graph segments.

(10) Calculates percentages for the data displayed.

(11) Prints the final generated screen display, meeting all the rules for distinguishing data as cited above.

3.3.1.2.4 Programmable Workstation - This workstation is a Wang stand-alone microcomputer that has a Wang interface to the local star network facility. Data files are stored on a local hard drive, but can be transferred to and from mass storage on the minicomputer, as required. All of these microcomputers are IBM AT-style machines (Intel 80286 and 80386) and were procured in two AMMUS purchases. The programmable workstation is used to run the following applications where a workstation is needed more than 2,000 feet from the minicomputer:

(1) Word processing programs

(2) Harvard Graphics for business graphics applications

(3) SIMS for billeting applications

The programmable workstations from the first purchase (92 percent of those currently used in ESIMS) are non-IBM-compatible versions, with 10-MB drives, that operate on MS-DOS 2.21 and can run some of the MS-DOS programs. They have a monochrome display adapter with non-standard graphics screen without a generally available supporting interface.

The newer machines are IBM-compatible versions, with 20-MB drives, that operate on MS-DOS 3.3x and are capable of running all MS-DOS applications without modification. They have a medium-resolution enhanced graphics adapter (EGA) graphics screen with supporting interface. In addition to the applications used on all of the programmable workstations, IGS (described in Section 3.2.2.1.3) can operate on the newer machines (8 percent of those used by ESIMS) and uses AutoCAD (from Autodesk, Inc.) as a CADD package.

3.3.1.2.5 Engineering Graphics Workstation - This workstation is a non-AMMUS Wang-supplied microcomputer that operates on MS-DOS 3.3 as a stand-alone unit and is capable of running any MS-DOS application without modification. Data files are stored on a local hard drive, but can be transferred to and from mass storage on the minicomputer, as required. All of these microcomputers are IBM AT-style machines (Intel 80286 and 80386) with standard IBM AT bus-based peripherals.

The engineering graphics workstation runs IGS (described in Section 3.2.2.1.3) and uses AutoCAD (from Autodesk, Inc.) as a CADD package and Harvard Graphics for business graphics applications. It has the following features:

(1) High-resolution video graphics adapter (VGA) graphics screen with supporting interface

(2) Serial mouse pointing device

(3) Wang interface to the local star network facility

3.3.1.2.6 Cash Drawer Workstation - This workstation is used where a data workstation is required at a cash sales point. It has at least one cash drawer with a mechanical key lock for manual operation, as well as an electronic lock operable under application software control. The drawer has a minimum of two compatible inserts to facilitate changing cashiers. This workstation has a transaction printer that can print at least 40 characters per line and can print both a customer receipt and audit tapes under application software control. Its associated printing mechanisms provide the following features:

(1) Alphabetical characters ("A" through "Z") for printing descriptive data

(2) Numerics for printing prices, quantities, dates, time, etc.

(3) Printing voids, over-rings, and under-rings for audit and management security

(4) Buffering which allows the cashier to continue entering items on the keyboard without waiting until printing is complete

(5) Communications capability to and from the minicomputer, permitting file transfer, terminal interaction, and programmed access to the minicomputer

<u>3.3.1.2.7 Food Service Workstation</u> - This workstation is a cash drawer workstation with built-in non-volatile memory and logic capable of performing the workstation functions needed to support a cafeteria food service operation. The current food service workstation is a custom device that has the following features:

(1) **Lockout** - When it receives an invalid identification number validation response from the minicomputer, the workstation prevents all non-cash sales from being rung up. The cashier can manually override the lockout, but must record and identify the override on the audit tape.

(2) **Programmable Feature** - Management can input various change functions (prices, item descriptions, etc.) through the keyboard and can download from the minicomputer.

(3) **Meal Summaries** - If the minicomputer fails, meal summaries can be saved for later minicomputer updating.

(4) **Rapid Cashier Entry and Workstation Response** - Entries and responses are made at a rate of at least five keystrokes per second.

(5) **Transaction Recording** - Transactions are recorded on customer receipt tape and on audit tape.

(6) **Illuminated Dual Sales Displays** - One display faces the cashier, and another faces the customer.

(7) **Negative Validation** - This feature identifies lost, stolen, or invalid meal card identification numbers entered in the workstation.

(8) **Add Feature** - Two features can be added:

(a) Automatic change dispensers

(b) Magnetic stripe or optic wand card reader

(9) **Customer Receipt** - It performs the following functions:

(a) Records the date, time, consecutive transaction number, and total sales amount.

(b) Records identification number and type of credit-customer transaction, when required.

(c) Identifies each item sale and price with numeric and a minimum of six alphabetic character descriptions.

(10) **Cash Drawer** - There is one cash drawer per workstation, which operates only when the cash drawer is closed (drawer compulsion feature). The drawer will not open for a credit transaction. Each cash drawer has the following features:

(a) Two removable inserts to facilitate changing cashiers

(b) Security device that locks the drawer closed

(c) Provision for opening the drawer without recording a customer count or transaction

(11) **Keyboard** - It has a minimum of 70 preset menu-item keys and an overlay keyboard or shift capability. Menu items are preset in memory at the start of each day, not between meals. The preset keys automatically recall from memory the price and symbolic designation associated with each key pressed. These entries are printed on the customer receipt and the audit tape. They are also stored in memory to provide management reports.

(12) **Keycaps** - They are identified by bold, legible names or abbreviations and can be easily changed by management.

(13) **Numeric Keypad** - It consists of ten numeric keys ("0" through "9"). They are used to enter codes for various management functions and to enter identification numbers (six- to ten-digit number at option of the Government). They are also used as multipliers for multiple orders of the same item (e.g., three hamburgers) and as a variable money amount entry when qualified by a function key (e.g., "Misc" or "Surcharge").

(14) **Command (Function) Keys** - They consist of the following keys:

(a) **"Total" Keys** - clear a cashier and reassign a new cashier to the same workstation. These keys allow separate revenue reporting.

(b) **"Subtotal" Key** - totals all items on a tray, increments the customer count, and prints a separate receipt. This key is used in conjunction with a "total" key to allow a single total payment transaction with several actions. The "total" key, when used in conjunction with the "subtotal" key, does not add to the customer count.

(c) **"Cancel" Key** - when depressed (only prior to totaling), is under cashier control and eliminates the previous key.

(d) **"Void" Key** - when depressed (only prior to totaling), is under cashier control and eliminates the entire transaction.

(e) **"Delete" Key** - is under management keylock control. It allows management to remove from memory any over-rings (totaled transactions that were erroneous). All monetary and accounting data associated with this transaction are recorded on the audit tape, but are eliminated from memory.

(f) **"Feed" Key** - advances the paper tape to allow the cashier to audit items that have been entered before totaling.

(g) **"Seconds" Key** - records a statistical count of "seconds" (a patron going through the line another time for additional items). This key does not record a meal count, but does record the money amount of the additional transaction.

(h) **"No Meal" Key** - records a statistical count of all patrons who purchase less than the meal count requirement (currently 10 cents and under at breakfast, and 20 cents and under at all other meals). This key does not record a meal count, but does record the money amount of the sale.

(i) **"S/C" (Surcharge) Key** - used in conjunction with the numeric keypad, enables the operator to enter variable money amounts designated as surcharges. Both count and money amount are stored in memory for later reporting on quantity and money amount of surcharges for each meal period.

(j) **"Contr" Contractor Key** - records the number and money amount of contractor meals served. The patron count is recorded separately from patron meal count.

(k) **"Misc" (Miscellaneous) Key** - used in conjunction with the ten-key keypad, enables the operator to enter variable money amounts designated as miscellaneous. Both count and money amounts are stored in memory for later reporting. This key is normally used to price any item not preset on the keyboard.

(15) **"SIK" (Credit Customer) Keys** - The user can enter and identify ten categories of subsistence-in-kind (SIK) customers:

(a) Local SIK (Meal Card)

(b) Air Force Transient

(c) Army

(d) Navy

(e) Marines

(f) Air Force Reserve

(g) Air National Guard

(h) Three "Other" Keys (blank categories to be defined by user, as needed)

Data entered about the most recent credit customer are stored in memory for later reporting by category for each meal period. The data include identification number, dollar amount of sale, and seconds, if any.

When the local "SIK" (meal card) category is used, the workstation can accept a six-to-ten-digit number and can print it on a customer receipt and on an audit tape. In addition, the transaction is recorded in memory so it can be summarized in a management report. A "SIK" sales transaction can not be completed and recorded without entry of an identification number.

When other categories are used, the workstation can identify each credit customer by identification number and category on the customer receipt and on the audit tape.

(16) **Key Lock Controls** - The workstation provides for two levels of key lock control:

(a) **Management Level** - performs the following functions:

- Sets date and time.
- Changes price.
- Changes item description.
- Accesses/deletes record of all over-rings.
- Accesses various management reports.
- Clears the system daily or after each meal except for control totals.
- Accesses "read" modes that print a portion of memory, such as menu price item count and cashier totals, without clearing or affecting the information stored.

(b) **Cashier Level** - only locks and unlocks the workstation.

(17) **Communication Capability** - The workstation can communicate with a minicomputer using the Electronics Industry Association (EIA) RS-232C electronic protocol with asynchronous characters formatted into messages. This two-way communication allows for polling on a real-time basis for access-control meal card verification. After the meal period, this feature transfers summary statistics and meal accounting information to the minicomputer. It can have, as a minimum, 300 baud, 1200 bits per second (bps), and 4800 bps communication rates. In addition, it can provide remote communication via modem over twisted pair telephone lines.

(18) **Audit Tape Printer** - A regular wide cash register tape duplicates the data recorded on the customer receipt; contains an entry for each change in the menu item/price program, including the date and time of the change; and includes a warning/stop feature to allow management to change the tape before it runs out.

The food service workstation's software performs the following functions:

(1) Maintains check-out line operations for menu item inventory, menu price, and credit and cash transactions.

(2) Provides access control/entitlement verification from the minicomputer through a user-provided application program.

(3) Stores summary sales data by meal for each customer.

(4) Using its negative validation, identifies lost, stolen, or invalid identification numbers entered at the workstation; and using its lockout feature, prevents all non-cash sales from being rung up. (Cashiers can override this lockout feature, but each override action must be recorded and identified on the audit tape.)

(5) Allows input of changes and updates (e.g., of prices and item descriptions) through the keyboard.

(6) Supports the following food services point-of-sales reports:

(a) **Revenue Report** - contains the following information:

- Number of times the workstation has been cleared due to a shift change
- Void count
- Dollar amount of voids
- Delete (over-ring) count
- Dollar amount of deletes (corrected over-rings)
- Miscellaneous dollar amount
- Miscellaneous transaction count
- Surcharge dollar amount
- Surcharge count
- Total "no meals" count

- Total number of cash customer transactions
- Gross dollar amount (cash customers)
- Total contractor meal count
- Breakdown into ten "SIK" (credit) customer categories by count and dollar amount
- Total "seconds" count

(b) **Item Sales Report** - contains an inventory of each preset menu item, the quantity sold by item, and the price per item.

(c) **Half Hourly Report** - contains a list of the total cash customers and meal card customers by the half hour.

(d) **Meal Card Report** - contains a list of "SIK" sales amounts by identification numbers.

(e) **Customer Receipt** - contains the following information:

- Date, time, transaction number, and total sales amount
- Customer identification number and type of "SIK" transaction (if applicable)
- Each menu item and its price with numeric and a minimum of six alphabetic character descriptions
- Total dollar amount of the customer transaction

(7) Provides an audit tape that duplicates the data recorded on the customer receipt, and contains an entry for each change in a menu item and menu item price, including the date and time of each change.

Each unit in service has a powerline filter or equivalent to protect the workstation from voltage fluctuations that would impede performance during a real-time identification number validation procedure. Additionally, each unit can operate at a 100-percent duty cycle for a minimum of 4 hours, ensuring uninterrupted customer flow during a power outage at the workstation. In event of a power outage, pulled plug, or a malfunction in the uninterruptible power supply (UPS), the workstation protects all totals, programs, and menu prices.

3.3.1.3 Languages

AMMUS supports three programming languages: COBOL, FORTRAN, and BASIC. Each of these languages not only meets its respective standard, but also exceeds it by providing syntax in the language to support full-screen, block-mode access to the terminals. Furthermore, FORTRAN and BASIC support syntax to define and use relative files and indexed-sequential files for input and output. (AMMUS supports Assembler in isolated instances to provide native mode access requirements, but AMMUS does not support this language for most of the ESIMS applications at most E&S locations. For example, HQ AFESC used Assembler to gain access to the network file transfer operating system service call in COBOL so that it could use a single printer on one system to serve two systems clustered supporting the whole center.)

3.3.1.4 Development Tools

AMMUS provides development tools that generate COBOL source code for simple screen definition, simple update programs, two-file reports, and general purpose macros. These tools provide many lines of COBOL source code per screen of definition for use in WIMS and SIMS applications. These tools also permit end-users to compile and link sets of source code files into programs automatically. The tools include a full-screen, windowed, and fully symbolic debugger that supports each language in its source syntax. The menus are supported in two forms: as a complete program (which can be obtained in source code form) and as a file that defines the menu.

3.3.1.5 Vendor Applications

Vendor applications include the calendar functions, advanced E-mail packages, and the menu system provided in Wang Office. All of these applications are specified as separate requirements that allow the vendor to repackage them in different groupings, provided the functionality is maintained.

3.3.1.6 System Support

AMMUS supports the following functions: performance management software, an application to consolidate the disk space used into a less fragmented surface, a backup and restore program, and other operating system functions with enhanced capabilities. All features, including the operator and System Security Administrator (SSA) functions, use a full-screen, fill-in-the-blanks human-machine interface, which allows the end-user to be the operator and the SSA with little training.

3.3.2 Communications

ESIMS has protocols and communications interfaces that allow end-users to communicate with systems in Supply (SBSS), Transportation (OLVIMS), Accounting and Finance (BQ), Contracting (BCAS), Personnel (BLMPS), NAFFMO (NAFMIS), and the Commissary (CAMNET and ACOS).

The system is capable of communicating with a variety of protocols - asynchronous (teletype), IBM 2780/3780, IBM 327X, X.25 commercial packet networks, the DDN full-suite service, and others.

On a base, network communications are computer-to-computer (i.e., between the minicomputers at the various ESIMS nodes). The various minicomputers are linked by a single dedicated synchronous line, but AMMUS provides no routing around failed primary links.

Between bases, DDN provides communications; it provides selected file transfer and E-mail between modem-equipped minicomputers. The lead minicomputer at one of the nodes may be configured as a DDN interface, with a single link to DDN.

Communications facilities are available on minicomputers and workstations to enable users to communicate with computers/ workstations and with each other for messaging and file service through computers. Each workstation is a node on a star network, with the minicomputer providing all resources, including communications. All workstation-to-workstation communications are mediated by the minicomputer, across the synchronous connections.

3.3.2.1 Super Minicomputer Communications

The minicomputers communicate in two modes and can interface with at least 30 communications lines:

(1) **Computer-to-Computer** - The minicomputers communicate with each other via three Government-furnished voice-grade lines, half-duplex or full-duplex, two-wire, four-wire, or dial-up. These communications have the following characteristics:

  (a) Data transmission rates of 300, 600, 1200, 2400, 4800, 9600, and 64000 bps

  (b) Synchronous, asynchronous, high-level data link control (HDLC), i.e., IBM; synchronous data link control (SDLC), i.e., IBM; X.25 modes; DDN full suite; and Ethernet (broadband and baseband)

(c) EIA RS-232C, RS-449, or EIA RS-366 hardware interfaces

(d) Point-to-point and multipoint network communications, either as a terminal emulator or as the network host

(e) Auto-answer and auto-dial functions

(f) Appropriate modems, all of which have compatible automatic calling units (ACUs), according to location:

- For on-base use (distances less than 10 miles), short-haul modems are used.

- Inside CONUS, Codex modems with speeds of 1200, 2400, 4800, 7200, and 9600 bps are used.

- Outside CONUS (OCONUS), the modems certified for use in the host country are used.

(2) **Computer-to-Workstation** - Each workstation can communicate with a host computer using the EIA RS-232C electronic protocol with asynchronous characters formatted into messages. Each workstation has, as a minimum, 300, 1200, and 4800 bps communication rates. Additionally, each workstation has remote communications via modem over telephone lines.

For on-base use, short-haul modems (for distances less than 10 miles) and/or concatenation, bridging, or multiplexing equipment are provided. In the same building, communications use dual coax with a data rate of 4.77 megabits per second.

For the food service workstation, this two-way communication allows real-time polling for access control and meal card verification, and, after the meal period, allows transfer of summary statistics and meal accounting information to the host computer.

3.3.2.2 Workstation Communications

Workstation communications are limited to two-way communication with a single minicomputer. These communications serve two functions:

(1) **Workstation-to-Computer** - These communications consist of file transfers only. File transfers to the workstations are typically screen displays. File transfers to the minicomputer are either interrogations or data updates.

On engineering graphics workstations, work files can be transferred for storage on the minicomputer or manipulation at the workstation.

(2) **Workstation-to-Workstation** - These communications exist only as file transfers to an intermediate minicomputer, which relays files from the source workstation to the destination workstation.

To support the required response times and the IGS file-sharing scheme, each workstation is a node in a star network and communicates to its respective host via a single coaxial link at a data rate of 4.77 million bps.

3.3.2.3 Communications Software

The communications software controls all communications components and performs the following functions:

(1) Permits designated consoles and designated users to broadcast to all workstations and to selected workstations without receiving action from the workstation operator.

(2) Logically connects and disconnects designated devices on demand.

(3) Allows all application programs to communicate with all workstations on-line.

(4) Translates ASCII and EBCDIC character codes.

(5) Provides auto-answer and auto-dial capabilities.

(6) Interfaces the programmable workstation (when on-line) with the host in the normal host workstation mode.

(7) Provides protocols to interface with Phase IV UNIVAC (2780 inverted software in U-1100/60), Honeywell 6000 (GERTS I), CDC 171-XX (CDC mode 4A), IBM (2780, 3780, and 3270 terminal emulation), IBM (HASP), and TTY emulation.

(8) Complies with the following protocol specifications:

MIL-STD-1777, Internet Protocol (IP)
MIL-STD-1778, Transmission Control Protocol (TCP)
MIL-STD-1780, File Transfer Protocol (FTP)
MIL-STD-1781, Simple Mail Transfer Protocol (SMTP)
MIL-STD-1782, TELNET Protocol

(9) Supports both dial-up and hard-wired communications lines.

3.3.3 Security

The SSA controls access to the minicomputer, the operating system programs, and all user programs, and allocates and controls all peripherals and resources. Entry to the computer room is restricted by a cipher lock.

ESIMS use on the terminals linked to the minicomputer is restricted to authorized passworded individuals. Each authorized user is assigned access to a range of ESIMS resources determined by the local SSA. Privileges and resources not specifically permitted are absolutely denied. Only the SSA, a privileged passworded user, is able to designate users and assign passwords. The overall system security of the AMMUS minicomputer and the terminals linked to it approximates the C2 level specified in DoD 5200.28-STD, Department of Defense Trusted Computer System Evaluation Criteria. However, the AMMUS machines have not been certified by the National Security Agency (NSA) for any of the levels specified in DoD 5200.28-STD.

When used in stand-alone mode, independent of the minicomputer, each of the stand-alone workstations operates as a dedicated system, offering virtually no security protection. The support software for the operating system of these workstations provides no user security, i.e., user identification and a user-application profile for each user. In stand-alone mode, these workstations operate at the D level, which is an uncertified classification.

3.3.4 Physical Plant

The physical plant consists of the minicomputer site, the workstation locations, and the network installation.

3.3.4.1 Central Processing Site

Each node's minicomputers are located in a separate uncarpeted, air-conditioned computer room, which has been designed to facilitate maintenance. AMMUS protects against power outages for up to 8 milliseconds.

3.3.4.2 Workstation Locations

Remote equipment is installed at various office locations within the E&S organizations. Workstations, storage devices, office printers, and modems fit on normal table tops or desk surfaces.

Conventional electrical power outlets (standard three-prong grounded within CONUS and standard two-prong grounded in some OCONUS locations) are required. Table 3-1 shows the voltages and frequencies available in different countries. The equipment is kept free of static discharge.

TABLE 3-1 FACILITY ELECTRICAL POWER

SITE	VOLTS	PHASE	WIRE	HERTZ
All U.S., Guam, Canal Zone, Korea, and Okinawa	120/240	1	3	60
Republic of the Philippines	120/240	1	3	60
Puerto Rico	120/240	1	3	60
Japan	100/200	1	3	50/60
Turkey	220	1	3	50
All other sites	220	1	3	50

Tolerance: Voltage ± 10%, Frequency ± 0.5 Hz

No cooling is provided specifically for the workstations and printers. They operate in a normal office environment where the temperature is between 60 and 90 degrees F and the relative humidity is between 20 to 95 percent, non-condensing. No special dust control is needed. The equipment operates at altitudes from sea level to 8,000 feet.

3.3.4.3 Network Installation

The network installation follows a star configuration and has dual coax as the transport medium for local workstations. The installation uses a Wang-unique version of X.25 for remote terminals over telephone lines.

The system communicates with a variety of protocols (IBM 2780/3780, IBM 327x, X.25 commercial packet access, DDN full-suite service, and others) used by the business world, such as vendors, suppliers, and contracting firms.

Almost all of the monochrome terminals that are dependent on the minicomputer are connected to the minicomputer with high-speed coaxial cable at a rate of 4.77 million bps. Each of the stand-alone workstations is connected to the minicomputer by a single unshared coaxial cable pair.

Section 4
Capability Shortfalls

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4 CAPABILITY SHORTFALLS

The E&S Information Management System (ESIMS) purchased under the Air Force Minicomputer Multiuser System (AMMUS) contract does not cost-effectively support the E&S missions and customers because it will not permit an automated business, as defined in Section 2.3. That is, there are still many functions that are either not supported at all, are not adequately supported, or operate on incompatible equipment (see Section 4.2.3 for a full discussion). Automating the many functional areas that fall into these three categories, however, would significantly increase the demand for an already overburdened system. Until E&S becomes a truly automated business, it will not be able to provide its customers the quality and extent of products and services they need to support their missions within the constraints of the reduced budgets and personnel quotas projected for the balance of the decade.

This section assesses the many capabilities of the ESIMS described in Section 3 from the customer, end-user, and technologist perspectives and identifies the areas where the current ESIMS does not adequately support the functions described in Section 2.2.

Where implemented and used, the ESIMS described in Section 3 has significantly improved the efficiency and effectiveness of E&S personnel. This success has, in turn, generated a large demand for workstations, disk storage, business color graphics displays, and engineering graphics. The existing AMMUS equipment, which permitted installation of acceptable systems in 1984, lacks the performance, interoperability, and capacity necessary to satisfy this unanticipated demand.

Because it uses dated technology, the current AMMUS hardware cannot support the functionality and capacity needed to meet current demand, much less the demand generated by a fully automated system. For example, at most bases, the AMMUS central minicomputer will accommodate only 128 workstations and a total of 178 ports for workstations, printers, and data communications. Exceeding that limit means replacing the central minicomputer. Workstation upgrades are also necessary; that is, most users currently use terminals that have no central processing unit (CPU), memory, or disk storage. Consequently, they must rely on the central minicomputer for these facilities. On ESIMS nodes with many users and heavy system workloads, such reliance causes unacceptably long response times (significant delays for the individual end-users), resulting in summary judgements such as "WIMS is maxed out" or "SIMS is maxed out." Because of these delays, users may become frustrated and seek alternative methods for accomplishing their work, resulting in a database that is incomplete and inaccurate.

As ESIMS evolves and automates more E&S functions, the demand for automated information handling at most base-level E&S organizations will exceed the capabilities of AMMUS. Thus, these bases will be unable to function effectively using only the existing AMMUS hardware.

Although it may be argued that the growing demand for higher capacity can be met by the purchase of upgrades, the provision for such purchases under the AMMUS contract expires in 1991. Even with upgrades, AMMUS cannot support the critical requirements needed to maintain ESIMS during combat and other crises:

(1) **Easy Deployability** - The future missions of E&S will require computer systems that can be deployed to the operations site. This requirement is essential during combat. If some of the E&S personnel at a base are assigned to a deployment or forward operating location, they will be required to "unplug and go" with whatever hardware needed to support that activity. Only the AMMUS workstation concentrator (a Wang VS5000) is portable; none of the others can be deployed.

(2) **"Peel-Down" Architecture** - This requirement, which is essential during wartime and other crises, provides for **prioritized loss of functionality to match the available processing capacity**. Work that must be interrupted is saved in a recoverable state. Peel-down architecture allows gradual shedding of less critical functional loads while maintaining essential services (see Figure 4-1).

(3) **"Graceful Degradation"** - This requirement responds to loss of hardware by **redistributing the functions to other available equipment and/or by reducing the level of performance while preserving all functions** (see Figure 4-2). Hardware being used for less essential wartime functions can be used as replacements for battle-damaged equipment and/or to restore processing performance.

(4) **Redundancy** - To maintain data currency if the system is taken off line, E&S must be able to replicate data files across separate systems (i.e., duplicate databases and multiple communication channels), preferably located outside of blast distance from each other.

(5) **Interoperability with Other Air Force Logistics Functional Components** - The Air Force has approved a communications-computer systems (C-CS) architecture to provide this interoperability, but AMMUS hardware in its current configuration is unable to support transition to that architecture. Additionally, the AMMUS

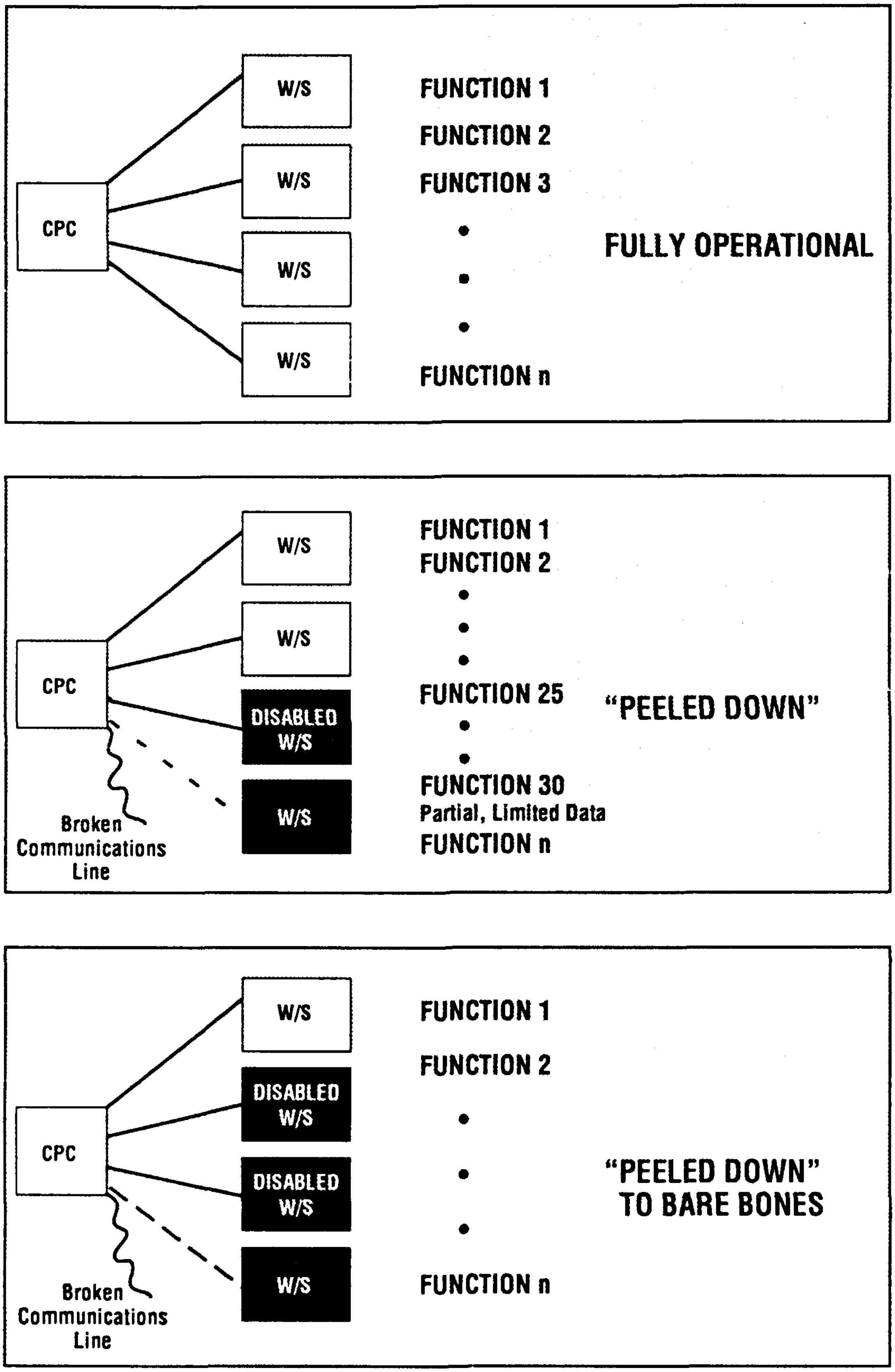

FIGURE 4-1 PEEL-DOWN ARCHITECTURE

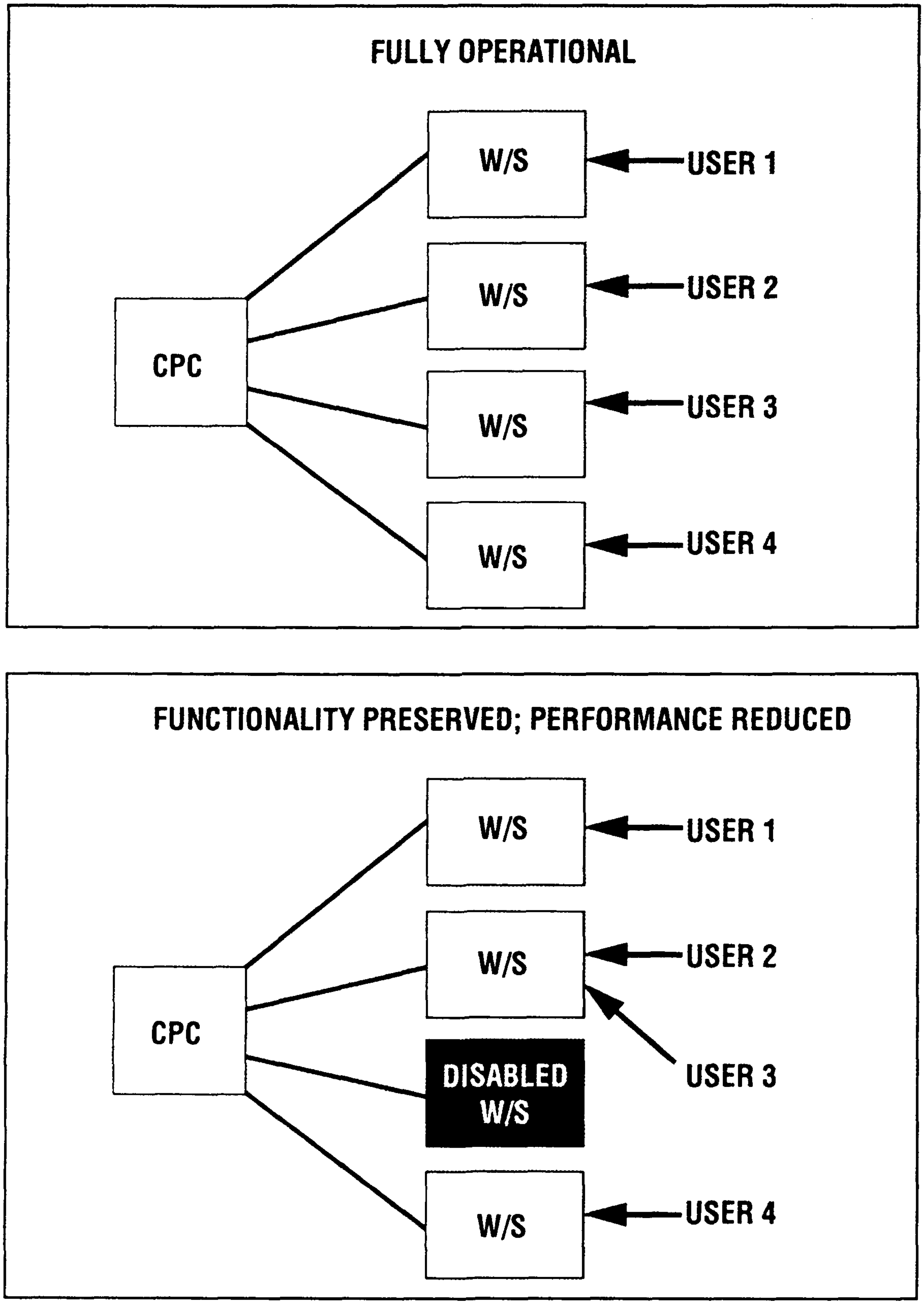

FIGURE 4-2 GRACEFUL DEGRADATION

communication hardware-software combination will not permit direct connection and smooth integration of the E&S electronic mail (E-mail) system to that of the other logistics functional components.

Furthermore, none of the available AMMUS super minicomputers nor many of the AMMUS workstations are able to take full advantage of the current commercial off-the-shelf (COTS) system software features, such as Engineering Tools, X-windows and desktop publishing. COTS products offer more capabilities and are easier to use, faster, and more quickly provided to the end-users than those available with AMMUS ESIMS.

Finally, the AMMUS hardware, like any other hardware, will require progressively more maintenance as it ages, but the existing maintenance contract with Wang Laboratories expires in 1994. Because of the unanticipated changes in technologies and economic conditions in the computer industry in general and at Wang in particular, E&S may not be able to renew its maintenance contract with Wang. In such an event, follow-on vendor support (i.e., additions, replacements, and maintenance) of this hardware and the associated operating systems would have to be acquired from a third-party vendor through the competitive contract process, resulting in delays and risk of non-support.

The specific shortfalls that have prevented E&S from becoming fully automated are discussed in the following subsections: Section 4.1 discusses the shortfalls in the products and services delivered to E&S customers, Section 4.2 addresses the functional applications and interfaces not available to or not used by the end-users, and Section 4.3 describes the deficiencies in hardware and software needed to support the end-users. Shortfalls to the customers imply shortfalls for the end-users or for the technologists. Shortfalls for the end-user usually imply shortfalls for the technologists. Because the technology shortfalls are the basis for the Future ESIMS requirements specified in Section 5, there are many cross references in the customer and end-user perspectives to the specific subsections in the technologist perspective that explain the technology shortfall that underlies the customer or end-user shortfall.

The ESIMS shortfalls appear on two levels:

(1) **Baseline Environment** - Those shortfalls that have already been identified and those anticipated before the baseline ends in 1995. The following sources were used to identify the baseline shortfalls:

(a) The Air Force Management Engineering Agency (AFMEA) study, The Organizational Impact of WIMS and SIMS on Base-Level Services Units (March 1990)

(b) Field interviews

(c) Technologist interviews

(d) Existing AMMUS contract requirements

(e) Air Force Information Systems Division (HQ LGXS) supported policies

(2) Future Environment - Those shortfalls that are projected between 1995 and 2010 based on a long-range planning process outlined in a draft report titled Future Vision: Taking Charge of Our Future, 14 July 1989. The Future Vision document identified numerous future trends that will affect the Department of Defense (DoD), the Air Force, and E&S as they carry out their missions. These trends span eight areas:

(a) Human factors

(b) Air Force operations

(c) Space operations

(d) Technology

(e) Energy

(f) Environmental engineering

(g) Services

(h) Acquisition

Thirty-three of these trends are listed in Table 4-1 (Page 4-62). Each of the three perspectives contains a Future Vision subsection (Sections 4.1.2, 4.2.4, and 4.3.5) that discusses the ESIMS shortfalls that derive from these trends. Because these shortfalls are projected well into the future, they are discussed in terms of the ESIMS capabilities needed to prepare E&S for the Future Vision trends.

Table 4-2 (Page 4-66) lists the required capabilities that are either inadequately supported by AMMUS ESIMS or not supported at all, and the information sources that identified each shortfall. These shortfalls are groped in 11 general categories that correspond to many of the major headings in this section, particularly those in the Technologist Perspective.

4.1 CUSTOMER PERSPECTIVE

As stated in Section 3.1, E&S customers are Air Force Headquarters (HQ USAF); the tenant organizations (i.e., the Wing Commander, et al.); the other Logistics functions (i.e., Supply, Munitions, Maintenance, and Transportation) at the base, major command (MAJCOM), and HQ levels; and all of the permanent and transitory personnel and visitors on a base.

A major ESIMS shortfall from the perspective of HQ, the tenant organizations, and the other Logistics functions is that ESIMS is unable to adequately support the E&S missions during combat and other crises, severely restricting E&S's decision-making ability and manpower effectiveness during these situations. (The technological shortfalls preventing this capability are discussed in Sections 4.3.1.1.1, 4.3.1.2, and 4.3.4.)

It is very difficult for Billeting to provide connectivity to the home station computers of transitory personnel and visitors because of the limited number of workstations supported by the AMMUS super minicomputer and the incompatibility of the AMMUS communication protocols. For the same reasons, Billeting's ability to make remote reservations for official trips by permanent personnel is also limited. (The technological shortfalls preventing these capabilities are discussed in Sections 4.3.1.1.3 and 4.3.2). Billeting customers cannot access the reservation and accounting systems via an 800 number or use the Defense Data Network (DDN) to access E-mail on their PCS computer system.

Another major shortfall is this definition of customer; it is too narrow. The success of AMMUS ESIMS and the satisfaction of those customers who receive ESIMS reports in addition to the products and services traditionally provided by E&S has generated new customer demand for ESIMS. The Army, Navy, Congress, and other Government agencies (such as the Environmental Protection Agency) want on-line access to ESIMS data so that they can track E&S activities more closely and can receive reports directly and automatically. AMMUS ESIMS, however, cannot satisfy these customer demands because it does not have appropriate communications ability. That is, it is not compatible with other Government systems; the technology shortfalls preventing ESIMS compatibility are discussed in Sections 4.3.1.1.2 and 4.3.2.

4.1.1 Interoperability Shortfalls

The following ESIMS services are not currently available to E&S customers (both the traditional ones and the potential ones) because AMMUS is not compatible with other systems:

(1) **Reporting** - Because AMMUS lacks computer-to-computer interfaces in high-level languages (see Section 4.3.1.4.1), E&S cannot automatically exchange reports and queries with higher levels of authority and with outside agencies. As a result, the customer has to manually run the report and attach its printout to an E-mail package for delivery, a time-consuming process. An example of where this type of exchange would be beneficial is the Air Force construction projects that are managed by the Air Force Regional Civil Engineers (AFRCEs), in conjunction with HQ-SAC/DEE, but performed by the Army Corps of Engineers and the Navy.

(2) **Request Generation** - Not all bases have the ability to use more than two files in a query without having to write an application using an automatic code-generation tool. There is no automated support for querying databases across multiple machines for information without human intervention. Without this capability, E&S has great difficulty preparing special information requests for its customers.

(3) **Coordination of Resources** - Many of the E&S customers within the Air Force lack direct access from their stations to information they need in ESIMS. For example, the Air Force is required by public law and Environmental Protection Agency (EPA) regulations to investigate hazardous waste spills for which the Air Force is responsible. However, Air Force budgeting, planning, and reporting systems cannot electronically access E&S HAZMAT cost estimating information in ESIMS

E&S customer services also suffer because the lack of coordination of ESIMS resources within E&S. That is, while each functional area within E&S has access to its own data, there is no universal graphical database, such as the Base Comprehensive Plan, that links all graphic information about the base and enables queries to the data processing files for lists of past, present, and future data. For instance, Environmental Engineering needs to track all hazardous materials (HAZMATs) brought onto a base. To ensure the safety of everyone on a base, it must know where the HAZMATs are stored, where they are used, and their final disposition. In the event of a fire, this branch needs access to location of spills, location and direction of plume, and locations of surface and groundwater so that it can clean up the spill before it becomes an environmental hazard. The Fire Department also needs this information so that it can minimize danger to its personnel and everyone on a base during a fire and can minimize the cleanup activities.

(4) **Data/Document Transfer** - Although AMMUS E-mail can transmit graphics, voice, and text, it cannot transmit them in a single integrated document. AMMUS E-mail is not completely compatible with other forms of Air Force E-mail. As a result, E&S personnel cannot exchange E-mail messages with all of its customers. (See Section 4.3.2.)

(5) **On-line Request Submittal and Status Monitoring** - Because AMMUS lacks software interfaces (see Section 4.3.1.6.5), E&S customers cannot electronically access ESIMS to submit workorders or check the status of the work. That is, customers cannot ascertain progress and expenditures to date, funds committed but not used, and balance of allocation for the project, nor can they determine the implications of the loss of funds. Customers can receive the necessary workorder and project information more quickly and accurately when they can readily obtain it without human intervention. Furthermore, subsequent unnecessary expenditures may be averted when problems are detected early during on-line monitoring.

4.1.2 Future Vision

This section discusses the customer shortfalls projected between 1995 and 2010 based on the long-range planning process outlined in the Future Vision document. These shortfalls are listed according to the numbered trends in Table 4-1.

The following shortfalls derive from Future Vision trends 1 and 2 (see Table 4-1). They involve the aging of the workforce, the decrease in professional and scientific degrees and lower general education level, and the related difficulties in recruiting career personnel.

ESIMS Shortfalls (TRENDS 1,2):

Because the workforce will have little or no experience with computers and/or little higher education, a sophisticated training program will be needed. Training should be accomplished through courses and state-of-the-art computer-aided-instruction (CAI) packages, on-line context-sensitive "HELP" procedures, etc. The hardware technology in use in the field should be used to provide color, video, and audio capabilities for all training media. More development of user interfaces and error detection is needed.

The following shortfalls derive from Future Vision trends 3, 4, 7, and 8 (see Table 4-1). They involve the reduction in overseas bases, the basing mode for land-based ICBMs, SDI implications, maintenance of aging air bases and facilities, uncertain air basing prospects, force projection from bases within the continental United States (CONUS), base recovery after attack, and worldwide low-intensity-conflict situations.

ESIMS Shortfalls (TREND 3):

This trend will increase the need for tenant organizations to share their base facilities. Customers will need to provide Civil Engineering (CE) and Services (SV) with their new requirements for the base to allow E&S to accommodate their needs. This will require more coordinated planning to accommodate forces returning from overseas bases, distribution of E&S assets and resources, and reallocation of MILCON.

ESIMS Shortfalls (TREND 4):

This trend will increase the need for bases to maintain older facilities and equipment. Maintenance of older facilities will increase in cost. Cost-benefit analyses will need to be performed to justify maintain/abandon decisions. There is no automated support for this activity. An automated Base Comprehensive Plan is necessary to facilitate design decisions and incorporation of as-builts into the Base Comprehensive Plan.

ESIMS Shortfalls (TREND 7):

The CE community must participate in the evaluation of SDI proposals. CE must assess feasibility to support the proposed systems and to prepare for construction, housing, and support of the facilities and crews in deployed systems. If satellite-borne systems are to be manned, the SV community must prepare means of providing food, lodging, laundry, and force management services.

ESIMS Shortfalls (TREND 8):

To support troop deployments and ad hoc air bases in any location, CE and SV functions must be deployable. ESIMS must continue to build the capability on each base to quickly report and assess damage, to identify useable resources and facilities, and to initiate the best repair efforts possible. Integration of CE data with the Base Comprehensive Plan will enable CE personnel to respond rapidly and effectively to most levels of damage/sabotage and resource deficiency.

The following shortfalls derive from Future Vision trends 12 and 13 (see Table 4-1). They involve establishing Air Force facilities on the Moon, on Mars, and on orbiting platforms. While the exact time frame for when these facilities shall be in place is still undetermined (due to budgetary issues), CE must still be prepared to provide the infrastructure to integrate space operations into the Air Force structure. This will require the allocation of development resources to provide the necessary software development and implementation.

ESIMS Shortfalls (TRENDS 12,13):

To operate in these hostile and remote environments, CE must participate in the design of closed-loop life support facilities, including mission-related facilities, housing, water purification, waste treatment, air purification (oxygen manufacturing), lighting, power generation, and repair shops. Very close tracking of inventories, order lead times, personnel resources, service lives of equipment, and other related information will require an enhanced automated information system. This may require additional ruggedization of some models of the hardware.

The following shortfalls derive from Future Vision trend 14 (see Table 4-1). They involve the increased power built into software, faster processing, lower hardware costs, availability of memory, slow software development, developments in input/output devices, and uninterruptible power supply (UPS).

ESIMS Shortfalls (TREND 14):

Maintenance of the information resource will become more automatic, both decreasing the time required to update the information and increasing the requirement for accuracy and completeness. Tactical and economic decisions will rely increasingly on automated information, making the integrity of the information mission-critical. The information resource will become as attractive a target for sabotage as aircraft and radar equipment. Data security will become a tactical issue.

The following shortfalls derive from Future Vision trends 17 and 18 (see Table 4-1). They involve the shortage of power generation plants, increasing demand for electricity, and cogeneration of power. These capabilities are defined to be real property installed equipment. However, interoperability is needed to read the status and/or input data to any of these systems from any workstation on the ADPE system.

ESIMS Shortfalls (TRENDS 17,18):

CE will institute major conservation efforts, which will include monitoring of use, scheduling of power-intensive activities to avoid peak loads, and re-engineering of facilities to conserve power and heat. CE will be called upon to manage the design and production of small Air Force owned/leased power generation systems, which may include solar, wind, and water power. These systems will serve to reduce peak load demands on commercial power, and as a reserve for emergency conditions.

Prioritized load shedding during peak usage requires automatic notification of the affected facilities, buildings, and/or base sectors of the load shedding procedures, with remote manual shutdown capability. To eliminate peak power penalty charges, the future computing environment is required to provide advance notification to the base power generation systems to allow the generators to come on line when needed, and to shut down at the appropriate time.

Systems which implement these functions will need to be able to interface with the energy management control systems package,which is already in place.

The following shortfalls derive from Future Vision trends 19, 20, 21, and 22 (see Table 4-1). They involve municipal development, waste disposal and minimization, and the growth of responsibilities in environmental engineering. AMMUS does not allow automatic data gathering from waste disposal and other environmental systems. Future ESIMS must perform automatic data gathering.

ESIMS Shortfalls (TREND 19):

Air Force facility planning and management functions will incorporate municipal and regional planning skills, and will require regular interaction with local planning authorities. ESIMS must support extraction of data to meet specific public demands and to highlight specific points. The ESIMS recycling system will support a consistent and effective recycling effort which will support local businesses and contribute to the local community.

ESIMS Shortfalls (TREND 20):

Waste treatment plants will require engineering and retrofitting to meet new standards. CE will be responsible for evaluating, planning, and implementing changes in the base waste treatment facilities. Automation of this activity will help E&S personnel with project planning and acquisition, management, and monitoring of contractor services.

Output of the waste treatment plant will be recycled or disposed of according to EPA guidelines. Both of these processes will use purified water, and the recycling process will recover expensive chemicals. ESIMS must track all of the products involved in both processes, including their storage, distribution, use, and final disposition.

The ESIMS recycling system will support proactive recycling programs at each base. One effect of these programs will be to enhance the image and public confidence in each base and in the Air Force generally.

ESIMS Shortfalls (TREND 21):

E&S must help develop waste minimization, detection, and prevention techniques for hazardous and toxic wastes. Waste minimization involves identifying and developing safer substitutes for hazardous and toxic materials, developing and implementing cleanup procedures, and physically reducing bulk contaminated material through chemical and organic processing. ESIMS must include data acquisition, modeling, and planning software for effective operation and management of a waste minimization program.

E&S must produce a viable recycling system plan which will identify recyclable commodities (such as paper, plastic, rubber products, organic solvents, contaminated fuels, metals, and wood) that can be economically collected and sold, thus making the process self-supporting at a modest "profit." Profits from the sale of recycled commodities are to be returned to the Air Force through established channels for redistribution. To this end, E&S must develop and maintain interfaces with the local recycling industry, and must establish a viable system to collect and dispose of the recycled commodities.

E&S will acquire contractor support for this activity. Using its management and accounting systems, E&S will also oversee the implementation of the recycling system and provide an audit trail for funds collected and distributed.

ESIMS Shortfalls (TRENDS 22):

Renovation of facilities will involve the removal of asbestos insulation, which is a carcinogen. Safer materials will have to be substituted to provide the soundproofing, insulation, and fireproofing qualities. Renovation of facilities will also involve retrofitting of insulation, efficient heating and cooling systems, and other energy conservation measures.

Environmental impact studies must be scheduled and performed to avoid future environmental tension between the military and local and regional governments.

The following shortfalls derive from Future Vision trends 23, 24, 25, and 26 (see Table 4-1). To remedy these shortfalls, E&S must effect improvements in food service, subsistence in space, automation in the lodging industry, mass casualty procedures, space casualty handling, and privatization. The facilities automation requires real property installed equipment (RPIE) that automatically reports its results to the central processing computer (CPC) for management decision processes.

ESIMS Shortfalls (TREND 23):

SIMS contingency planning capabilities should include the ability to assemble a nutritious menu to feed a large number of in-transit troops on short notice from existing stocks.

ESIMS Shortfalls (TREND 24):

The emergence of debit cards and the popularity of credit cards points to the opportunity to use this technology at the point-of-sale terminal to speed up checkout (if implemented properly), increase the accuracy of accounting, and further reduce the possibility of cash theft.

For in-transit personnel or others with temporary entitlement to food services, a magnetic strip debit card (similar to that used in the Washington, D.C. Metro system) can be issued and used to grant and control access and use.

Templates and training must be provided to show kitchen staff how to specify the sequence of automated and manual operations, how to gather data to use for process control, and how to use SIMS planning data to drive the unified operation.

Local or regional automated food preparation will provide opportunities to purchase in bulk quantities, and to create individual portions without intermediate packaging or handling. The larger quantities will increase the chance of error, thereby requiring automated inventory management and computer-aided planning.

Automated systems should provide not only for optimized routine service, but must also for extended production to support crisis operations.

ESIMS Shortfalls (TREND 25):

SV will provide additional in-transit services such as computer terminals or connections in guest rooms. This will require retrofitting of existing facilities to provide communications to the rooms, and system administration and accounting procedure modifications to enable each guest to access the system at their PCS base. This provides communications with the guest's PCS base.

Sensors installed in the rooms will detect the presence of occupants, making possible energy conservation and increased security.

Automatic checkin and checkout can reduce the time required for in-transit activities, as well as increase the accuracy of the data maintained in the system. The use of credit, debit, and smart cards will enhance this alternative to the manual process.

ESIMS Shortfalls (TREND 26):

Use of contractors and consultants requires Air Force presence for policy, financial, supervisory, and regulatory issues. The Air Force must provide validation, verification, and quality control.

The following shortfalls derive from Future Vision trends 30 and 31 (see Table 4-1). They involve reading RPIE, contract management, build-lease acquisitions, computer support, and force projection.

ESIMS Shortfalls (TREND 30):

Use of contractors and consultants requires Air Force presence for policy, financial, supervisory, and regulatory issues. The Air Force must provide validation, verification, and quality control.

ESIMS Shortfalls (TREND 31):

Because build-lease reduces the manpower requirement for maintaining the building (vendor maintenance), the emphasis will be on management and contract administration, rather than on physical operations.

Because build-lease contractors will select and install their own environmental control and monitoring equipment (within Air Force specifications only for new buildings), the environmental monitoring and reporting software must be locally modifiable in order to capture data from a wide variety of systems and sensors.

4.2 END-USER PERSPECTIVE

The most widespread shortfall for the ESIMS end-users is training. That is, many E&S personnel have not yet been adequately trained to use these systems. The AFMEA study implies, however, that a significant increase in computer processing workload will result if adequate training is provided to enable full and consistent use of the current software, and that the current AMMUS hardware and system software could not possibly support the workstations and storage capacity required to support the workload. On many bases, even those with fully configured WIMS and SIMS, just this increase in use will exceed the systems' workstation support, data storage, and central processing capacities. In fact, AMMUS hardware and software cannot adequately support the current workload. This shortfall is discussed in detail in Section 4.3.1.1.

The following subsections discuss the other existing shortfalls in the ESIMS human-machine interface (Section 4.2.1), the component application systems (the Work Information Management System [WIMS], the Services Information Management System [SIMS], etc.) (Section 4.2.2), and the application programs available to the personnel in the CE and SV squadrons (Section 4.2.3), and the ESIMS deficiencies expected between 1995 and 2010 (Section 4.2.4).

4.2.1 Human-Machine Interface

Although, as mentioned in Section 3.2.1, every ESIMS end-user has access to a full suite of office automation products in a convenient, easy-to-use-and-learn environment, AMMUS still lacks many of the tools and capabilities that are essential for a truly automated business. For example, AMMUS does not offer enough workstations to support windowing for all end-users. (A virtual workstation is required for each window, and the AMMUS super minicomputer supports only 128 workstations, an insufficient number to fully support windowing and the many applications demanded on a typical ESIMS node.) Windowing allows screen access to two different activities at the same time. It is essential for comparing and transferring information in two different tasks, and for monitoring peripheral activity while performing other tasks. Additionally, the AMMUS operating system interfaces do not comply with current standards (see Section 4.3.1.1.2), denying the end-users the latest available technologies and capabilities (e,g., text-driven commands and pointing-device-driven commands). Furthermore, AMMUS does not provide a "default desktop", a standard keyboard for all workstation levels, text-driven commands, file services within a workstation that allow access to the minicomputer files from within workstation applications, an intelligent context-sensitive "HELP" system, on-line tutorials for all standard applications, or volume control, headphone jacks, a large format monitor (19 inches or greater), or pointing devices for terminals.

There are many features now available in vendor applications that are not available to ESIMS end-users because AMMUS hardware and system software will not support them. Examples include digitized audio attached to the E-mail messages, a phonetic spell-checking option, a grammar checker, extended line-drawing characters and graphics in a word processing document, integrated engineering graphics, and an adequate query capability. (Section 4.3.1.5 contains a full discussion of the vendor application features not supported by ESIMS.) There are also many system support functions not available to ESIMS end-users; these are discussed in Section 4.3.1.6.

Because ESIMS languages and development tools on the AMMUS minicomputer are not compatible with those on the programmable workstations, end-user/programmers are restricted and experience delays in generating code and applications (see Sections 4.3.1.3 and 4.3.1.4).

4.2.2 ESIMS Application Systems

Although both WIMS and SIMS offer applications in most areas of CE and SV, respectively, many E&S personnel do not use them. Major reasons are lack of training and reluctance to be trained. Even easy-to-use computer systems can be quite complicated to those not familiar with them. AMMUS ESIMS lacks the innovative computer-based training (CBT) techniques necessary to solve this problem: multiple-path training curricula involving text, graphics, voice, video on the computer, and a training tracking system which allows managers to monitor progress (see Section 4.3.1.5.5). However, if all personnel not using the myriad ESIMS applications described in Section 3.2.3 are properly trained to use them, the existing AMMUS hardware and system software would be unable to handle the workload (see Section 4.3.1.1).

Additionally, ESIMS does not provide CE and SV supervisors who participate in the budgeting process with analytical tools that support budget planning and execution processes. Statistical and trend-analysis tools would allow the supervisors to access past costs and activities information, enabling them to build baseline information they can use to project future activities and their respective costs. Effective defense of budget items is essential to maintaining the level of service that is expected of the CE and SV organizations.

Furthermore, E&S end-users cannot generate on-line graphical forms and produce hardcopy versions that are acceptable to other organizations within the Air Force and DoD (see Sections 4.3.1.2 and 4.3.1.5.4). Both CE and SV end-users need this capability to support planning duties and capture information efficiently. The forms must have borders, shaded areas, and other formatting aids. The visual format of the on-line version must be the same as the hardcopy version. The on-line version must contain fields keyed to data elements in both the WIMS and

SIMS databases for automated and accurate update and capture. In addition, these on-line forms must be able to retrieve information from word processing documents and from databases on other systems. An imaging capability in the forms creation tool must support inclusion of several types of graphical images (e.g., floor layouts, site plan details, engineering drawing details, and images of photographed damage) either entered explicitly from the user's workstation or drawn from the WIMS database. These engineering images should be editable using the WIMS graphic editor.

Specific shortfalls in the CE systems, SIMS, and the interoperability of ESIMS are discussed in Sections 4.2.2.1, 4.2.2.2, and 4.2.2.3, respectively.

4.2.2.1 Civil Engineering (CE)

Because of costly communications and a shortage of workstations, many CE shops do not have access to WIMS applications. Consequently, shop supervisors lack confidence in WIMS availability, and most shops still maintain manual log books to back up the system. Additionally, some CE shops are not permitted access to the Civil Engineering Material Acquisition System (CEMAS), a purchasing subsystem within WIMS, because the superintendents believe the shops do not have accurate data or are incapable of handling the material ordering process.

The Integrated Graphics System (IGS), a three-dimensional computer-aided design and drafting (CADD) application designed to be used in combination with WIMS, is not a fully integrated system. Because AMMUS super minicomputers cannot intelligently share data with the workstations (see Section 4.3.1.6.5), IGS cannot operate on fully interactive workstations linked to the minicomputer. As stated in Section 3.2.2.1.3, IGS offers only three-dimensional CADD and can operate only in stand-alone mode on 8 percent of the AMMUS programmable workstations and on non-AMMUS engineering graphics workstations. Thus, very few CE personnel have access to three-dimensional CADD capability, and those that do lack access to a Graphic Interface System (CIS) linked to the CADD databases. As discussed in Section 4.2.3.1, this capability would greatly enhance productivity in the Operations and Maintenance branch and in the Engineering and Environmental Planning branch. Without it, the personnel in the Engineering Technical Design section cannot automate the Base Comprehensive Plan, which, complete with its graphics, is the source of the engineering prints used throughout a base.

4.2.2.2 Services (SV)

Because of the way application software is produced in the SV community, some of the SIMS software does not support the end-users' job functions. Unlike the CE community where model software is released to the end-users who tailor it to their needs, SV personnel, particularly those involved with financial accountability and

Privacy Act issues, work mainly with "standard systems" and are not given source code for the software. They must submit changes to programmers at a central development site for implementation sometime in the future. Furthermore, the request for change and difficulty report processes are not automated. That is, the end-users cannot identify the system-code location where the software fails so they can tell the programmer where change is needed. If the end-user could identify the location, there is no way to put that information into a window where the comments can be built, assembled into a package, and shipped to the programmer while the end-user is using the application system. As a result, insight gained by the end-users while working with the applications is never incorporated into the programs, thereby limiting their effectiveness.

4.2.2.3 ESIMS Interoperability

ESIMS end-users cannot easily access information for update and retrieval and cannot seamlessly transfer information from one minicomputer to another. Structured Query Language (SQL) would remedy this shortfall; see Section 4.3.1.5.7.

ESIMS end-users cannot communicate with non-AMMUS nodes at other bases and sites while using most applications. This shortfall is caused by a deficiency in the protocol (TELNET) that provides terminal services within DDN, the wide-area network (WAN) that connects the various Air Force bases and sites. Within full-screen applications, TELNET is difficult or impossible to implement, uses an enormous amount of system resources when activated, and is therefore not available for most applications within ESIMS. The TELNET shortfall is discussed in Section 4.3.2.1.

ESIMS end-users cannot automatically create files for non-E&S users and transfer them to the target system under application control. As a result, E&S supports non-E&S users by building files which are manually transferred to the non-E&S system for processing as desired, creating potential for error. E&S personnel must transfer these files rather than use the Network File System (NFS) protocol to directly share data because direct data sharing makes computer support of organizational change very difficult.

4.2.2.3.1 WIMS Information Flows - WIMS has no real-time automated link with the Standard Base-Level Computer (SBLC) and, thus, no time-sensitive access to supply data, accounting and finance data, or transportation data. There are also no real-time data available on the comptroller functions not located on the SBLC. An automated information flow process between WIMS and the SBLC would provide real-time supply status and access to financial data. Thus, ESIMS needs an enhancement to meet the functional community's needs to exchange data, and to comply with the Air Force standard architecture.

4.2.2.3.2 SIMS Information Flows - The Mortuary Affairs Office cannot electronically exchange information with the Air Force Institute of Pathology, the FBI, the Air Force Office of Special Investigations, or military medical and dental facilities during identification of remains. Interfaces are needed that will transfer E-mail and visual imaging data associated with medical records and criminal reports (see Section 4.3.2).

Food Service cannot adequately exchange data with the Automated Commissary Ordering System (ACOS), necessitating manual ordering and price exchange. The interface with ACOS must be enhanced so that it can send and receive files under application control (see Section 4.3.2). Additionally, SIMS has no electronic interface with the Base Contracting Accounting System (BCAS), preventing Food Service from transferring contract compliance information to Base Contracting and from receiving automated contract management support.

4.2.3 Functional Application Programs

This section addresses the current shortfalls in base-level E&S applications from the perspective of the people who use them to do their jobs. Examples of deficiencies (identified in the AFMEA study, from site visits, and from other sources) are presented in the same CE and SV organizational structure as used in Sections 2.2.1 and 3.2.3.

4.2.3.1 Civil Engineering (CE)

There are many specific application shortfalls in the eight functional areas of CE:

(1) **CCQ/CCF/DEA - Squadron Section/First Sergeant/ Administration** - The WIMS applications in this area have been used very little because of inadequate (if any) training for the personnel, insufficient AMMUS utilities, and failure of the System Security Administrator (SSA) to assign correct file access rights. As a result, the Unit Administration function does not use interrelated data files nor Unit Administration-specific applications. Thus, CE personnel data are not automated.

Unit Administration's applications are not compatible with those of the Publication Distribution Office (PDO), which are written in d-Base, because AMMUS lacks the file-translation services necessary to convert d-Base directly into an ESIMS format (see Section 4.3.1.6.4). As a result, despite computer support, publications management is still a manual operation.

(2) **DEM - Operations and Maintenance** - Some bases are still using manual systems, ledger books, and grease boards for project status information because the operations officers have not been trained to use the WIMS "project status" applications. The operations officers merely need quick access to data summaries without having to interpret data or go to multiple menus to extract the data they need. Various other shortfalls exist in the eight sections of this branch:

(a) **DEMP - Pavements** - This section does not have an application that provides structural analysis of runways and roads. It needs a pavement analysis package, linked to the Base Comprehensive Plan, that provides detailed condition of pavements and substrata. This package should include design programs that can provide a bill of materials that is compatible with the WIMS workorder applications.
All of these applications should include the fully interactive three-dimensional CADD capability and CIS link that is lacking in the current IGS (see Section 4.2.2.1).

(b) **DEMG - Grounds** - Although there is an application for managing pesticides, there are no model applications that support the other aspects of the pest management function.

This section needs a Maximum on Ground (MOG) package that allows personnel to determine the maximum number of aircraft that can be placed on the apronway. This package should also include the fully interactive CADD capability and CIS link that IGS currently lacks.

(c) **DEMM - Mechanical** - This section has no programs that support recordkeeping and trend analysis for boiler maintenance. Because there are no WIMS workstations where the logs are maintained in the steam, water, and sewage plants, it is difficult to enter data and generate the necessary applications. As a result, these logs are handwritten and require computer input for analysis.

(d) **DEMS - Structural** - The software applications that support water and waste management are too cumbersome. Wang utilities are unable to satisfy the requirements of the two principal forms used by this function: AF Form 1462, Water Pollution Control Utility Operating Log - General, and AF

Form 1463, Water Pollution Control Plan Operating Log - Supplementary. As a result, personnel complete these forms manually.

Because of shortfalls in AMMUS communications (see section 4.3.2), personnel in this section are unable to access the RPIE sensors and data needed to perform trend analysis of wastewater treatment inflow and to monitor outflow, as required by EPA.

(e) **DEME - Electrical** - This section lacks the interoperable communications and analytical tools needed to monitor power use, distribution, maintenance, and generation on a base.

(f) **DEMA - Systems Management** - The energy monitoring system lacks upward reporting features that incorporate updates as they are made and automatically report them to the next level of command. The current practice of transmitting the reports via E-mail does not fully utilize the capabilities of the automated system and requires a reports control symbol to approve direct data transmission between the EMCS systems and the MAJCOM super minicomputer. The reports and briefing materials produced by this system could be greatly improved by incorporating graphics. The production process could be improved if the end-users had windows to allow them to view several documents/graphics at once. However, AMMUS supports neither CADD nor windows.

(g) **DEML - Logistics** - Personnel in this section are unable to electronically fill out the preprinted forms used by non-E&S communities, although the data already reside in WIMS. As a result, they have to write the information on the forms. Electronic signatures are also desirable.

(h) **DEMR - Requirements** - To properly manage its work requirement and assignment tasks, this section needs the fully interactive three-dimensional CADD capability and CIS link that is lacking in the current IGS. Additionally, there are deficiencies in the specific applications used by both of the units in this section:

- **DEMRC - Production Control** - Schedulers now receive the information for automated AF Forms 561 and 1734 from the various shop supervisors via telephone, electronic memo, or hand-carried written summary and must then enter it themselves. This method of labor reporting requires duplicate work by the supervisor and scheduler, creates potential for misinformation or delayed entry resulting in incorrect labor status, and causes the scheduler to seek out the supervisor to research labor errors. Maintenance teams on base need remote access to scheduling information to eliminate duplication and ensure that their hours are reported correctly.

- **DEMRP - Planning** - Planners now have access only to manhour standards developed by the NAVFAC Industrial Engineering Center (NIEC). Access is also required to the manhours portion of the Simplified Acquisition of Base Engineering Requirements (SABER). Other COTS planning packages such as MEANS, DODGE, and Richardson would also be helpful. Access to these planning applications would give planners an alternative estimation capability to fill in missing data in the standard NAVFAC planning applications. Planners need performance reports that are generated from completed workorders to compare the actual hours needed to accomplish workorders with the estimated hours. This information must contain sufficient detail to allow "fine tuning" of future estimates and to determine whether further variance analysis is needed to identify discrepancies.

(3) **DEE - Engineering and Environmental Planning** - The physical storage of paper drawings of the Base Comprehensive Plan needed to keep operations current is very labor intensive and costly. CE's backlog in drafting and design seriously impedes the maintenance of a high level of readiness within the base infrastructure. In addition, physical drawings are not tied to an integrated database which allows the call-up of a particular location on the Base Comprehensive Plan to query for information about that location. Use of central drawing storage and management is fundamental to the integration of E&S information systems.

All engineers need an integrated, standard CADD system with standard templates and symbols, such as those that support Harvard Graphics, to support their presentations and to illustrate tactical issues. Drawings generated by the standard CADD system will require an interface into a business graphics package such as Harvard Graphics. Such a CADD system would lessen the backlog of design work at most bases and would provide an easy link between workorders and projects. As stated in Section 4.2.2.1, the recently prototyped IGS, which provides these capabilities, exists only on stand-alone non-AMMUS workstations, and thus cannot support the interoperable, interactive applications needed throughout CE.

There are also shortfalls in the specific applications used by each of the four sections in this branch:

(a) **DEEE - Engineering Technical Design** - Because of the labor-intensive nature of design plans and lack of automated applications, many times the Base Comprehensive Plan, the fundamental base-level CE plan, was not properly updated.

Within AMMUS, there are no integrated engineering design software applications with databases for filing engineering record drawings, and no integrated construction-progress reporting system for contracting.

(b) **DEEC - Contract Management** - According to the AFMEA study, there are no perceived WIMS shortcomings in this section. The WIMS programs support the needs of inspectors and supervisors, and personnel are using WIMS to its current maximum capability.

However, field interviews revealed there is no integrated planning and implementation process to track all information concerning a project from the initial planning stages through procurement of services/deliverables to completion of the project.

(c) **DEEV - Environmental and Contract Planning** - There are no applications to support the many environmental impact reports required by law. One of the overriding limitations of the manual environmental management function is its inability to efficiently pass data through the chain of command from base to MAJCOM to the Directorate for Engineering & Services (HQ CE) or the Air Force Engineering and Services Center (HQ AFESC). Reports control symbols must be obtained, and the reports must be automated, so that the data can be passed more frequently. Additionally, where necessary, the data used for the reports must be rolled up or aggregated for use at the MAJCOM level or at HQ CE or HQ AFESC.

Without a fully interactive IGS, personnel in this section lacks the three-dimensional engineering drawing capability and data space needed to perform plume analyses, which enable them to determine the priority of a cleanup operation, particularly for old spills.

(d) **DEER - Real Estate** - Because business data files cannot be shared with engineering graphics data (see Section 4.3.1.6.5), the information supporting real property cannot be accessed from the prototype Base Comprehensive Plan. As a result, this information is kept in two different locations, causing duplication of work and potential for error.

(4) **DEF - Fire Protection** - Better communications are needed in this area. Remote Fire Protection branches are not connected via high-speed communications, which would improve WIMS response time and would increase the quality of Fire Protection's service.

Field interviews revealed that comments carried on manually generated work requests are not included in automated workorders. Each base would like to be able to correlate work request numbers or incorporate Fire Protection requirements into the workorder system. Providing the capability to attach comments to the workorder and to the Base Comprehensive Plan for all workorder reviewers would help to ensure that comments are seen.

There are also shortfalls in the specific applications used by each of the three sections in this branch:

(a) **DEFA - Administration** - DD Form 2324, the primary fire incident report required by DoD, is not automated. Although the appropriate information is available in WIMS, personnel must manually complete the form.

The firefighter physical fitness application is not integrated into WIMS model software. Such integration would eliminate redundancies and centralize training data.

(b) **DEFT - Technical Services** - The fire and housing inspection scheduling is currently done manually. If it were automated and integrated with the Family Housing Management branch, the scheduling could be centralized in a single, common schedule.

(c) **DEFO - Operations** - There are currently no standard applications for fire alarm system communications. Many bases have their own unique fire alarm systems, which are not linked to WIMS, and the bases update pre-fire plans manually.

(5) **DEH - Family Housing Management** - Although housing personnel have the appropriate information available in WIMS, because AMMUS has no electronic signature capability, they must manually complete the forms used when tenants move in or out of housing, including AF Form 594: Authorization to stop, start, or Change Basic Allowance for Quarters (BAQ). Additionally, this branch has no application for tracking commodities issued by the self-help store to a facility. Such an application would show each issue and date, enabling the reviewer to detect abuse.

The Multiple Listing Service, used to help newcomers to a base find housing, cannot be easily accessed from WIMS.
Remote offices are not connected by high-speed communications, slowing the response time from the WIMS computer.

Because of the limited number of workstation connections with the minicomputer, fire and housing inspections are scheduled manually, and the schedules are not integrated with the Fire Protection branch.

Maintenance contractors do not have WIMS terminals; each day Family Housing Management personnel receive information from contractors and have to re-enter it in WIMS, resulting in potential for error and unnecessary time expenditure. Allowing maintenance contractors to load data into WIMS will also provide the Air Force with a more accurate facility history and will make house reassignment more efficient when maintenance is complete.

(6) **DEI - Industrial Engineering** - There are no applications for reports on unit performance. AFMEA has developed software which could be adapted to WIMS to help prepare unit performance reports, but personnel have not been trained to generate these applications. There are no applications that provide statistical data on overdue job orders, balance of work between controllers, analysis of materiel lead

time, analysis of time between completion of backordered materials and commencement of work, and economic analysis of facility life-cycle costing. Additionally, function-specific management indicators are not addressed. Finally, there is no automated support to produce budget plans for future years based on past requirements.

(7) **DEO - Readiness** - The applications used by this branch lack in-garrison and portable capability (see Sections 4.3.1.1.1 and 4.3.1.2). This capability is needed to provide computer support for the Prime BEEF units at bare-bones remote sites and during wartime. When it becomes deployable, WIMS should eliminate this deficiency.

(8) **DEU - Financial Management** - Because there is no direct communication with Accounting & Finance to provide budget calls and distributions and to obtain financial information, Financial Management personnel initiate distribution and redistribution actions by telephone, and follow-up with a manually prepared document (AF Form 1269: Request for Load/Change in Fund Targets). Additionally, Financial Management personnel do not have access to the WIMS "budget call" application.

There is no electronic communications or application to capture Morale, Welfare, and Recreation (MWR) reimbursement data and automatically generate a report to MWR to provide workorder costs that recaps the data on AF Form 1441: Real Property Voucher (IRA). As a result, each month, Financial Management sends workorder cost data to MWR via letter, requiring manual recapping of the AF Form 1441 data.

4.2.3.2 Services (SV)

(1) **SVA - Squadron Section/First Sergeant/Administration** -The SIMS applications in this area have been used very little because of inadequate (if any) training for the personnel, insufficient AMMUS utilities, and failure of the SSA to assign correct file access rights. As a result, the Unit Administration function does not use interrelated data files nor Unit Administration-specific applications. Thus, SV personnel data are not automated.

Unit Administration's applications are not compatible with those of the Publication Distribution Office (PDO), which are written in d-Base, because AMMUS lacks the file-translation services necessary to convert d-Base directly into an ESIMS format (see Section 4.3.1.6.4). As a result, despite computer support, publications management is still a manual operation.

(2) **SVF - Food Service** - Although barcodes appear on most of the items received by Food Service branches, there is no system to read the barcodes and to produce an inventory of goods received, stocked, and distributed; and there is no interface to food preparation systems. As a result, commodities are inventoried manually as they arrive at the food distribution sites and checked against the invoice using manual forms. An effective barcode reading and inventory control system would reduce errors, increase productivity, and provide more positive control. Such a system requires barcode reader/printer peripherals for ESIMS workstations and portable, self-contained barcode reader units (see Section 4.3.1.1.6).

Food Service cannot use the recently fielded quality assurance evaluation (QAE) software because AMMUS lacks portable, battery-operated workstations (see Section 4.3.1.2). SIMS workstations would have to be transported to various Food Service locations to support the on-site QAE inspections required by AFP 146-5, Food Service Managers' Handbook. (Information completed on the portable workstation could be uploaded to the minicomputer to update the system files.) Additionally, because there is no electronic link between SIMS and BCAS (see Section 4.2.2.3.2), Food Service cannot transfer the contract compliance information obtained form the QAE inspections to Base Contracting. Such a link would complete the automated support currently required for contract management of Food Service.

(3) **SVH - Billeting** - Although barcodes appear on most of the items received by Billeting branches, none of the sections has a system to read the barcodes and to produce an inventory of goods received, stocked, and distributed. As a result, commodities are inventoried manually as they arrive and are checked against the invoice using manual forms. A barcode reading system would reduce errors, increase productivity, and provide more positive control. Such a system requires barcode reader/printer peripherals for ESIMS workstations and portable, self-contained barcode reader units (see Section 4.3.1.1.6).

All four of the Billeting sections need an effective barcode reading and inventory control system: (a) Temporary Lodging Services, (b) Furnishings Management, (c) Linen Exchange, and (d) Laundry and Dry Cleaning. Only Temporary Lodging Services has specific application shortfalls:

- Because it lacks contractual agreements with travel services, Temporary Lodging Services is unable to connect directly, through SIMS, with the contract quarters systems to determine availability and pricing, to schedule incoming personnel, and to verify arrival, departure, and charges against an individual's account. Additionally, because of incompatible communications and no electronic signatures, this section cannot automatically submit to Accounting and Finance the total costs. These capabilities would eliminate all manual processes within Billeting and would provide information to Travel Accounting when it is designed and implemented. Although much of this information is currently captured, it must be compiled and integrated to eliminate the manual supplementary information. This requires commercial data interchange standards between the hotel/motel industry and the U.S. Government.

- Billeting does not have two-way interface to airline information through the Transportation Management Office (TMO). Such an interface would provide access to TMO's records of flight/land-travel ticketing information.

- Because SV lacks contractual agreements with travel services, rental cars cannot be authorized and reserved through SIMS, and miscellaneous expenses cannot be recorded.

- Because of incompatible communications, customers are unable to make reservations at any base Billeting facility worldwide from their workstations. This capability would save hours per year per traveler.

- Voice messages and graphics cannot be appended to reservation records (see Section 4.3.1.5.5). This capability would enhance the quality of service and reduce errors (such as misinterpreting special service requests).

(4) **SVR - Force Management** - Application shortfalls exist in both of the sections in this branch:

(a) **Force Development** - This section has no automated program that maintains an inventory of expendable supplies, produces deficiency reports, and facilitates the retirement of expired expendables. Likewise, this section has no automated program that tracks war reserve materiel (WRM) equipment or that manages WRM inventory and maintenance. Additionally, there is no automated scheduler that supports routine maintenance of equipment and supplies during their useful lives.

(b) **Management Support** - As mentioned in Section 4.2.2.3.2, the Mortuary Affairs Office cannot electronically exchange information with the Air Force Institute of Pathology, the FBI, the Air Force Office of Special Investigations, or military medical and dental facilities during identification of remains.

Mortuary Affairs also lacks a forms package allowing personnel to generate forms of acceptable quality to other agencies. These forms require multiple character fonts and boxes that can be shaded for emphasis. The existing multipart forms should be replaced with laser-printed forms having multiple copies.

4.2.4 Future Vision

This section discusses the end-user shortfalls projected between 1995 and 2010 based on the long-range planning process outlined in the Future Vision document. These shortfalls are listed according to the numbered trends in Table 4-1.

The following shortfalls derive from Future Vision trends 1 and 2 (see Table 4-1). They involve the aging of the workforce, the decrease in professional and scientific degrees and lower general education level, and the related difficulties in recruiting career personnel.

ESIMS Shortfalls (TRENDS 1,2):

Because the workforce will have little or no experience with computers and/or little higher education, a sophisticated training program will be needed. Training should be accomplished through courses and state-of-the-art CAI packages, on-line context-sensitive "HELP" procedures, and must be attractive, frequent, and comprehensive.

An artificial intelligence (AI) shell is needed to notice frequent errors and either suggest appropriate responses or create an alias command for that user to accomplish the desired task. (For example, repeated "file not found" messages would automatically trigger a menu of valid file names from which the user could make a selection.)

High turnover and widely divergent proficiency levels will require much more attention to the user interface, including absolutely consistent commands across applications, robust sets of help and tutorial programs, and the array of training and support.

The following shortfalls derive from Future Vision trends 3, 4, 5, 6, 7, 9, 10, and 11 (see Table 4-1). They involve the reduction in overseas bases, maintenance of aging air bases and facilities, uncertain air basing prospects, force projection from CONUS bases, base recovery after attack, and worldwide low-intensity conflicts.

ESIMS Shortfalls (TREND 3):

Current ESIMS functionality will plan much of the work, locate inventory, facilitate communications, support contract administration, and assign and monitor the work. Disposition and redistribution of property, cooperative use of air bases (i.e., sharing with host country military and civilian uses), and readiness for potential rapid redeployment may require additional functions for ESIMS. Problems include the capacity for a surge in workload, lack of an integrated CADD system, and inability to add workstations at bases where the current WIMS or SIMS has reached its capacity (i.e., is "maxed out").

Downsizing operations are information-intensive and must be automated to make the planning and management less labor-intensive, more efficient, and effective.

ESIMS Shortfalls (TREND 4):

Maintenance of aging facilities will increase the CE workload. Robust information management and analytical tools will enable CE to evaluate repair histories and to make economical repair/replace decisions.

Repair resources, including scarce spares, can be located on the worldwide ESIMS network. Cannibalizing of abandoned facilities may be the best source of repair resources because the removed components will be accessible (via the inventory database), and thus will be more likely to be used.

Development of new facilities, as well as retrofitting of new technology into existing facilities, is best accomplished with a full set of CADD engineering tools.

ESIMS Shortfalls (TRENDS 5,6):

CE must support this reconfiguration of air power by reconfiguring CONUS base facilities to support larger operational units and a wider range of missions.

SV must prepare sufficient capacity, flexibility, and information support to respond to large, rapid troop movements, and to deploy with the operational units to forward bases outside CONUS.

These trends will require ESIMS to have flexible, user-generated tools that will allow for base-specific requirements. ESIMS will need to provide state-of-the-art user-generated tools software as well as modular, easily modifiable applications for this purpose.

ESIMS Shortfalls (TREND 7):

Both the CE and SV responses to these new weapons systems will require flexibility in ESIMS and additional interfaces and capabilities.

ESIMS Shortfalls (TREND 9):

Mobile launching systems, with mobile crew support requirements, will require portable (or at least deployable) ESIMS workstations to perform construction, repair, and support roles on the premises. This trend will require new applications to be created to support the new methods of basing for ICBMs. The end-user will need to assist in designing the appropriate software applications to support these efforts.

ESIMS Shortfalls (TREND 10):

Rapid repair response requires an information management and decision support system that can (1) collect damage reports and status information, (2) evaluate repairability and contribute to the repair/abandon decision, (3) identify available resources, (4) display the appropriate information to support command decisions, and (5) launch repair orders and monitor the progress of repairs.

The information systems equipment on which the base recovery system operates must be self-sufficient, rugged, portable, and repairable from the base inventory of systems and spares. It should not require operation that is different from the "regular" ESIMS.

ESIMS Shortfalls (TREND 11):

ESIMS must continue to build the capability on each base to quickly report and assess damage, to identify useable resources and facilities, and to initiate the best repair efforts possible. Integration of CE data with the Base Comprehensive Plan will enable CE personnel to respond rapidly and effectively to most levels of damage/sabotage and resource deficiency.

This trend will increase the need for new, appropriate applications, such as damage reports and resource and facility identification. The end-user will need to assist designing the appropriate software applications to support these efforts.

The following shortfalls derive from Future Vision trends 12 and 13 (see Table 4-1). They involve establishing Air Force facilities on the Moon, on Mars, and on orbiting platforms. While the exact time frame for when these facilities shall be in place is still undetermined (due to budgetary issues), CE must still be prepared to provide the infrastructure to integrate space operations into the Air Force structure.

ESIMS Shortfalls (TRENDS 12, 13):

Space operations will require the development of specialized applications within ESIMS. It is expected that the these applications will be developed on Future ESIMS and will then be transferred to space-borne systems. These trends are mentioned here only to give an indication of future development work which must be accommodated on the Future ESIMS platform. End-users and specialists must be able to use Future ESIMS to develop space-borne applications which are easily modifiable to adapt to unforseen circumstances.

The following shortfalls derive from Future Vision trends 14 and 15 (see Table 4-1). They involve the increased power built into software, faster processing, lower hardware costs, availability of memory, and slow software development.

ESIMS Shortfalls (TRENDS 14, 15):

Tactical and economic decisions will rely increasingly on automated information, making the integrity of the information mission-critical. The information resource will become as attractive a target for sabotage as aircraft and radar equipment. Data security will become a tactical issue.

End-user generation of requirements and prototypes using high-level languages and application generators will provide innovation and will meet smaller immediate needs without affecting the workload of system developers. End-user development will continue to focus ESIMS on the day-to-day needs of the user community and will build a corporate-wide knowledge base of how to plan, perform, and monitor E&S functions.

The Air Force data standard will facilitate consistent data naming, which, in turn, will facilitate sharing of information across organizational boundaries.

Interoperable computer systems will enable use of software developed on one computer platform by users of other platforms. Source-code portability will enable the software to be utilized on multiple manufacturers' equipment with minimal re-programming.

The following shortfalls derive from Future Vision trends 17 and 18 (see Table 4-1). They involve the shortage of power generation plants, increasing demand for electricity, and cogeneration of power.

ESIMS Shortfalls (TRENDS 17, 18):

CE will institute major conservation efforts, which will include monitoring of use, scheduling of power-intensive activities to avoid peak loads, and re-engineering of facilities to conserve power and heat. CE will be called upon to manage the design and production of small Air Force owned/leased power generation systems, which may include solar, wind, and water power. These systems will serve to reduce peak load demands on commercial power, and as a reserve for emergency conditions.

Prioritized load shedding during peak usage requires automatic notification of the affected facilities, buildings, and/or base sectors of the load shedding procedures, with remote manual shutdown capability. To eliminate peak power penalty charges, the future computing environment is required to provide advance notification to the base power generation systems to allow the generators to come on line when needed, and to shut down at the appropriate time.

Systems which implement these functions will need to be able to interface with the energy management control systems package, which is already in place.

The following shortfalls derive from Future Vision trends 19, 20, 21, and 22 (see Table 4-1). They involve municipal development, waste disposal and minimization, and the growth of responsibilities in environmental engineering.

ESIMS Shortfalls (TREND 19):

Air Force facility planning and management functions include municipal and regional planning skills, and require regular interaction with local planning authorities. To represent the base's needs and to advocate the Base Commander's proposals, ESIMS must be able to produce presentation graphics, including facility maps, trend analysis, and details from the engineering drawing database, quickly and inexpensively. These graphics must be colorful and professional. ESIMS must support extraction of data to meet specific public demands and to highlight specific points of interest.

The ESIMS recycling system will support a consistent and effective recycling effort that, in turn, will support local businesses and contribute to the local community.

ESIMS cannot support these activities within its current environment.

ESIMS Shortfalls (TRENDS 20-23)

The end-user shortfalls derived from these trends are the same as those for the customers (see Section 4.1.2).

The following shortfalls derive from Future Vision trends 24, 25, 26, and 28 (see Table 4-1). They involve improvements in food service, automation in the lodging industry, and mass casualty procedures.

ESIMS Shortfalls (TREND 24):

The end-user shortfalls derived from this trend are the same as those for the customers (see Section 4.1.2).

ESIMS Shortfalls (TREND 25):

Billeting managers will rely on SIMS to analyze and plan resources, staff, and facilities. End-users will need to set requirements for new applications.

ESIMS Shortfalls (TREND 26):

This trend will require software applications to maintain a contract database. End-users should be involved in determining requirements.

ESIMS Shortfalls (TREND 28):

To rapidly identify civilian casualties without military records, the Mortuary Affairs system must interface with appropriate medical, insurance, and law enforcement databases.

The following shortfalls derive from Future Vision trends 29, 30 and 31 (see Table 4-1). They involve remote sensing equipment, contract management, build-lease acquisitions, computer support, and force projection.

ESIMS Shortfalls (TREND 29):

ESIMS software must be modular so that site-specific information can be set aside and a new site brought on-line without having to regenerate the entire database system. Model software that supports deployment plans must be supplied to each deployable system.

ESIMS hardware and software must be able to support the prepositioning of forces that will move to forward bases. This support includes planning, buildup of software and data for the forward location, preconfiguration of the deployable computer system, and the preparation and positioning of assets to be moved to the forward base.

ESIMS Shortfalls (TREND 30):

Use of contractors and consultants requires Air Force presence for policy, financial, supervisory, and regulatory issues. The Air Force must provide validation, verification, and quality control. Automated support of the contract monitoring function includes the following capabilities:

- Detection of waste, fraud, and abuse
- Planning and estimating
- Maintenance of bidder lists
- Control of the bid, proposal, and award process
- Coordination of inspections and achievement of milestones with payables
- Scheduling and supervision of activities

ESIMS Shortfalls (TREND 31):

E&S must have a statistical trend-analysis system to monitor vendor and material quality and to establish availability of quality vendors and materials.

4.3 TECHNOLOGIST PERSPECTIVE

As is evident in Section 4.2, the AMMUS technology described in Section 3.3 cannot support the applications that the ESIMS end-users need to cost effectively support the E&S customers. Furthermore, as shown in Section 4.1, AMMUS can neither support the combat requirements of the Air Force nor provide the direct-access needs of its traditional and potential customers. In other words, using the AMMUS procurement, the ESIMS technologists (i.e., the hardware, operating system, system applications, database, and communications experts responsible for developing and operating ESIMS) have been increasingly unable to meet the demand generated by the success of AMMUS ESIMS for quality of service, transparency mechanisms, information storage, application portability support, network structures, security mechanisms, and user-access facilities.

This section describes the AMMUS technological shortfalls in the following areas: hardware and system software (Section 4.3.1), communications (Section 4.3.2), security (Section 4.3.3), electrical power (Section 4.3.4), and Future Vision capabilities (Section 4.3.5). These shortfalls are the basis for the Future ESIMS requirements specified in Section 5.

4.3.1 Hardware and System Software

Shortfalls in AMMUS hardware and system software exist in the following areas, which correspond to Sections 4.3.1.1 through 4.3.1.6, respectively:

(1) Central processing computer (CPC)

(2) Workstations

(3) Languages

(4) Development tools

(5) General applications

(6) System support

4.3.1.1 Central Processing Computer (CPC)

The AMMUS super minicomputer (the central processing resource in the AMMUS ESIMS node) is not a CPC because it will not accommodate multiple CPUs connected together electrically (see Figure 4-3). As stated in Section 3.3.1.1, multiprocessing on the AMMUS minicomputer can be achieved only by connecting entire minicomputers via communications links. Consequently, end-users cannot access all of the workstations in their node transparently. They must manually switch to another minicomputer, requiring knowledge of the other addresses and additional time. More importantly, if a minicomputer is disabled, none of the workstations connected to that minicomputer can be accessed. Furthermore, the ability to add and subtract CPUs transparently is needed for "peel-down" architecture: the gradual shedding of less critical functional loads while maintaining essential services (see Figure 4-1), which is a critical wartime requirement. The other limitations of the AMMUS minicomputer are discussed in the following subsections.

4.3.1.1.1 Deployability - Because AMMUS minicomputers lack deployment kits with spares and a ruggedized shipping case capable of being carried by two persons, they cannot be transported to combat locations quickly and easily. Thus, as noted in Section 4.1, E&S has no automated support for its wartime missions.

4.3.1.1.2 Interoperability - The AMMUS minicomputer and its operating system do not comply with FIPS-PUB-146, Government Open System Interconnection Profile (GOSIP), and FIPS-PUB-151, Portable Operating System Interface (POSIX). As a result, ESIMS is not compatible with other systems, and the traditional and potential E&S customers are denied on-line access to ESIMS and the services discussed in Section 4.1.1.

4.3.1.1.3 Processing Capacity - The AMMUS CPUs do not have the processing capacity needed to support all of the existing applications and those scheduled for implementation, not to mention the unsupported functions discussed in Section 4.2.3. Furthermore, the minicomputer only supports 128 workstations. Most base-level nodes require more than this limit to permit all of the trained personnel to perform their automated functions. Since lack of training was cited as the most widespread end-user shortfall, a workforce fully trained to use existing WIMS and SIMS applications would generate a workload that would far outstrip the AMMUS processing capacity. Creation of applications to remedy the shortfalls in Section 4.2.3 would further increase the workload, not to mention the impact of achieving the Future Vision capabilities outlined in Sections 4.1.2 and 4.2.4.

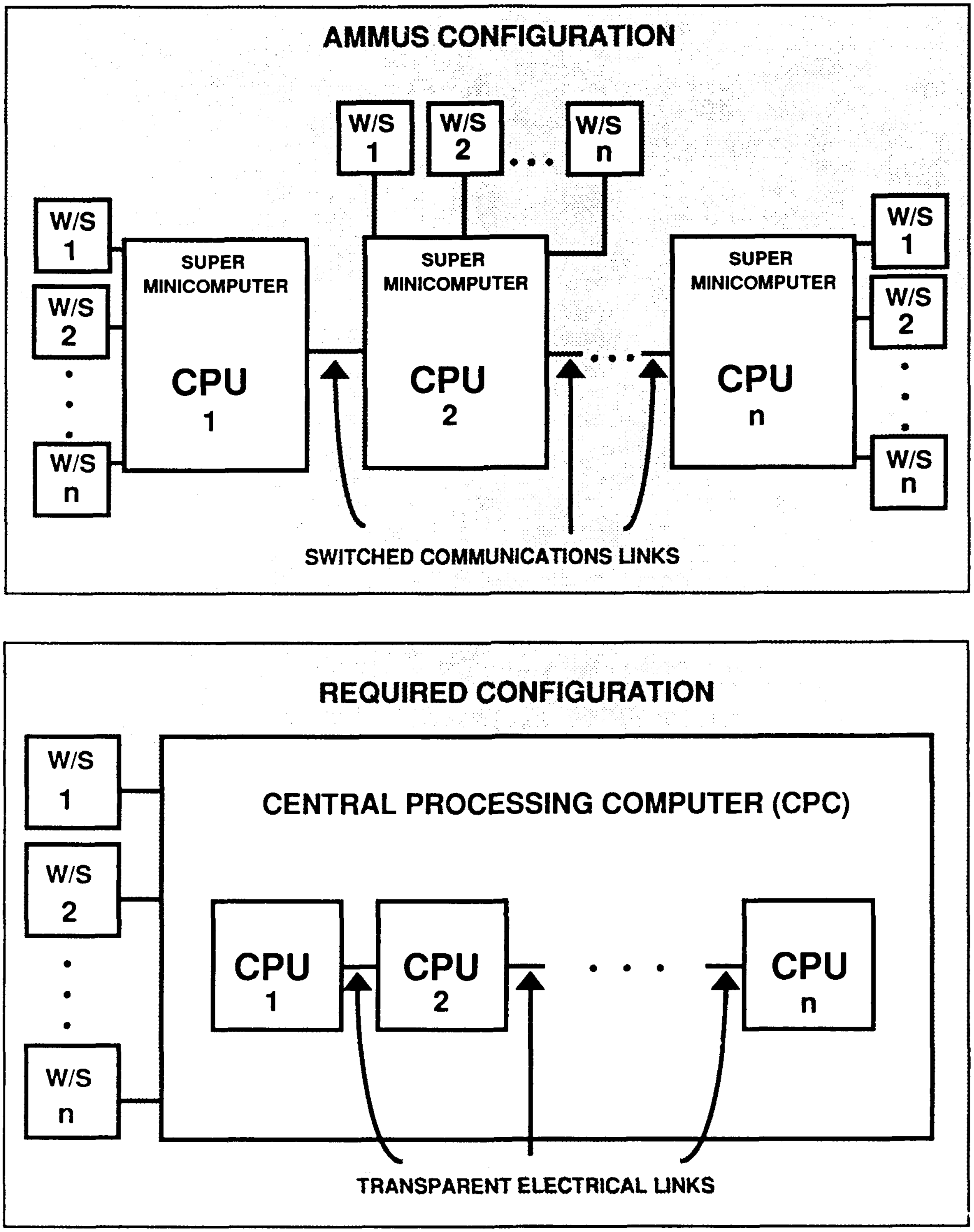

FIGURE 4-3 CENTRAL PROCESSING SHORTFALL

4.3.1.1.4 Memory Capacity - The AMMUS minicomputer lacks the main memory capacity needed to support the existing applications and those scheduled for implementation without significantly increasing the response time. The impact of a fully trained workforce, fully automated functions, and Future Vision capability would significantly exacerbate the problem.

4.3.1.1.5 Storage Capacity - The AMMUS minicomputer also lacks the random access disk storage capacity needed to support the existing applications and those scheduled for implementation. At the current rate of expansion of the storage, the largest ESIMS nodes will soon run out of the disk drive peripheral ports needed to expand storage capacity, necessitating additional systems to accommodate the storage requirements. Once again, the impact of a fully trained workforce, fully automated functions, and Future Vision capability would significantly exacerbate the problem.

4.3.1.1.6 Peripheral Support - AMMUS is unable to effectively support the following peripheral requirements:

(1) **Independent Peripheral Activity** - Peripheral activity that is independent of the activity of the CPC allows on-line application programs to run without interruption.

(2) **A Multitude of Ports** - The AMMUS minicomputer lacks the number of ports needed to physically connect the number of workstations, input peripherals (such as imaging technology, barcoding technology, scanners, voice, etc.), and output devices (such as printers, plotters, tape drives, etc.) required to support end-user demand. On most bases, the AMMUS computer will accommodate only 128 workstations and a total of 178 ports for workstations, input peripherals, and output devices. This number does not currently support the amount of use on some ESIMS nodes. The number of end-users generated by a fully trained workforce, fully automated functions, and Future Vision capability would certainly create a significant backlog on most nodes.

(3) **Communications Connectivity and Support** - AMMUS minicomputers cannot automatically detect the type and location of peripherals attached, requiring the technologists to manually locate the attached peripherals, a time-consuming process. Furthermore, the AMMUS minicomputer cannot change peripheral locations without restarting the system, requiring the system to shut down when changing configurations.

4.3.1.2 Workstations

None of the current ESIMS workstations can be easily deployed. AMMUS does not have portable workstations, nor does it supply wireless link terminals to be used in portable environments. There are no deployment kits, shipping cases, spares, and supplies. The workstation hardware is not ruggedized. The workstations cannot handle electrical power of questionable quality. AMMUS does not provide deployable printers. Thus, as noted in Section 4.1, E&S has no automated support for its wartime missions.

AMMUS does not permit a generic interchangeable workstation capable of data processing, word processing, business graphic display, and engineering graphic display. As stated in Section 3.3.1.2, the current ESIMS uses seven different standard workstation configurations. None of these configurations is interchangeable or compatible with any other. That is, the AMMUS operating system is unable to change workstation configurations without completely shutting down and performing an initial program load. To support the interoperability requirements of the ESIMS end-users and the E&S customers, workstations must be compatible and interchangeable between and within nodes. Workstation compatibility will also ensure that one workstation can be readily substituted for another in an emergency (i.e., workstation crash, an accident, sabotage, or combat). This capability is essential during wartime.

The simplest and cheapest way to achieve interchangeability and compatibility is to define a single generic workstation that is fully compatible with but can operate independently of the CPC, and that can add and subtract software and peripherals as necessary to accommodate all of the functions supported by the seven existing configurations. As stated in Section 3.3.1.2, only three of the seven configurations are stand-alone units, with their own CPUs, that operate independently of the minicomputer: programmable, engineering graphics, and food service. The current food service workstation cannot perform generic workstation functions, and the engineering graphics workstation is not an AMMUS machine. Thus, the programmable workstation is the only logical choice as a model for the generic workstation. However, the AMMUS programmable workstation has many shortfalls, which are discussed in the following paragraphs.

The programmable workstations lack interconnectivity. They are unable to use high-speed connections (or more traditional paired connections) interchangeably to the CPU as standard equipment. They do not support network connectivity, interactive video, digitized audio support, or voice input support. They do not have network ports. These workstations do not support an indexed sequential access file system as an embedded part of the operating system, which is the backbone of all business software. They do not provide file services that allow access to the minicomputer files from within workstation applications.

Furthermore, because they do not support POSIX interfaces, as required by FIPS-PUB-156, the programmable workstations are unable to support COTS software, which is more economical than customized software and is required by Air Force C-CS architecture.

As noted in Section 3.3.1.2.4, the programmable workstations were purchased in two procurements. Those from the initial purchase, 92 percent of the current programmable workstations, have insufficient disk storage to load most ESIMS applications and data. They also lack an arithmetic floating-point processor, which is necessary to operate a CADD system. Those machines that are compatible with CADD are unable to share data with the minicomputer, as is necessary to support an integrated CADD system (see Section 4.3.1.6.5). They also lack the disk storage necessary to adequately support large CADD products. Furthermore, they lack the interoperability needed to exchange CADD data with other systems because they do not comply with the necessary standards: FIPS-PUB-120, Graphical Kernel System (GKS), and MIL-D-28000, Integrated Graphics Exchange Specification (IGES). Compliance with GKS is needed for exchange with other systems within Air Force Logistics, and compliance with IGES, a Computer-aided Acquisition & Logistic Support (CALS) standard, is needed for exchange with the Army, the Navy, and other government agencies. (The non-AMMUS engineering graphics workstations lack compliance with GKS and IGES.)

Finally the programmable workstations cannot perform the following functions:

- Support human-machine interface requirements.
- Run multiple independent programmable workstation tasks simultaneously while accessing the CPU.
- Accommodate virtual disks on the host minicomputer, preventing easy data sharing between workstations.
- Enter the mixed environment mode with the minicomputer.
- Support CD-ROM for portable library and standards retrievals.
- Allow easy listing of the backup contents from the backup and restore programs.
- Provide video input, or image or audio capture.
- Support integrated voice, graphics, and data.

- Provide a procurement method for the compatible projection systems that it defines.
- Provide software support for debit and credit card transactions.
- Support PF key access to resident applications, making its access to ESIMS programs different from that of the minicomputer.
- Support context-sensitive "HELP" for all workstation applications.
- Capture keystrokes similar to the glossary-by-example capability in the minicomputer.
- Provide error-sensing capability that is similar to that available on the minicomputer.
- Automatically protect software upgrades.

4.3.1.3 Languages

Several major programming languages are not available in AMMUS. For example, Ada is not supported, although it is required by Air Force C-CS architecture. C is not supported, although it is needed to import COTS software (another requirement of Air Force C-CS architecture) into ESIMS. Neither network and SQL nor interactive SQL is supported, although both are required for more complex reporting and network file sharing under the Air Force C-CS architecture. Additionally, those languages that are available (i.e, COBOL, FORTRAN, and BASIC) are not supported the same way on the programmable workstation as on the minicomputer.

4.3.1.4 Development Tools

The program development tools provided on the programmable workstation are different from those on the minicomputer. Thus, the program development capabilities and user interfaces on the two systems are different. As a result, code cannot be generated on the programmable workstation, and the end-user/programmers must adjust to differences in the editors when changing from one to the other, causing delays.

AMMUS does not support source-code version control management software and date-sensitive compilation scripts, and does not provide access to context-sensitive "HELP" from within the source-code programming language editors. AMMUS also has shortfalls in its language tools and data dictionaries.

4.3.1.4.1 Language Tools - AMMUS does not provide a cross-language thesaurus to allow easy comparison of similar language structures and verbs in traditionally dissimilar languages. Such a thesaurus would assist in the conversion of COBOL programs (and any other language programs) to the equivalent programs in Ada. It would also help Ada programmers provide minor maintenance on older code in non-Ada languages.

Furthermore, AMMUS does not provide application-to-application program interfaces. As a result, data sharing between IGS data files and the business data files is nearly impossible.

4.3.1.4.2 Data Dictionaries - A data dictionary was not defined nor required for AMMUS ESIMS. FIPS-PUB-156, Information Resource Dictionary System (IRDS) specifies a data dictionary format which defines the dictionary files, file structure, name, format, data types, and other information about the data elements. Compliance with this FIPS is a requirement under federal procurement regulations.

In order to meet mission-related requirements, MAJCOM- and base-level CE and SV units must be able to reorganize their automation systems internally to meet the challenges of local needs. Under AMMUS, computer support is very closely linked to the organizational structure and is required to respond to each organizational change.

Use of a single dictionary for all of E&S would require approval by all of the organizations that use the dictionary for any changes needed by a single organization. This would hinder considerably the required flexibility in automated support of the mission, possibly causing mission failure. To avoid this obstacle, each level of command and each organization needs an internal IRDS-compliant data dictionary to allow internal flexibility while preserving the integrity of the data to be shared. A data dictionary support system is needed to facilitate the creation and maintenance of data elements within the dictionaries. This system should provide the following capabilities:

- Access to any data dictionary, subject to security requirements, to help the end-user select data elements needed to produce applications
- Version control for multiple definitions of a single data element, which would facilitate changes in applications
- A method of migrating data elements from one data dictionary to another

- A method of locking and unlocking data dictionaries used in development and prototyping

- An automated method, subject to security requirements, to check and approve naming convention compliance within any data dictionary, using the owning community's customized compliance rules

- A method of cross referencing the applications that use data elements within the data dictionary, based on any parameter or combinations of parameters defined within the data elements

- A method of concatenating data structures to create new data structures

By using multiple IRDS-compliant data dictionaries, E&S will be able to build dictionaries capable of defining data structures used in support of interfaces to other organizations, as well as maintain the capability to change internally without affecting the automation support of other organizations.

4.3.1.5 Vendor Applications

Because the AMMUS hardware and system software use dated technology, ESIMS software currently lacks features in many vendor applications, which are discussed in the following subsections. Furthermore, AMMUS is unable to support context-sensitive "HELP" for any of the vendor applications except office automation.

4.3.1.5.1 Office Automation - AMMUS does not support digitized audio attached to the E-mail messages, nor does it support electronic signature verification compatible with that used by Accounting and Finance. (Because these capabilities are considered an integral part of system architecture, their requirements are specified as part of the "paperless office" concept in Section 5.2.1.4 rather than as a vendor application.)

4.3.1.5.2 Word Processing - AMMUS does not provide for version numbering and modification control within documents. It does not identify the persons responsible for each portion of text changed within a document, nor does it support change control approval. It does not support simultaneously shared word processing text with simultaneous update capability, which is needed to create effective group documents. Furthermore, AMMUS does not support a phonetic spell-checking option, a grammar checker, extended line-drawing characters in word processing documents, mixing graphics, images, text within a word processing document, and the more complex technical requirements.

The programmer and operator interrupt key does not function in word processing. AMMUS software does not permit the user to exchange formatted documents with other word processing systems. AMMUS does not permit the user to automatically extract data from the business data file and use them in a document.

4.3.1.5.3 Presentation Graphics and Imaging - AMMUS does not support color graphics and typeset text within the presentation graphics. It cannot import engineering drawings and images within presentation graphics, and cannot support graphics scanners.

4.3.1.5.4 Engineering Graphics - There is no integrated CADD in ESIMS because AMMUS does not permit intelligent data sharing between the minicomputer and the workstations (see Section 4.3.1.6.5). The only engineering graphics capability available in ESIMS is three-dimensional CADD on a few stand-alone workstations: 8 percent of the AMMUS programmable workstations (i.e., those from the second procurement) and on the few non-AMMUS engineering graphics workstations scattered throughout the E&S organizations. As mentioned in Section 4.3.1.2, all of these workstations lack the interoperability needed to exchange their drawings with other logistics systems within the Air Force and DoD-wide.

4.3.1.5.5 Computer-Based Training (CBT) and Administration - AMMUS does not support full interactive video, digitized audio, voice input, or integrated voice, graphics, and data. It does not allow audio responses to training media requests. These capabilities would allow the training packages to be more readily understood. Furthermore, AMMUS CBT cannot monitor or report student progress.

4.3.1.5.6 Statistical and Trend Analysis - AMMUS does not provide statistical and trend-analysis tools. These tools must be integrated within ESIMS to access any data within the ESIMS.

4.3.1.5.7 Query Language - The only AMMUS query language is the report generator, which is limited to two-file input and has limited arithmetic capabilities. To support reporting requirements and table generation, however, most ESIMS processes require access to information stored in more than two files simultaneously. ESIMS end-users need query capability to access information in all four types of file structures: relational, relative, sequential, and indexed sequential. The query capability must be accessible from three different human-machine interfaces: text mode for expert users, menu and fill-in-the-blanks mode for more casual users, and graphical mode using a mouse or other pointing device. SQL, a recent development which is being supported in many database environments, would satisfy these needs. It allows the user to access information for update and retrieval in a relatively easy manner. AMMUS does not support FIPS-PUB-127, Structured Query Language (SQL), either at the network level or at the user interface level. Figures 4-4 and 4-5 illustrate the SQL support needed to remedy the ESIMS query language shortfall.

4.3.1.5.8 Automated Expert Assistance - AMMUS cannot support a system that can store the knowledge of and the decision processes used by specific functional experts, and make it simultaneously accessible in question-and-answer form throughout the Air Force. This type capability does not exist in AMMUS. Such a system would allow the aggregation of knowledge and experience from multiple sources over time. It would provide a practical, cost effective way for functional personnel to benefit from the knowledge and experience of experts in a variety of areas (such as roofing, structural steel, electrical distribution, and other E&S-related skills) when they encounter problems.

4.3.1.5.9 Electronic Remote Library Support - AMMUS does not support remote borrowing of information media from the E&S central library. Additionally, the information search criteria and the availability of information is not equally accessible to all bases and all functional communities, including tenant organizations, on any base.

4.3.1.6 System Support

Additional support tools and capabilities needed to adequately manage software and data distribution and updates have been identified through the knowledge gained from the AMMUS implementation. ESIMS currently lacks a wide variety of useful system support functions. As the ESIMS requirements and system capacity increases, these support functions will be in greater demand and will become essential for efficient execution of ESIMS applications.

4.3.1.6.1 Electronic Software/Data Distribution - There is no capability to electronically gather, ship, and cause time-sensitive implementation for new and updated items in ESIMS. As a result, information is released to the field through a series of manual, error-prone procedures implemented at each separate site.

4.3.1.6.2 Technical Support - Technical support must be constant, consistent, and orderly for optimal results. ESIMS is currently deficient in the following technical support areas:

(1) **Electronic Question-and-Answer Media** - Neither the minicomputer nor the programmable workstations are able to define question-and-answer-sensitive user-supported context-sensitive "HELP" text associated with error analysis. Without these media, it is often difficult to find the technical expertise needed to correct

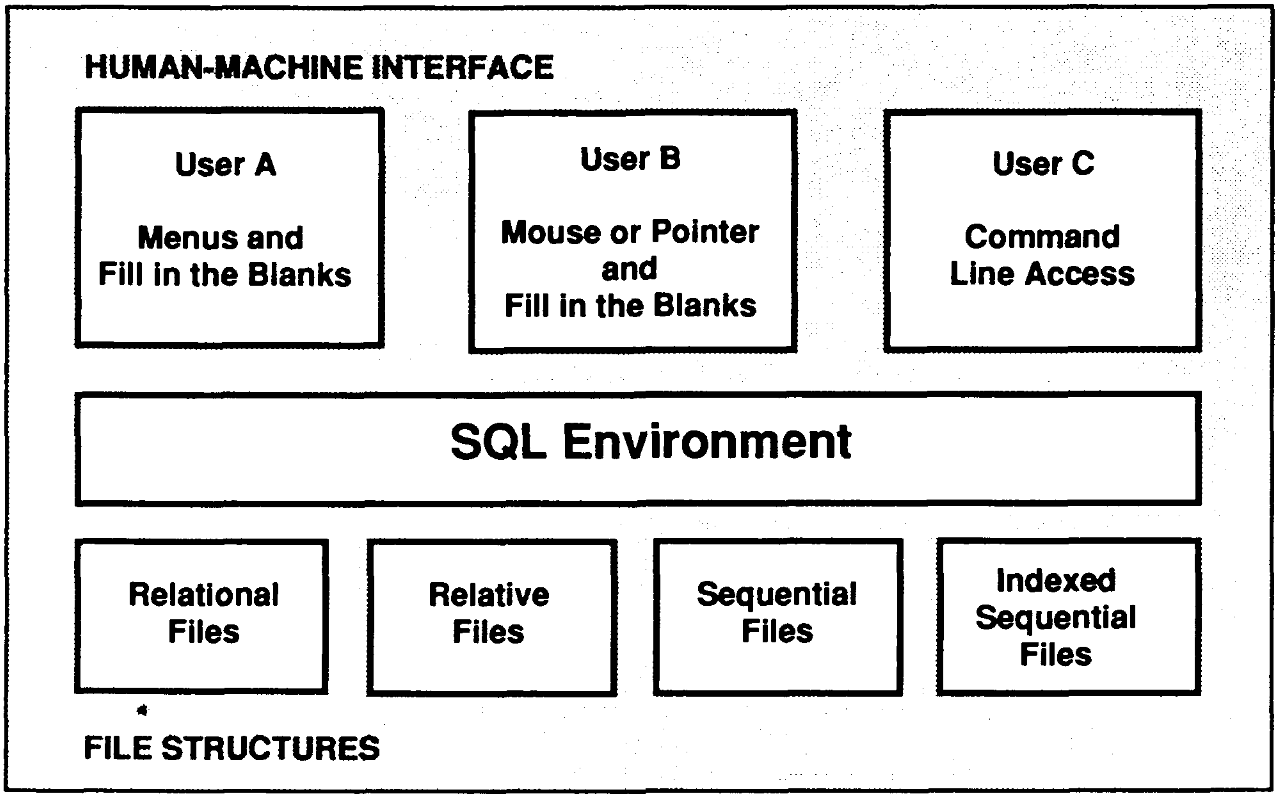

FIGURE 4-4 SQL IN SINGLE CPU ENVIRONMENT

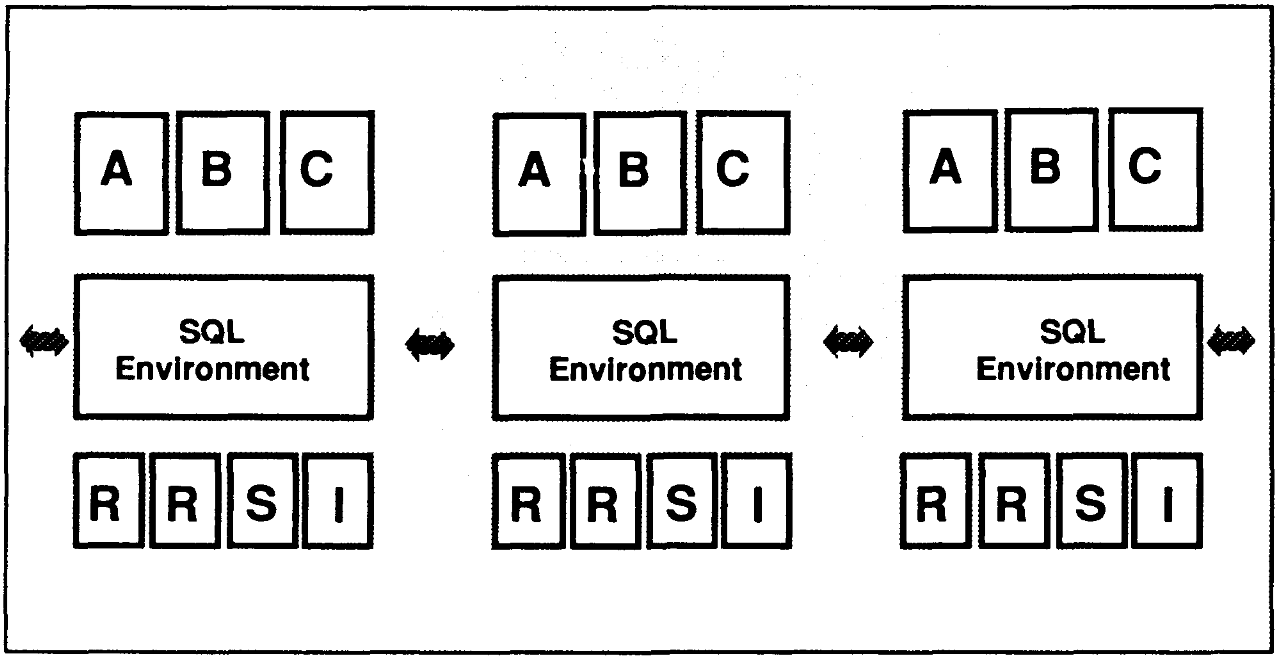

FIGURE 4-5 SQL IN MULTIPLE CPU ENVIRONMENT

problems in a timely manner. An electronic question-and-answer capability would not only provide answers to the person initially reporting the problem, but would also allow others to scan the list of problems and solutions so they could help themselves.

(2) **Short-Term Workstation Session Logger** - AMMUS does not provide an automatic short-term historical user-input capture capability. Often the problems experienced in the field are not accurately communicated to the technical assistant for resolution. The ability to capture 16 full screens of user input, whether in full-screen mode or in character-by-character text mode, would greatly facilitate problem solving.

(3) **Electronic Idea Interchange Forums** - AMMUS does not provide these forums for specialties and interest groups. Such forums would enhance general knowledge and help specialties and interest groups run more effectively.

4.3.1.6.3 Reliability, Repairability, and Maintainability - AMMUS cannot warn the SSA when the system approaches workload limits. Additionally, it does not permit remote field servicing and remote diagnostics. Furthermore, it cannot upgrade both the workstation and minicomputer software automatically without interrupting the applications, destroying data, or causing the system to be inaccessible.

4.3.1.6.4 File Translation Services - AMMUS does not support all of the required file conversion services between spreadsheets or all of those required between word processing documents. Although AMMUS supports the industry standard data interchange format (DIF), the standard lacks the formatting needed for effective data exchange. Although the AMMUS word processing capability can exchange files with the vendor's word processing, it cannot exchange documents with the rest of the Air Force because it does not comply with the Navy Document Interchange Format (NDIF), which is the Air Force document exchange standard.

4.3.1.6.5 Support for Network File Sharing - Contrary to Air Force C-CS architecture requirements, there is no network file-sharing system between the AMMUS minicomputer and any of its workstations (programmable or non-programmable) to allow it to intelligently share data with the workstations. In fact, end-users cannot use minicomputer files on programmable workstations without conversion. Thus, business data and drawing storage files cannot reside in the same environment, while being accessed by CADD software. This kind of data sharing is required to complete the integrated data environment and prevent inconsistent data from being reported. Consequently, AMMUS is not compatible with CADD and cannot support a CADD system such as IGS or any computer-aided design (CAD) capability.

<u>4.3.1.6.6 Context-Sensitive "HELP"</u> - AMMUS does not support on-line, context-sensitive "HELP" in all languages for all applications. The kind of context-sensitive "HELP" that is supported on the minicomputer is vastly different from that supported on the programmable workstations. Thus, the "HELP" user interfaces on the two systems are different. As a result, the end-users must adjust to differences in the "HELP" when changing from one to the other, causing delays. (Although this capability is considered system support in terms of baseline analysis, it will be considered support for software in Future ESIMS; accordingly, its requirements are specified in Section 5.2.7.2.4 rather than under system support.)

4.3.2 Communications

AMMUS ESIMS does not support all of the requirements of the addressing scheme used by DDN (the WAN that connects the various Air Force bases and sites), thereby limiting the addressing capability to classes A and B addresses. This limitation makes it difficult to configure network gateways in a way that logically relieves congestion in base-level aggregate communications.

Although DDN provides network addresses automatically, AMMUS cannot use the Domain Name Service Protocol (DNSP) to update the known network address file and find unknown network addresses within DDN. As a result, the base-level SSA has to manually look up the network addresses for DDN access points.

AMMUS E-mail uses DDN for physical and data link layers, but permits only basic E-mail transfer to other organizations. To comply with GOSIP, ESIMS must comply with all of the features contained in International Organization for Standards (ISO) X.400 and ISO X.500 (i.e., the GOSIP suite requirements for mail routing, directory services, and return address indicators).

AMMUS is not certified for classified processing in any form. However, most war-planning functions require classified E-mail access to their planning partners in the base-level CE Planning unit. To avoid classifying an entire system, E&S can transmit the classified E-mail over secure telephone systems using TEMPEST programmable workstations in stand-alone mode.

AMMUS cannot provide direct-dial access in the event of network failure without reconfiguring network communications. To support the peel-down architecture and graceful degradation requirements for combat support, ESIMS must be able to automatically redirect communications during a communications failure.

AMMUS does not comply with the following major features required by the Unified Local Area Network Architecture (ULANA) specification: baseband Ethernet, 802.3, and broadband Ethernet. As a result, ESIMS does not provide a two-way path to E&S information for those base-level Logistics functional areas that require it.

The Integrated Services Digital Network (ISDN) is not supported by AMMUS. Air Force C-CS architecture requires ISDN for connectivity between remote workstations and host CPCs.

AMMUS does not support any type of radio attached workstations. Consequently, the fire response plans and the considerable information used in disaster response in ESIMS cannot be accessed by the on-site team. Instead, this information is dynamically updated in the data files and is transmitted to the on-site team orally or via telephone; the on-site team then maintains the information on paper records. Additionally, radio attached workstations are necessary to provide initial data communications at a deployed site because there is a lag between the initial deployment of troops and the implementation of hard-wired communications.

When providing application access from both local workstations (LAN access) and remote terminals (DDN TELNET access), AMMUS system software cannot provide "display and read" features that are transparent to the application. To support both remote (TELNET) and LAN access to an ESIMS application, two separate screen applications must be written and maintained. This significantly increases the programming workload, network traffic load, and the processing workload of each host computer. For example, to create a full-screen application on a remote terminal, the TELNET protocol must be set up to deliver each single character keystroke to the host program. The host program must then emulate the services provided by a normal terminal by deciding from each keystroke where to position the cursor and whether the keystroke is legal. Cursor positioning instructions and the character to be displayed are then returned to the terminal. Accomplishing this task in the various required languages of ESIMS would yield representative line counts as follows: 1,500 lines in COBOL, 1,800 lines in Ada, 1,200 lines in C, and about 800 in FORTRAN, compounding the software maintenance and debugging task for each ESIMS application. This code is totally incompatible with the "display and read" process used for full-screen programming.

Because AMMUS does not support Virtual Terminal (VT) protocols, it cannot comply with GOSIP, making communications between ESIMS and non-AMMUS systems extremely difficult. Two varieties of virtual terminals are permitted by GOSIP: VT-A (asynchronous) and VT-S (synchronous). VT-A is an asynchronous terminal capability defined in two parts: terminal emulation and application network access. VT-S is similar to VT-A, except the virtual terminal is block-mode (i.e., it uses an entire screen at a time). Like VT-A, VT-S is defined by terminal emulation and application access components.

ESIMS applications are generally full-screen, fill-in-the-blanks. Implementing these applications over a networking medium using VT-A causes unacceptably high network packet traffic. That is, a packet must be dispatched with each keystroke from the terminal, creating demand for a return packet as well, and most of these ESIMS applications contain a minimum of 50 keystrokes per screen. To remedy this shortfall, ESIMS needs VT-S in addition to VT-A for remote terminal support. VT-S is defined to manage a screen at a time. After the initial screen is passed, the return packet will not be issued until one of the special keys indicating action required is pressed.

AMMUS cannot access E-mail using Unix-to-Unix CoPy (UUCP), which is required to transfer Unix E-mail between different Unix networks. In many of its activities, E&S research and development uses Unix E-mail instead of normal DDN Simple Mail Transfer Protocol (SMTP) mail and have demonstrated that the additional E-mail access provides more effective mail paths to other research and development organizations using Unix.

AMMUS does not support facsimile (fax) capability. In many of its commercial activities, E&S uses fax technology and has demonstrated that it can greatly facilitate message exchanges with minimal delay.

AMMUS lacks interoperability with other logistics systems, both within the Air Force and DoD-wide, because it does not comply with the following CALS communications standards:

(1) **MIL-STD-1840A, Automatic Interchange of Technical Information (AITI)** - This noncompliance prevents electronic publishing of technical orders or the interchange of technical order data with other agencies.

(2) **MIL-M-28001, Markup Requirements and Generic Style Specification** - This noncompliance significantly inhibits exchange of textual documents associated with publishing regulations and directives.

(3) **MIL-D-28003, Computer Graphics Metafile (CGM) Application Profile System** - This noncompliance significantly inhibits the transfer of presentation graphics between application packages.

Finally, AMMUS cannot access commercial WANs. As a result, its only connectivity is through extremely primitive teletype operations, which lack file transfer. Without this transfer, the Air Force has to rent file storage space on the host computer. An example of this problem is the pavement model, which is currently running at the University of Illinois, used to diagnose and recommend pavement replacement procedures.

4.3.3 Security

As stated in Section 3.3.3, the overall system security of the AMMUS minicomputer and the terminals linked to it approximates the C2 level specified in DoD 5200.28-STD, DoD Trusted Computer System Evaluation Criteria. However, it has not been certified by the National Security Agency (NSA) because AMMUS security does not comply with the recently added object reuse criteria specified in DoD 5200.28-STD. That is, AMMUS does not automatically write random patterns over all of the disk, main memory, and tape when the operating system releases them. To support the security needs of E&S, ESIMS must be certified by the NSA for at least the C2 level of protection specified in DoD 5200.28-STD.

Additionally, AMMUS does not support Data Encryption Standard (DES) file encryption and decryption, nor does it support message element encryption of E-mail. Although neither of these capabilities are required by DoD 5200.28-STD criteria, both are necessary to meet the privacy needs of E&S personnel.

4.3.4 Electrical Power

The standards established by the electrical power industry define a maximum outage during a power switch operational cycle as 20 milliseconds. AMMUS lacks the electrical power storage capacity to survive a one-half cycle power outage without power conditioning or UPS system support, both of which it also lacks. In fact, AMMUS hardware functions correctly for only 8 milliseconds during a power outage. Furthermore, based on AMMUS ESIMS experience, the power industry standard is too short to protect very expensive electrical power distribution equipment. As the power distribution equipment ages, the switching time increases, sometimes to 35-40 milliseconds. AMMUS ESIMS experience dictates that the outage requirement should be increased to 1 second (60 cycles) to avoid computer shutdown during minor outages. (The electrical power industry has determined that 99 percent of all power outages last less than 1 second and considers outages of 1 second or less minor outages.)

Because AMMUS lacks both power conditioning and an UPS system, it is obviously unable to support the minicomputer during a major outage (more than one second). A 20-minute UPS capability is required to back up sufficient data to the workstations so they can carry on activities until either the electrical power source is restored or a diesel generator can be started to provide power for the CPC. This capability is needed to provide the "peel-down" architecture and "graceful degradation" capabilities needed during combat. Eight hours of protection would be required to confidently compensate for surges, sags, noise, and lightning.

The AMMUS electrical power specifications do not recognize momentary outages caused by commercial switching equipment and thus cannot guarantee the continuous computing capability required during wartime and emergencies. ESIMS needs power conditioning equipment that will supply continuous computing. AMMUS is also unable to protect ESIMS during brownouts, i.e., reductions in voltage while maintaining current flow. (Under heavy load conditions, the electrical power industry provides full power at lower voltage rather than shedding part of the power load. This is done to allow passive resistive heating appliances to continue to function when power system production capacity has been exceeded.) Power conditioning equipment detects low voltage and restores the voltage to an operational level before delicate electronic components are damaged by the reduced voltage. The Power Conditioning and Continuation Interfacing Equipment (PCCIE) Handbook requires the following: "The PCCIE may be an integral (built-in) component of the system it supports, or may be an adjacent separate part of it. Adjacent PCCIE should be provided by the same contractor that installed the equipment it supports, to avoid the division of responsibility and noncompatibility."

Finally, the switching power supply used by the AMMUS minicomputer and workstations creates harmonics on the powerline that can damage the other equipment in a building and emergency power generation equipment. Modern computer power supplies turn the power on for a small portion of the AC cycle to regulate their output voltage. In the process of switching each cycle, there are some harmonic frequencies produced on the powerline supplying the equipment that should not be present outside the minicomputer and the workstations. These harmonic currents (especially the third harmonic in three-phase power systems) tend to add together and cause unacceptably high currents in the neutral phase of the powerline, which in not protected from overcurrents. These peak surges in current also tend to be additive in the phases of the power generation equipment as the switching load becomes a significant part of the generator's load. With the increasing quantity of computer equipment present in wartime, there is a risk of damaging the mechanical and electrical components of the field generators, as well as the possibility of overheating the neutral conductors in the power distribution system.

Note: AMMUS did specify and provide power protection against fast rise-time surges. The electrical power shortfalls identified here are lessons learned from actual implementations worldwide.

4.3.5 Future Vision

This section discusses the technologist shortfalls projected between 1995 and 2010 based on the long-range planning process outlined in the Future Vision document. These shortfalls are listed according to the numbered trends in Table 4-1.

The following shortfalls derive from Future Vision trends 1 and 2 (see Table 4-1). They involve the aging of the workforce, the decrease in professional and scientific degrees and lower general education level, and the related difficulties in recruiting career personnel.

ESIMS Shortfalls (TRENDS 1,2):

Because the workforce will have little or no experience with computers and/or little higher education, a sophisticated training program will be needed. Training should be accomplished through courses and state-of-the-art CAI packages, on-line context-sensitive "HELP" procedures, etc. The latest hardware technology should be used to provide color, video, and, audio capabilities for all training media. More development of user interfaces and error detection is needed.

The following shortfalls derive from Future Vision trends 3, 4, 5, 6, 7 and 8 (see Table 4-1). They involve the reduction in overseas bases, the basing mode for land-based ICBMs, SDI implications, maintenance of aging air bases and facilities, uncertain air basing prospects, force projection from CONUS bases, base recovery after attack, and worldwide low-intensity conflicts.

ESIMS Shortfalls (TREND 3):

This trend will require new applications to be created to support the new methods of basing for ICBMs. The technologist will need to assist in designing and creating the appropriate software applications to support these efforts.

ESIMS Shortfalls (TREND 4):

This trend will force the bases to maintain older facilities and equipment and to integrate them into new facilities and equipment. To support these operations, ESIMS will need additional software applications and appropriate system software and hardware, including CADD applications, networking and communications software, and computers with large processor, memory, and disk capacities. The technologist will have to help supply the needed hardware and software.

ESIMS Shortfalls (TREND 5,6):

This trend will require ESIMS to have flexible, user-generated tools that will allow for base-specific requirements in support of the needs of CE and SV. ESIMS will need to provide state-of-the-art user-generated tools software as well as modular, easily modifiable applications for this purpose.

ESIMS Shortfalls (TREND 7):

This trend will require ESIMS to be able to quickly report and assess damage and to identify useable resources and facilities, to initiate the best repair efforts possible, and to provide self-sufficient, rugged, portable, and repairable equipment. This will require state-of-the-art workstations and remote sensing equipment, as well as the appropriate software applications to support these efforts.

ESIMS Shortfalls (TREND 8):

This trend will increase the need for new, appropriate applications, such as damage reports and resource and facility identification. The technologist will need to assist in designing and creating the appropriate software applications to support these efforts.

The following shortfalls derive from Future Vision trends 12 and 13 (see Table 4-1). They involve establishing Air Force facilities on the Moon, on Mars, and on orbiting platforms. Although, because of budgetary issues, it has not been determined exactly when these facilities will be needed, CE must be prepared to provide the infrastructure to integrate space operations into the Air Force structure.

ESIMS Shortfalls (TRENDS 12,13):

This trend will increase the need for new, appropriate applications (such as food, lodging, laundry) that will support crews for extended periods. This will require state-of-the-art, ruggedized workstations, as well as a DDN connection to remote sites in space.

The following shortfalls derive from Future Vision trends 14, 15, and 16 (see Table 4-1). They involve the increased power built into software, faster processing, lower hardware costs, availability of memory, slow software development, and developments in input/cutput devices.

ESIMS Shortfalls (TREND 14):

Maintenance of the information resource will become more automatic, both decreasing the time required to update the information and increasing the requirement for accuracy and completeness. Tactical and economic decisions will rely increasingly on automated information, making the integrity of the information mission-critical. ESIMS technologists must use this new software for its applications.

ESIMS Shortfalls (TREND 15):

This trend will increase the need for programmers and developers to be freed to produce more software code. Customers should, along with end-users, help in generating the requirements and prototypes for ESIMS applications. In addition, ESIMS should make use of the latest advances in COTS software and interoperability among different hardware platforms. This will alleviate the need for technologists to rewrite source code for different software and hardware environments.

ESIMS Shortfalls (TREND 16):

Specification of standard physical interfaces and data interfaces will permit ESIMS workstations to incorporate any of the new peripherals as needed. As input/output devices become available, additional types of data will be available, and will contribute to the ESIMS "corporate" data resource. A wider variety of user interfaces will be available, providing new ways to obtain information from and supply input to a computer. Technologists need to acquire and properly configure these new items into the ESIMS applications.

The following shortfalls derive from Future Vision trends 17 and 18 (see Table 4-1). They involve the shortage of power generation plants, increasing demand for electricity, and cogeneration of power.

ESIMS Shortfalls (TRENDS 17,18):

These trends will require customers to use major energy conservation programs. Technologists should work with customers and end-users in determining the requirements for such programs, including any software applications needed to monitor power usage. Such applications should include CADD generated output. Technologists should also acquire equipment with the most advanced electrical protection and UPS.

The following shortfalls derive from Future Vision trends 19, 20, and 21 (see Table 4-1). They involve municipal development, waste disposal and minimization, and the growth of environmental engineering responsibilities.

ESIMS Shortfalls (TREND 19):

Air Force facility planning and management functions will incorporate municipal and regional planning skills, and will require regular interfacing with local planning authorities. The technologist must provide the connection for this interface.

To represent the base's needs and to advocate the Base Commander's proposals, ESIMS must be able to produce presentation graphics (including facility maps, trend analysis, and details from the engineering drawing database) quickly and inexpensively. These graphics must be colorful and professional. The technologist must ensure that the appropriate CADD hardware is in place to accommodate these graphics requirements.

ESIMS must support extraction of data to meet specific public demands and to highlight specific points.

The ESIMS recycling system will support a consistent and effective recycling effort which will support local businesses and contribute to the local community.

ESIMS Shortfalls (TREND 20):

Waste treatment plants will require engineering and retrofitting to meet new standards. CE will be responsible for evaluating, planning, and implementing changes in the base waste treatment facilities. Automation of this activity will help E&S personnel with project planning and acquisition, management, and monitoring of contractor services.

Performance and operations of the plant will be captured by RPIE automatically, providing baseline data and triggering alarms when thresholds are reached.

RPIE detectors will monitor inflow of hazardous substances into the treatment plant, identify the source, and indicate action. These data sources will also be reportable to the CPC.

Output of the waste treatment plant will be recycled or disposed of according to EPA guidelines. Both of these processes will use purified water, and the recycling process will recover expensive chemicals. ESIMS must track all of the products involved in both processes, including their storage, distribution, use, and final disposition.

ESIMS Shortfalls (TREND 21):

ESIMS must include data acquisition, modeling, and planning software for effective operation and management of a waste minimization program.

E&S must develop and maintain interfaces with the local recycling industry.

The following shortfalls derive from Future Vision trends 23, 24, 25, 27, and 28 (see Table 4-1). They involve improvements in food service, subsistence in space, automation in the lodging industry, mass casualty procedures, space casualty handling, and privatization.

ESIMS Shortfalls (TREND 23):

ESIMS must include menu management software that not only supports planning of menus with a broader selection and nutritional information, but also uses sales data to provide trend analysis.

Procurement software must provide for quality, freshness, nutritional content, and dependability factors, as well as price factors in selecting food service vendors.

For crisis conditions, the WAN must support SIMS foodstuffs inventory software to combine inventories in a geographical area so that bases can mutually support each other until supply lines reopen.

To use local, commercial stocks of foodstuffs, SIMS must be able to read, decode, and use barcodes; to interpret both Logistics Marking and Reading Symbol (LOGMARS) barcodes and commercial universal product code (UPC) labels; and to correlate the equivalent codes for similar foodstuffs in the food services inventory. This barcoding capability will greatly facilitate inventory control.

ESIMS Shortfalls (TREND 24):

SIMS must include not only planning, inventory management, and budgeting, but also interfaces to process control systems that run automated food preservation and preparation equipment.

The emergence of debit cards and the popularity of credit cards points to the opportunity to use this technology at the point-of-sale terminal to speed up checkout, increase the accuracy of accounting, and further reduce the possibility of cash theft.

There must be electronic access to credit card clearing services to validate purchases.

For in-transit personnel or others with temporary entitlement to food services, a magnetic strip debit card (similar to that used in the Washington, D.C. Metro system) can be issued and used to grant and control access and use.

Local or regional automated food preparation will provide opportunities to purchase in bulk quantities, and to create individual portions without intermediate packaging or handling. The larger quantities will increase the chance of error, thereby requiring automated inventory management and computer-aided planning.

ESIMS Shortfalls (TREND 25):

Services will provide additional in-transit services such as computer terminals or connections in guest rooms, thereby providing guests with direct digital access to their normal computing support facility.

RPIE sensors installed in the rooms will detect the presence of occupants, making possible energy conservation and increased security.

Automatic check-in and check-out can reduce the time required for in-transit activities, as well as increase the accuracy of the data maintained in the system. The use of credit, debit, and smart cards will enhance this alternative to the manual process.

Billeting managers will rely on SIMS to analyze and plan resources, staff, and facilities. E&S customers will benefit from this use of SIMS software. They will be able to verify room charges, make automated travel arrangements, request services, and connect through DDN to their home base system. The in-transit locator will permit sending E-mail to in-transit personnel.

ESIMS Shortfalls (TREND 27):

Because a space site is remote and in a hostile environment, constant remote maintenance monitoring is necessary so that any repairs will be minor; the consequences of a major failure of any system will be catastrophic.
As new ways are developed to meet personnel subsistence needs, these methods, equipment, and subsystems must be accommodated within the Air Force equipment, support, and training systems. Planning and implementing these methods and systems will require additional interfaces, multiple skills per person, and software support.

ESIMS Shortfalls (TREND 28):

To rapidly identify civilian casualties without military records, the Mortuary Affairs system must interface with appropriate medical, insurance, and law enforcement databases.

The following shortfalls derive from Future Vision trends 31, 32, and 33 (see Table 4-1). They involve remote sensing equipment, contract management, build-lease acquisitions, computer support, and force projection.

ESIMS Shortfalls (TREND 31):

Because build-lease contractors will select and install their own environmental control and monitoring equipment (within Air Force specifications only for new buildings), Future ESIMS must be able to interact with the environmental control and monitoring equipment.

E&S must maintain as-built drawings for these buildings. Thus, the CADD system must be able to exchange existing drawings from vendor-supplied formats to Air Force format.

E&S must have a statistical trend-analysis system to monitor vendor and material quality and to establish availability of quality vendors and materials.

ESIMS Shortfalls (TREND 32):

Future buildings will contain sensors, communications, and a central control point. Future ESIMS must be able to interact with the control point to extract maintenance and usage-sensitive data associated with building occupancy.

ESIMS Shortfalls (TREND 33):

E&S procurement requisition processes must interface with the logistics acquisition systems, to launch procurements efficiently, to obtain unit costs quickly, and to report status.

Interfacing with local commercial suppliers requires data communications and appropriate interface software.

TABLE 4-1 FUTURE VISION TRENDS

1. "The workforce is aging. More women are entering the workforce. The demand for educated and skilled workers will increase."

   There will be two trends in users. More of the older workers will have used computers in previous jobs. On the other hand, more workers with no computer experience will be required to use computers.

   Sections 4.1.2, 4.2.4, 4.3.5

2. "Numbers of degrees granted are expected to decline. Education is becoming more perishable. Lifelong training and retraining will become more common."

   Sections 4.1.2, 4.2.4, 4.3.5

3. "Tactical Air Forces are likely to be faced with a significant reduction in overseas bases."

   Sections 4.1.2, 4.2.4, 4.3.5

4. "Air bases of the near future will be much like those of today. Most of the USAF CONUS bases in the year 2000 already exist and maintenance of these aging systems will be a prime E&S task. By 2010, some significant air base changes driven by new technology and operational concepts will begin to emerge."

   Sections 4.1.2, 4.2.4, 4.3.5

5. "Access to overseas bases is diminishing. Access to airfields and airspace has changed dramatically. Present strategy recognizes the potential of our air power, but requires us to depend on uncertain air basing prospects."

   Sections 4.2.4, 4.3.5

6. "Reduction in overseas forces will lead to operational strategies for force projection from CONUS bases, which will generate added requirements to provide adequate air base support for many types and locations of forward air operations."

   Sections 4.2.4, 4.3.5

7. "Strategic defensive operations are coming ever closer to reality. Major strategic defensive systems could begin deployment within the next 10 years."

   Sections 4.1.2, 4.2.4, 4.3.5

8. "US Air Forces are finding themselves increasingly involved with low-intensity conflict operations in all parts of the world."

   Sections 4.1.2, 4.3.5

9. "No new, large land-based ICBM (beyond Peacekeeper) seems likely to be developed within the next 20 years. A smaller, mobile ICBM is currently under development. A high degree of uncertainty persists regarding the best basing mode to be used for land-based ICBMs."

   Sections 4.2.4, 4.3.5

10. "Recent programs have been toward acquiring a capability to manage and accomplish base recovery after attack."

    Sections 4.2.4, 4.3.5

11. "US Air Forces are finding themselves increasingly involved with low-intensity conflict operations in all parts of the world."

    Sections 4.2.4, 4.3.5

12. "US projects manned Lunar and Mars bases."

    Sections 4.1.2, 4.2.4, 4.3.5

13. "Air Force E&S is planning for the support of future space operations."

    Sections 4.1.2, 4.2.4, 4.3.5

14. "Software will continue to become more powerful, making computing and data storage capabilities more useful to end-users."

    Sections 4.1.2, 4.2.4, 4.3.5

15. "Software development and production are not keeping up with hardware capabilities."

    Sections 4.2.4, 4.3.5

16. "The variety of input/output devices is expanding and will continue to widen."

    Section 4.3.5

17. "The demand for electric power throughout the U.S. is continuing to increase while the number of generating plants available for providing this power continue to decrease. This will lead to major shortages of power within the next 10 years."

    Sections 4.1.2, 4.2.4, 4.3.5

18. "There will be a significant shift toward smaller, distributed, cogeneration power systems."

    Sections 4.1.2, 4.2.4, 4.3.5

19. "Bases will continue to be threatened by encroachment from municipal development, lack of coordinated municipal and airport planning, and effective local zoning as the population continues to concentrate in urban areas."

    Sections 4.1.2, 4.2.4, 4.3.5

20. "Waste disposal practices will come under increasing scrutiny."

    Sections 4.1.2, 4.2.4, 4.3.5

21. "Waste minimization techniques will become more economically attractive."

    Sections 4.1.2, 4.2.4, 4.3.5

22. "Environmental Engineering will become an integral part of system design and construction."

    Sections 4.1.2, 4.2.4, 4.3.5

23. "The pace of daily activity and higher disposable incomes will continue to fuel the demand for wide menu selection, excellent meal quality, and flexibility in off-premise consumption."

    Sections 4.1.2, 4.2.4, 4.3.5

24. "Technology, in the form of automation and robotics, will also dramatically change the way food service activities operate and how they are managed."

    Sections 4.1.2, 4.2.4, 4.3.5

25. "The transient lodging industry, like many others in the U.S., is seen as becoming increasingly bi-modal, with an upscale end for most vacation and business travelers and an economy end offering few amenities but very low rates. Automation will become increasingly pervasive in the lodging industry, being used more and more by both management and guest."

    Sections 4.1.2, 4.2.4, 4.3.5

26. "Privatization and the use of service contracts will increase, especially in the federal sector."

    Sections 4.1.2, 4.2.4

27. "As increasing numbers of people, including military crew members and support personnel, spend increasing lengths of time in space, new ways are being developed to satisfactorily meet their subsistence needs."

    Section 4.3.5

28. "Despite efforts to decrease the likelihood of large numbers of simultaneous casualties, the complexity of our world increases the possibility of mass casualty situations."

    Sections 4.2.4, 4.3.5

29. "[Operations and Maintenance] O/M of future bases will respond to operational strategies of force projection from CONUS main operating bases. Therefore, Air Force E&S will be called on to more rapidly provide base support at forward operating locations."

    Section 4.2.4

30. "There is a shift from in-house engineering, construction, operation, and maintenance to contracts with specialist companies and consultants."

    Sections 4.1.2, 4.2.4

31. "Industry is using build-lease as an acquisition strategy."

    Sections 4.1.2, 4.2.4, 4.3.5

32. "Buildings and bases will be managed using increasing quantities of computer like equipment that will require both hardware and software maintenance strategies."

    Section 4.3.5

33. "Logistics acquisition systems are becoming increasingly computer based and interactive."

TABLE 4-2 ESIMS SHORTFALLS

Each shortfall listed below is a required C-CS capability that is either inadequately supported by AMMUS ESIMS or not supported at all.

Key to Information Sources of Capability Deficiencies

AFMEA	= Air Force Management Engineering Agency study
AMMUS	= Existing AMMUS contract requirements
FI	= Field interviews
FV	= Future Vision document
LGXS	= AF Information Systems Division (HQ LGXS) supported policies
TI	= Technologist interviews

ESIMS Deficiencies			Information Sources of Deficiency
I.	**HUMAN-MACHINE INTERFACE**		
	A.	Windows	FI, TI
	B.	Default desktop	FI, TI
	C.	Standard keyboard for all workstation levels	AMMUS, FI
	D.	Intelligent context-sensitive "HELP" system	AMMUS, FI, FV, TI
	E.	On-line tutorials for all standard applications	FI, FV, TI
	F.	Pointing devices (track balls, mice, etc.)	FI, TI
	G.	Headphone jack with volume control	FI, TI
II.	**FUNCTIONAL APPLICATIONS**		
	A.	Civil Engineering	
		1. CADD support for site planning and landscape architecture	FI, FV, TI
		2. Increased capacities and facilities	FI, FV, TI
		3. Software support for downsizing of operations	FI, FV, TI
		4. Support of integrated specifications and traceability	FI, TI
		5. Expansion of WIMS engineering tools	AFMEA, FI, FV, TI
		6. CE data support for emergency responses	FI, FV, TI
		7. Support of repair responses	AFMEA, FI, FV, TI
		8. Support of rapid turnaround for repairs	AFMEA, FI, FV, TI
		9. Modeling support for optimization of power plants	FI, FV, TI
		10. Expansion of facility engineering tools	AFMEA, FI, FV, TI
		11. Integration of CADD with WIMS Data	AFMEA, FI, FV, TI
		12. CE data for recyclable materials	AFMEA, FI, FV, TI
		13. Environmental engineering CADD tools	AFMEA, FI, FV, TI
		14. Pavement analysis database	FI, TI
		15. HAZMAT database	FI, TI
		16. Recycling system interfaces with other systems	FI, FV, TI
	B.	Services	
		1. Scheduling system for interment	AFMEA, FI, FV, TI
		2. Interfaces with other databases for rapid identification of remains	FI, FV, TI
		3. Material requirements planning for SIMS	AFMEA, FI, TI
		4. Enhancement of SIMS food service software	AFMEA, FI, FV, TI
		5. Software support for downsizing of operations	FI, FV, TI
		6. Increased capacities and facilities	FI, FV, FI
		7. SIMS software to interface cost accounting	AFMEA, FI, FV, TI
		8. Automation of SIMS interface to Commissary information	AFMEA, FI, FV, TI
		9. SIMS support of debit-card creation	FV
		10. Expansion of SIMS	AFMEA, FI, TI
		11. SIMS Billeting Management software connected to worldwide reservation and MIS network	AFMEA, FI, FV, TI

	C.	Management and Planning		
		1.	Support of warranty tracking and reporting	FI, TI
		2.	Modular ESIMS software	FV
		3.	On-line database for rules and regulations	FI, TI
		4.	Support for local control and monitoring equipment	FI, TI
		5.	Local workstations for requisitioning	FI, TI
		6.	Software for build-lease management	FI, FV, TI
		7.	Planning and estimating support	AFMEA, FI, FV, TI
		8.	Reporting and control software for project management	FI, TI
		9.	Maintenance of bidder lists for contracts	FI, FV, TI
		10.	Automated support for reporting HAZMAT spills	FI, FV, TI
		11.	Model software for contract awarding process	FI, FV, TI
		12.	Tracking of contracts and schedules	AFMEA, FI, FV, TI
		13.	Support for prepositioning of forces	AFMEA, FI, FV, TI
		14.	Database for accounts balances	FI, TI
		15.	Software support for CE and SV vehicle maintenance tracking	FI, TI
III.	**CENTRAL PROCESSING COMPUTER (CPC)**			
	A.	Transparent multiprocessing		FI, FV, TI
	B.	Deployability		AMMUS, FI, TI
		1.	Deployment kits, spares, and supplies	FI, FV, TI
		2.	Ruggedized, portable shipping cases	FI, FV, TI
	C.	Interoperability standards compliance		FI, TI, LGXS
		1.	FIPS-PUB-146, GOSIP	FI, TI, LGXS
		2.	FIPS-PUB-151, POSIX	FI, TI, LGXS
	D.	Processing capacity		FI, FV, TI
	E.	Memory Capacity		AMMUS, FI, FV, TI
	F.	Storage Capacity		AMMUS, FI, TI
	G.	Peripheral Support		FI, TI
		1.	Independent peripheral activity	FI, TI
		2.	A multitude of ports	FI, TI
		3.	Communications connectivity and support	AMMUS, FI, TI
IV.	**WORKSTATIONS**			
	A.	Deployability		AMMUS, FI, TI
		1.	Ruggedized workstation hardware	FI, FV, TI
		2.	Portable workstations	FI, FV, TI
		3.	Deployment kits, shipping cases, spares, and supplies	FI, FV, TI
		4.	Ability to handle electrical power of questionable quality	FI, FV, TI
	B.	Interoperability standards compliance		FI, TI, LGXS
		1.	FIPS-PUB-146, GOSIP	FI, TI, LGXS
		2.	FIPS-PUB-151, POSIX	FI, TI, LGXS
	C.	Interchangeable generic workstation		FI, FV, TI
		1.	Fully compatible with but independent of CPC	FI, TI
		2.	Modular hardware and software to accommodate all functions	FI, FV ,TI

D. Support for software

1.	Imaging	FI, FV, TI
2.	COTS software compatibility	FI, TI
3.	Network connectivity and support	FI, FV, TI
4.	Interactive video support	FI, FV, TI
5.	Digitized audio support	FI, FV, TI
6.	Voice input support	FI, FV, TI
7.	CALS-compliant graphics	FI, TI, LGXS
a.	FIPS-PUB-120, GKS	FI, TI, LGXS
b.	MIL-D-28000, IGES	FI, TI, LGXS
8.	Network interface with capacity to transfer graphics files	FI, FV, TI
9.	Remote-sensing capability	FV, FV, TI
10.	Error-sensing capability	FI, TI
11.	Portable barcode reading capability	FI, FV, TI
12.	Debit/credit-card reader	FV, TI

V. LANGUAGES

A.	Major programming languages	AMMUS, FI, FV, TI
1.	Ada	AMMUS, FI, FV, TI
2.	C	FI, FV, TI
3.	SQL and Interactive SQL	FI, FV, TI
B.	Consistent support between programmable workstation and CPC for available languages (BASIC, COBOL, and FORTRAN)	AMMUS, FI, FV, TI, LGXS

VI. DEVELOPMENT TOOLS

A.	Editing tools	
1.	Consistent tools between programmable workstation and CPC	FI, FV, TI, LGXS
2.	Source-code version-control management system	FI, TI
3.	Date-sensitive compilation scripts	FI, TI
4.	Access to context-sensitive "HELP" from within source-code language editors	FI, FV, TI
B.	Language tools	
1.	Cross-language thesaurus	TI
2.	Application-to-application program interfaces	FI, TI
C.	Data dictionaries	FI, TI, LGXS
1.	Compliance with FIPS-PUB-156, IRDS	FI, TI, LGXS
2.	A data dictionary support system that facilitates creation and maintenance of data elements within dictionaries.	TI, LGXS
3.	Standard data naming conventions	FI, FV, TI, LGXS

VII. VENDOR APPLICATIONS

A.	Office Automation	
1.	Interactive video support	FI, TI
2.	Digitized audio attached to E-mail messages	FI, TI
3.	Voice input support	FI, TI
4.	Electronic signature verification	FI, TI

	B.	Word processing	
		1. Version and modification control	FI, TI
		2. Identification of user making specific changes	FI, TI
		3. Change-control approval	FI, TI
		4. Shared text and simultaneous update capability	FI, TI
		5. Phonetic spell-checking option	FI, TI
		6. Grammar checker	FI, TI
		7. Exchange of formatted text with other word processing systems	FI, TI
	C.	Presentation graphics and imaging	FI, TI
		1. Color graphics and typeset text	FI, FV, TI
		2. Direct interface to CADD, text, and functional databases	FI, FV, TI
		3. Graphics scanners	FI, FV, TI
	D.	Engineering graphics	FI, FV, TI
		1. Integrated CADD	FI, FV, TI
		2. Interoperability with other AF and DoD logistics systems	FI, FV, TI
	E.	Training presentation and administration	FI, FV, TI
		1. Digitized audio support	FI, FV, TI
		2. Voice input support	FI, FV, TI
		3. Integrated voice, graphics, and text	FI, FV, TI
	F.	Statistical and trend-analysis tools	TI
	G.	Query language	FI, TI
		1. Query capability in four kinds of files: relational, relative, sequential, and indexed sequential	FI, TI
		2. Compliance with FIPS-PUB-127, Database Language SQL	FI, TI
	H.	Automated expert assistance	FI, TI
	I.	Electronic remote library support	FI, TI
VIII.	**SYSTEM SUPPORT**		
	A.	Software/data distribution	TI
	B.	Technical support	FI, TI
		1. Electronic question-and-answer media	FI, TI
		2. Short-term workstation session logger	FI, TI
		3. Electronic idea interchange forums	FI, TI
	C.	User training	FI, TI
		1. Full interactive video and full audio	FI, TI
		2. Audio responses to training media requests	FI, TI
	D.	Reliability, repairability, and maintainability	FI, TI
		1. Advance notification and shutdown capability	FI, FV, TI
		2. Remote maintenance monitoring/diagnostics	FI, TI
		3. Automatic upgrade of workstation and CPC software	FI, TI
	E.	File translation services	FI, TI
		1. All conversion services between spreadsheets	FI, TI
		2. All conversion services between word processing documents	FI, TI
		3. Compliance with NDIF	FI, TI

	F.	Support for network file sharing	FI, TI
	G.	Context-sensitive "HELP" in all languages and all applications	FI, TI
		1. Consistent "HELP" interface between programmable workstation and CPC	FI, TI
IX.	**COMMUNICATIONS**		
	A.	Full compliance with DDN's addressing scheme	TI
	B.	Direct-dial access to redirect communications	TI
	C.	Compliance with major features required by ULANA	TI
	D.	ISDN for connectivity with remote workstations	TI
	E.	Transparent "display and read" features	TI
	F.	E-mail access using UUCP	TI
	G.	Fax capability	FI, TI
	H.	Access to commercial WANs	FI, TI
	I.	Compliance with CALS interoperability standards	FI, TI, LGXS
		1. MIL-STD-1840A, AITI	FI, TI, LGXS
		2. MIL-M-28001, Markup Requirements and Generic Style Specification	FI, TI, LGXS
		3. MIL-D-28003, CGM Application Profile System	FI, TI, LGXS
X.	**SECURITY**		
	A.	NSA certification for C2 level of trust (DOD Directive 5200.28-STD)	FI, TI, LGXS
	B.	Ability to automatically write random patterns over all of the disk, main memory, and tape	FI, TI
	C.	DES file encryption and decryption	FI, TI
	D.	Message element encryption of E-mail	FI, TI
XI.	**ELECTRICAL POWER**		
	A.	Ability to survive a one-half cycle power outage	TI
	B.	Power conditioning equipment	FI, FV, TI
	C.	UPS system	FI, FV, TI
	D.	Protection against brownouts	TI

Section 5

Target Environment

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5 TARGET ENVIRONMENT

This section specifies the technical solution that will enable E&S to carry out the missions stated in Section 2.1 using fewer people and spending less money. The requirements for the E&S communications-computer systems (C-CS) target environment (Future ESIMS) will permit E&S to become a truly automated business, as defined in Section 2.3. Future ESIMS will retain all of the baseline capabilities described in Section 3 and will add the capabilities needed to correct the shortfalls cited in Section 4.

Sections 3 and 4 discuss the capabilities that Future ESIMS must include from the perspective of the three groups of people who influence the direction of the E&S Information Management Systems (ESIMS): customers, end-users, and technologists. The products and services demanded by the E&S customers, which reflect the E&S assigned missions, shape the needs of the ESIMS end-users who perform the functions designed to meet their customers' demands. The end-users, in turn, shape the requirements of the technologists, who are tasked with obtaining, developing, and maintaining the hardware and software environment that the end-users need to support their application systems and programs.

Because the various ESIMS needs of each of the three groups are identified in terms of shortfalls in Section 4, this section focuses only on the requirements designed to correct the technology shortfalls identified in Section 4.3 and to enhance the existing environment with the capabilities to support future Air Force requirements and directions. These corrections and enhancements will enable the end-users to overcome the shortfalls they have identified (Section 4.2), as well as those identified by their customers (Section 4.1).

The Future ESIMS capabilities will fully automate all of the end-users' many information management and reporting tasks associated with the E&S mission- and customer-support functions described in Section 2.2. Specifically, E&S will be able to train all of its personnel to use the ESIMS hardware and system software and all of the 5,000-plus applications already available. E&S personnel will have the workstations, interoperability, performance, and disk storage they need to perform most efficiently once they are trained, and they will be able to develop any additional applications they need to make ESIMS the "prime mover" for all of their information-intensive functions. With this fully automated system, the end-users will be able to remedy the shortfalls in customer support cited in Section 4.1, and will have the capabilities and environment they need to develop the systems identified in Future Vision requirements and directions of the Air Force (Sections 4.1.2, 4.2.4, and 4.3.5).

This section covers the following topics:

(1) **Alternative Technical Solutions (5.1)** - briefly examines the alternative solutions for meeting the E&S information management needs of the future.

(2) **Required Minimum Technical Solution (5.2)** - specifies in detail the system functionality required to provide the minimum technical solution for Future ESIMS.

The best available technical solutions are prescribed, as customary in engineering practice, though it is clear that in the long term better technical solutions will replace those proposed here. In the C-CS marketplace, the long term may be only 5 years instead of the 20 years that the Air Force expects for mechanical equipment. In other words, the technical requirements proposed in this section should not be taken to exclude better solutions as and when they become available.

(3) **Size and Capacity Requirements (5.3)** - describes the workload test, as specified in Section 5.2, for the minimum system capacity needed to support Future ESIMS activities and to evaluate the vendor-proposed solutions.

(4) **Future ESIMS Implementation and Continuing Support (5.4)** - describes the implementation and continuing support schedule required to properly acquire, install, and maintain Future ESIMS.

(5) **Impact if Disapproved (5.5)** - describes the impact on E&S mission-related tasks if this specification is not approved.

5.1 ALTERNATIVE TECHNICAL SOLUTIONS

To remedy the shortfalls described in Section 4, a number of alternative solutions have been evaluated:

(1) Removal of the automated system

(2) Shared or excess C-CS resources

(3) Commercial services

(4) Acquisition through an existing Air Force contract

(5) Augmenting or upgrading AMMUS ESIMS

(6) Redesigning existing (AMMUS) ESIMS equipment

(7) Competitive procurement of commercial off-the-shelf (COTS) hardware and software

Future ESIMS cannot be supported using current resources. All existing ESIMS equipment is at or near maximum utilization, and the Air Force Minicomputer Multiuser System (AMMUS) procurement contract, under which ESIMS hardware is purchased, ends in 1993. The small amount of equipment that becomes available through base closings is quickly reallocated to other sites having the greatest equipment shortfalls. There is no other computer equipment available to E&S that would provide the capacity, processing power, and interface capabilities needed and could be ported to AMMUS software at an affordable cost. Evaluation of these alternatives have, together with requirements for functional capabilities, processing and data capacity, deployability, and open architecture, defined the recommended technical solution.

5.1.1 Removal of the Automated System

Removal of ESIMS means return to a manual system of reporting and information management. Return to a manual, hardcopy information system would reverse economies that have been demonstrated in E&S (and documented in the E&S Air Force Management Engineering Agency [AFMEA] studies in personnel, reallocation of paperwork billets to resource management, and function-related positions) and in redundant spares and safety stock. A manual system would necessitate an increase in staffing and, accordingly, an increase in billets within E&S of as much as 50 percent. These increases could double the E&S yearly budget during a period of intense pressure for personnel and budget reductions. Even with doubled budgets, acquiring information would take weeks and months, instead of seconds and minutes under ESIMS, and the quality of mission-support services provided by E&S to its customers would plummet. With the proposed personnel and budget reductions, the E&S missions would fail.

This alternative is rejected for reasons of economy, staffing requirements, and quality of service.

5.1.2 Shared or Excess C-CS Resources

The Air Force C-CS equipment complement has been evaluated for currently available and capable systems. However, for the following reasons, it is extremely unlikely that enough of the type of equipment required by E&S will be available:

(1) Because of current budget conditions, almost all non-obsolete systems are in use and are not likely to be released by their current users.

(2) A large amount of equipment is required to re-equip E&S operations at all Air Force sites: more than 200 super minicomputers and more than 40,000 workstations.

(3) Most Air Force systems do not provide the functionality, performance, architecture, and capacity required by E&S. One reason for approval of the AMMUS procurement was that no other procurement contract offered a computer system that could meet the architecture, capacity, and performance requirements of the data-intensive and highly interactive E&S functions.

Furthermore, available equipment from other organizations is not likely to operate with the AMMUS software (without porting and modifying), requiring format conversions to achieve data sharing.

The prospect of using central, shared C-CS equipment is also unlikely. Previous studies have demonstrated the disadvantages of a shared regional computer system. The true cost of such a system has been shown to be higher than local systems when the costs of software changes, justification, coordination, and inadequate control are included. The primary features of a regionally shared information processing resource and their consequences for E&S are as follows:

(1) **Central Control of C-CS Resources** - Because the commander of the central C-CS resource does not report to the local Base Commander, each Base Commander has little control over allocation of resources, granting of priorities, and expediting emergencies, thereby removing management authority from base level. This situation also prevents the Base Civil Engineer (BCE) from responding to the Base Commander's management style in a timely manner. The intent of any information system is to provide information, not dictate policy.

Without local control of C-CS resources, significant additional staff time is required to prepare precisely written requests for change (even for small items), to justify the requests, and to coordinate services.

Using ESIMS transactions, instead of paper, as the "prime mover" of the many E&S operations requires real-time transaction response. As the prime movers of authorizations, planning decisions, and resource information, WIMS and SIMS are mission-critical.

Delegation of decisions about their processing priorities and response times to people outside the chain of command could result in mission failure.

(2) **Central Application Development and Support** - The size and complexity of ESIMS applications combined with the necessity for base-level customization would create massive problems in coordination, development, configuration management, and support. These problems would negate the "efficiency" of centralized application software support. Separate, customized versions of much of the ESIMS application software are needed to accommodate the site-specific base-level E&S requirements, differences in organizational structure, and differences in management and customer priorities. Providing for many versions fits the computer to the work, whereas providing only one version forces the work to fit the computer system.

(3) **Multiple Layers of Telecommunications** - A regional computing center would require multiple layers of telecommunications. Such a system would neither support the transaction capacity nor response time required for the WIMS and SIMS applications, unless a multitude of very high-speed communication links could be established and maintained with the regional computer system.

The Work Information Management System (WIMS) workload is massively interactive. Through the network and information resource, WIMS permits optimization of work requests and scheduling, coordination of several crafts (Air Force shops and contractors), material availability and procurement, contract management, engineering design and analysis, budgeting, planning, material logistics, emergency response, accounting and finance activities, and reporting. The Services Information Management System (SIMS) workload is even more varied, including base hotel, restaurant, linen, furniture, mortuary affairs, and war-readiness operations. These operations are subject to a great deal of scrutiny and require massive recordkeeping and reporting. The central processing computer (CPC) response time required to support interactive processing must remain under a half-second (as with the current WIMS and SIMS) to support real-time recordkeeping.

(4) **Use of DDN** - A regional computing center would use the Defense Data Network (DDN) as its wide area network (WAN). However, protocols used by DDN do not support block-mode terminal operations, which are the ESIMS standard interface, required for full-

screen forms, graphical human-machine interfaces, and modern computer-based training (CBT). Additionally, the DDN bandwidth is not sufficient to support the communications workload needed to effectively sustain base-level E&S activities.

Furthermore, DDN (which intended for inter-base information sharing) is not designed to transfer the large blocks of information generated by requests for one-time reports, most of which occur within a base, not between bases. Additionally, most current technological directions seem to indicate more, not fewer, of these requests in the future. For example, one advantage of a CPC is easier information sharing, and the next generation of application software technology includes network-wide data dictionaries with database ad-hoc query capability. Transferring the large quantities of information generated by this request and response traffic (as well as a massive amount of transaction traffic) via DDN to a regional computer could cause message collision signalling and, accordingly, failure of DDN. Absence of a functioning WAN to feed information to the regional computer could cause mission failure of all bases connected to it.

Finally, during a crisis (natural disaster or military emergency), communication lines become critical to successful response, but are often the first resource to fail. Reliance on an overburdened DDN or on any long and complex communication lines for mission-critical, information-intensive support cannot be justified in any realistic scenario. Local redundancy to permit continuity of operations would negate the intended "economy" of a regional center.

For all of these reasons, surplus, shared local, and shared regional information processing equipment are therefore rejected as cost-effective or functionally effective alternatives. Reliance on any of these alternatives would result in mission failure.

5.1.3 Commercial Services

Some specific engineering applications are currently provided by commercial or university data processing services, but only for those activities that can be isolated and run in batch mode. In those cases, the requirement for commercial services is intermittent, and does not warrant Air Force acquisition of the software and training of the required technical support personnel.

Reliance on commercial services to operate ESIMS involves a number of difficulties:

(1) Performance standards (response time, processing capacity, and job/session priorities) are determined by financial and marketing considerations outside the control of the Air Force.

(2) Within the limits of the contract with the commercial vendor, E&S would not receive required changes to the software unless the commercial vendor deems the change mutually beneficial for all customers.

(3) Aggregation of non-sensitive data on a commercial system could create a security risk. That is, documents considered non-sensitive unto themselves may become classified when all of their information is available in aggregate, as on a single unclassified system.

(4) As with a regional computer, communications to commercial services cannot be assured during crisis. Loss of the commercial services could result in mission failure.

Use of commercial service is therefore rejected as a cost-effective or functionally effective alternative.

5.1.4 Acquisition Through an Existing Air Force Contract

No current procurement contract or combination of known current contracts provides the types, capabilities, and quantities of CPCs, generic workstations, communications, and peripheral equipment that will support the requirements of Future ESIMS described in Section 5.2. In fact, none of the non-AMMUS hardware under contract today can even support the workload already supported by AMMUS ESIMS. The cost of replacing AMMUS hardware, which is unable to support the C-CS needs of E&S, with hardware available under other contracts has already been demonstrated to be more than twice that of the original AMMUS hardware. Thus, use of hardware available under current contracts would result in system degradation and, ultimately, system failure.

5.1.5 Augmenting or Upgrading AMMUS ESIMS

Much of the AMMUS hardware has already been fully upgraded. Further upgrade would mean complete replacement of the super minicomputers with CPCs to obtain sufficient communications support for generic workstations. All the non-Wang PC and Zenith PC workstations would have to be replaced with 286-based or 386-based personal computers (PCs). Because of limitations inherent in PCs, such replacement would still not support E&S's efforts to migrate to the required Air Force C-CS architecture.

5.1.6 Redesigning Existing AMMUS Equipment

Redesign of the Wang hardware is beyond the scope of E&S technologists. Redesign at the E&S level means purchasing new hardware.

5.1.7 Competitive Procurement of COTS Hardware and Software

By using DoD, Air Force, and commercial standards as a baseline for the overall design of an interactive computing resource, E&S has been able to produce a solution which appears to be the best alternative of those investigated. Air Force regulations and standards, as written, allow sufficient room for interpretation. As a baseline, however, these regulations and standards provide E&S with the required guidance to develop a workable solution to computing needs which vendors can produce. The system proposed in Section 5.2 combines the requirements of the regulations and standards with the hard-earned experience of AMMUS ESIMS end-users and technologists and the application of time-tested and proven engineering skills.

5.2 REQUIRED MINIMUM TECHNICAL SOLUTION

The purpose of Future ESIMS is to help non-computer-experts (i.e., most ESIMS end-users) perform their mission-related tasks. Thus, the Future ESIMS platform must provide sufficient technical expertise to allow the end-user to accomplish these mission-related tasks without assistance from technical computer experts. As with AMMUS ESIMS, the end-users must also be able to modify the model software or generate new applications to accommodate local needs in support of the requests and requirements of the Base Civil Engineer, the Base Services Officer, the Base Commander, the Wing Commander, and higher Headquarters. (This capability was a major factor in the success of AMMUS ESIMS.)

The functional objectives of Future ESIMS are as follows:

(1) Improve service for E&S customers and mission-related activities.

(2) Provide a system that can support crisis operation and combat: a workable, durable, deployable, easily modified system using "peel-down" architecture, "graceful degradation," and redundancy.

(3) Increase effective use of information sources for resource management and decision support.

(4) Increase productivity, and free the existing staff from current labor-intensive automated and paperwork tasks without increasing additional staff size.

(5) Extend to field bases and exercises the benefits of adequate support and planning tools through a portable and deployable Future ESIMS.

(6) Support interoperability with the rest of Air Force Logistics by complying with the Air Force C-CS architecture.

(7) Anticipate future requirements and directions of the Air Force.

Future ESIMS shall combine the AMMUS ESIMS capabilities outlined in Section 3 with the capabilities needed to correct the shortfalls in Section 4. Thus, Future ESIMS shall include the functionality specified by emerging standards and shall respond to the end-users' functional needs at least as quickly as AMMUS. These requirements dictate a system and subsystems that have enough computing power, memory, disk space, tape capacity, printer speed, and communication speed to enable the end-users to perform their regular jobs interactively and efficiently. Because the requirements specified in this section prescribe a completely new system rather than merely describing an existing one, the order in which they are presented differs from that of the AMMUS ESIMS technology capabilities and capability shortfalls in Sections 3.3 and 4.3, respectively, although all of those capabilities are included. For the same reason, this specification includes additional categories. The requirements categories and their order reflect the issues, in chronological sequence, faced by a procurement specialist when building a worldwide information system. They are as follows:

(1) General architecture

(2) Capacity/throughput

(3) Communications

(4) Support for Air Force architecture

(5) Security

(6) File management system

(7) Software

(8) Development tools

(9) Vendor applications

(10) System support

(11) Central processing computer (CPC)

(12) Workstations

(13) Peripheral devices

(14) Physical plant

Additionally, the vendor shall provide any features available to its commercial customers that will enhance the Future ESIMS specified here. The intent is to ensure that the end-user benefits from new technologies that were not anticipated in this specification.

5.2.1 General Architecture

To support the E&S missions, Future ESIMS must meet the following architecture requirements:

(1) **"Peel-Down" Architecture** - This requirement, which is essential during wartime and other crises, provides for **prioritized loss of functionality to match the available processing capacity**. Peel-down architecture allows gradual shedding of less critical functional loads while maintaining essential services (see Figure 4-1).

To support the peel-down requirement, all of the central processing units (CPUs) within an ESIMS node shall be connected together as a single computer: the CPC. (A node, shown in Figure 5-1, is the basic local ESIMS computing network.) The CPC shall function and be managed as a large single CPU, and the end-user shall not be able to distinguish between CPUs in the CPC. Each CPU shall be self-contained and interchangeable with any other, allowing incremental processing growth and shrinkage as processing workload requirements change. In extreme cases, the generic workstation shall require source-code-compatible compilers to allow any CPC program to be recompiled, without source-code changes, for execution on the generic workstation.

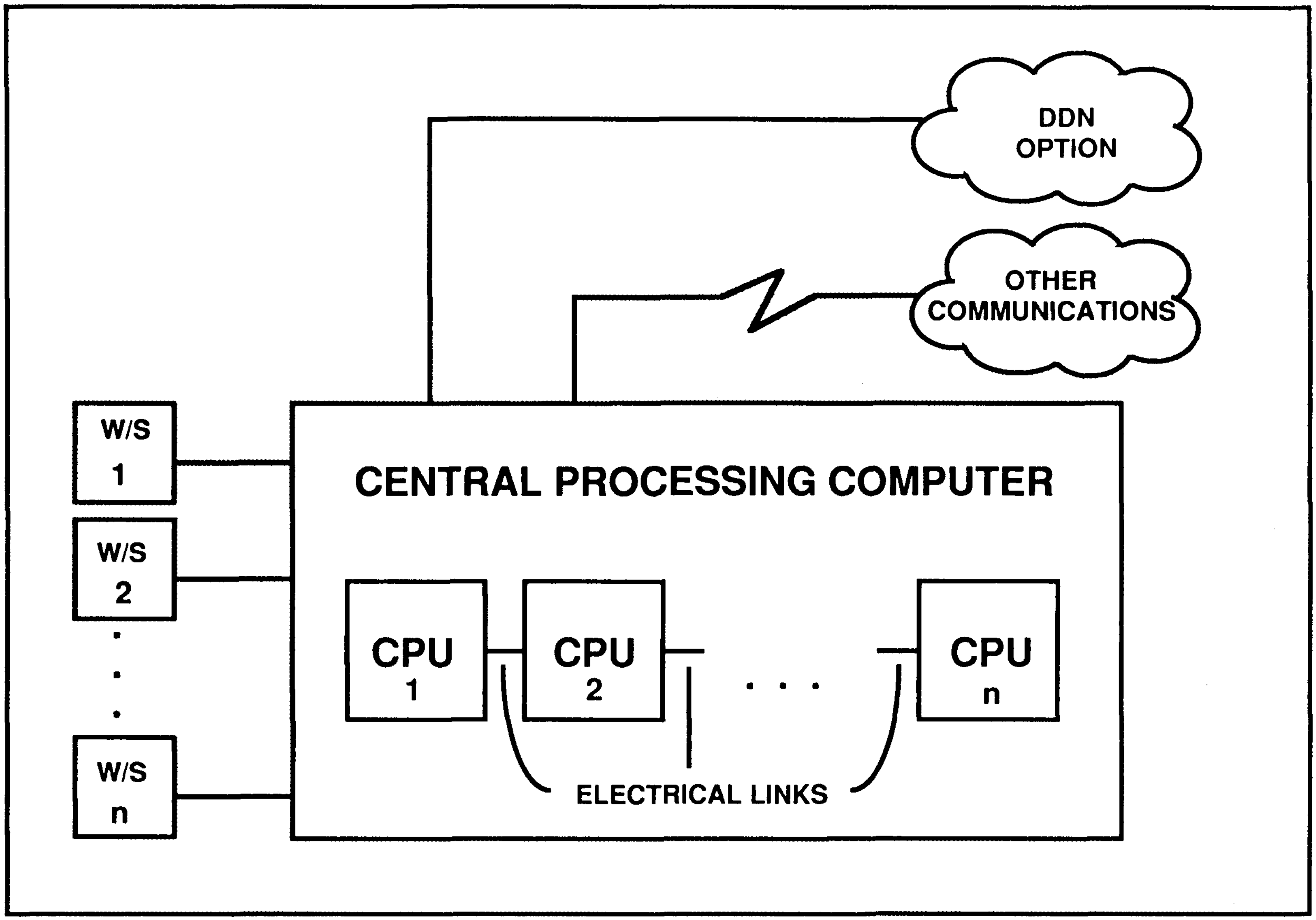

FIGURE 5-1 A REPRESENTATIVE FUTURE ESIMS NODE

Peel-down architecture is an essential component of the wartime phased deployment of E&S personnel, where the resident squadrons break up and deploy in phases, requiring full CPC support in multiple geographic locations.

(2) **Data Security in "Hostile" Physical Environments** - Any unexpected work interruptions caused by outside influences shall be automatically recovered after the disturbance to include complete recovery of the last complete screen of work transmitted to the CPC.

(3) **"Graceful Degradation"** - This requirement responds to loss of hardware by **redistributing the functions to other available equipment and/or by reducing the level of performance while preserving all functions** (see Figure 4-2). Hardware being used for less essential wartime functions can be used as replacements for battle-damaged equipment and/or to restore processing performance in a crisis environment.

(4) **Redundancy** - Redundancy for this purpose does not mean multiprocessing within a single box. It means replication of data files across separate systems (i.e., selectively duplicated databases and multiple communication channels), preferably well protected and physically isolated from each other.

(5) **Easy Deployability** - The future missions of E&S will require computer systems that can be readily deployed to the operations site. This requirement is especially critical during combat and crisis situations. If a portion of the E&S personnel at a base are assigned to a deployment or forward operating location, they will be required to "unplug and go" with whatever hardware needed to support their activity while maintaining central processing capability at the original location.

(6) **Interoperability with Other Air Force Logistics Functional Components** - The Air Force has approved a C-CS architecture to provide this interoperability. In addition to the need to communicate with their own units, both internally and vertically, the E&S units require connectivity with other functional areas on base as specified by Air Force C-CS architecture. AMMUS communications capability shall be enhanced to support this architecture. For applications requiring a human-machine interface (including screen display and keystroke entry), remote terminals and local terminals shall have the same human-machine interface access capability. Electronic mail (E-

mail) interchange shall comply with the Domain Name Server definitions for address resolution, ensuring compatibility and accessibility across all Air Force bases.

5.2.1.1 Compatibility

Future ESIMS shall comply with emerging Federal Information Processing Standards (FIPS) such as the Government Open Systems Interconnection Profile (GOSIP) for communications and the Portable Operating System Interface (POSIX) for application interoperability, as well as database, graphics, and other standards. The Air Force and DoD source documents for these standards are listed in Section 1.3.

5.2.1.1.1 GOSIP - GOSIP provides guidelines, which are supported by industry with commercial products, to describe the connection from one computer to another at seven levels, from the shape of the network connector plug (level 1) to the appearance of the application on the user's screen (level 7). In addition to this connectivity model, AFR 700-3, Communications-Computer Systems Requirements, describes the standard Air Force implementation of a standard architecture.

To ensure compatibility of E-mail messages with the various Air Force C-CS and with commercial systems, each ESIMS product that includes E-mail must comply with ISO X.400 (Message Handling and File Transfer) and with ISO X.500 (Directory System Protocol). X.400 defines a mail packet format and a method for transferring mail messages between unlike systems. X.500 provides a distributed directory and routing system that will enable Air Force-wide E-mail distribution between unlike systems. All options defined under X.400 shall be implemented to prevent loss of services now provided under AMMUS. As new systems are fielded in other areas with which E&S must communicate, full compliance with all options under X.400 will allow communications capabilities to increase without rendering Future ESIMS obsolete. As improvements are made to GOSIP and adopted as part of Air Force C-CS architecture, the vendor shall upgrade the system to maintain compliance.

5.2.1.1.2 POSIX - POSIX defines an operating system set of library functions and a command language intended to allow easier migration of products from one computing platform to another. POSIX (P1003.x) is described in a series of documents that have adopted as Air Force C-CS architecture requirements.

All vendor-supplied applications shall be executable under the POSIX command language, both interactively and under command file execution. Applications shall be executed using the command language text defined in the POSIX standard and the library support intended to serve the American National Standards Institute

(ANSI) "C" language standard as the "standard library". The "C" compiler shall fully implement the POSIX library functions, and these functions shall be available in all supplied languages and shall be callable and executable (via linkable object code modules) from any of the Future ESIMS source-code programming languages.

Any additional support needed for full-screen applications shall be provided in a similar library permitting full access to all terminal modes in all languages. Device-driver generation shall also be supported to allow developers to add device drivers for special-purpose equipment needed to support mission-related requirements.

5.2.1.1.3 Peripheral Devices - Each peripheral device shall support both the CPC interface and the generic workstation interface. The CPC may use a variety of interfaces to the peripherals to maintain high performance, but each peripheral must also contain the interface needed to connect to the generic workstation.

For the high-speed peripheral devices, the small computer system interface (SCSI) shall be used as the physical connection to the generic workstation. Utility software shall be provided that allows the generic workstation to copy and utilize file structures used by CPC peripherals if the CPC is not available. This is required to support "peel-down" architecture in the worst-case scenario: the CPC is down, files are on the CPC's disks, and the generic workstations are the only means of accessing the data.

For the printers, both the Centronics and the RS-232C interfaces, in addition to the interface provided by the vendor for the CPC, shall be available and usable on the generic workstation. The vendor shall choose and provide on the generic workstation interfaces for pointing devices that support all workstation configurations. Pointing devices shall not be used on the CPC directly.

To avoid unnecessary delays when transitioning from the present system, all of the computers proposed for Future ESIMS must accept the current AMMUS application source code, with only minimal change, for compilation and execution. Delays could reduce the viability of the future system.

5.2.1.2 Interoperability

Interoperability requirements pertain to ESIMS' ability to share data with other systems. Future ESIMS shall support the Network File System (NFS), Network SQL, and Virtual Terminal Asynchronous (VT-A), Virtual Terminal Synchronous (VT-S), and older communications protocols. These are described in detail in later subsections.

Future ESIMS shall comply with the following interoperability standards:

Hardware Standards

(1) FIPS-PUB-1-2, Code for Information Interchange, ASCII (American Standard Codes for Information Interchange) System Requirements (ANSI X3.4-1977, X3.32-1973, X3.41-1974), 14 November 1984

(2) FIPS-PUB-17-1/FED-STD-1011, Character Structure and Character Parity Sense for Serial-By-Bit Data Communications in the Code for Information Interchange (ANSI X3.16-1976/R1983), 1 September 1977

(3) FIPS-PUB-25, Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase Encoded) (ANSI X3.39-1973), 30 June 1973

(4) FIPS-PUB-32-1, Optical Character Recognition Character Sets (ANSI X3.2-1970/R1976, X3.17-1981, X3.49-1975/R1982), 25 June 1982

(5) FIPS-PUB-33-1, Character Set for Handprinting (ANSI X3.45-1982), 5 November 1985

(6) FED-STD-1001, Telecommunications, Synchronous High-Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment, 15 June 1975

(7) FIPS-PUB-71/FED-STD-1003A, Advanced Data Communications Control Procedures (ADCCP) (ANSI X3.66-1979), 14 May 1980

(8) FIPS-PUB-50, Recorded Magnetic Tape for Information Interchange, 6250 CPI (246 CPMM), Group Coded Recording; must employ the one-half-inch-wide tape format (ANSI X3.54-1976), 1 February 1978

(9) FIPS-PUB-52, Recorded Magnetic Tape Cartridge for Information Interchange, 4-track, 6.30 mm (0.250 inch) 63 BPMM (1600 BPI) Phase Encoded (ANSI X3.56-1977), 15 July 1978

(10) FIPS-PUB-60-2, Input/Output (I/O) Channel Interface, 29 July 1983

(11) FIPS-PUB-61-1, Channel Level Power Control Interface, 13 July 1982

(12) FIPS-PUB-62, Operational Specifications for Magnetic Tape Subsystems, 14 April 1983

(13) FIPS-PUB-63-1, Operational Specifications for Variable Block Rotating Mass Storage Subsystems, 14 April 1983, including supplement dated 14 April 1983

(14) FIPS-PUB-85, Optical Character Recognition (OCR) Inks (ANSI X3.86-1980/R1987), 7 November 1980

(15) FIPS-PUB-86, Additional Controls for Use With American National Standard Code for Information Interchange (ANSI X3.64-1979), 29 January 1981

(16) FIPS-PUB-89, Federal Standard for Optical Character Recognition (OCR) Character Positioning (ANSI X3.93M-1981), 4 September 1981

(17) FIPS-PUB-97, Operational Specifications for Fixed Block Rotating Mass Storage Subsystems, 4 February 1983

(18) FED-STD-1027, General Security Requirements for Equipment Using the Data Encryption Standard, 14 April 1982

System Software Standards

(1) FIPS-PUB-79, Magnetic Tape Labels and File Structure for Information Interchange (ANSI X3.27-1978), 17 October 1980

(2) FIPS-PUB-146, GOSIP, to include all options under X.400, 24 August 1988

(3) FIPS-PUB-151, POSIX (IEEE 1003.1/Draft 12), 12 September 1988

(4) FIPS-PUB-156, IRDS (Information Resource Dictionary System) (ANSI X3.138-1988), 25 April 1989

(5) FIPS-PUB-127, Database Language SQL (Structured Query Language) (ANSI X3.135-1986)

(6) FIPS-PUB-120, GKS (Graphical Kernel System) (ANSI X3.124-1985)

(7) FIPS-PUB-128, CGM (Computer Graphics Metafile) (ANSI X3.122-1986), 16 March 1987

(8) PHIGS (Programmer Hierarchical Interactive Graphics System)

(9) RFC-796, Address Mappings; the host must be able to support all three classes of addresses

(10) MIL-STD-1777, Internet Protocol (IP), 12 August 1983

(11) MIL-STD-1778, Transmission Control Protocol (TCP), 12 August 1983, and RFC-792, Internet Control Message Protocol (ICMP), and Notice 1, 26 October 1983

(12) MIL-STD-1780, File Transfer Protocol (FTP), 10 May 1984

(13) MIL-STD-1781, Simple Mail Transfer Protocol (SMTP), and RFC-883, Domain Names - Implementation and Specification, 10 May 1984

(14) Domain Name Service Protocol (DNSP)

(15) MIL-STD-1782, TELNET Protocol, 10 May 1984

(16) DoD Directive 5200.28, Security Requirements for AIS, 21 March 1988

(17) DoD 5200.28-STD, DoD Trusted Computer System Evaluation Criteria. December 1985

(18) MIL-HDBK-59, CALS Program Implementation Guide

(19) MIL-STD-1840A, AITI (Automatic Interchange of Technical Information), 22 December 1987

(20) MIL-D-28000, Digital Representation for Communication of Product Data, IGES (Initial Graphics Exchange Standard) Applications Subsets, 22 December 1987

(21) MIL-M-28001, Markup Requirement and Generic Style Specification for Electronic Printed Output and Exchange of Text, 26 February 1988

(22) MIL-R-28002, Raster Graphics Representative in Binary Format, Requirement for, 30 October 1989

(23) MIL-D-28003, Digital Representation for Communication of Illustration Data, CGM Application Profile, 20 December 1988

Language Standards (Ada, BASIC, C, COBOL, FORTRAN)

(1) ANSI/MIL-STD-1815A-1983, Ada Programming Language

(2) DoD-STD-1838A, Common Ada Programming Support Environment (APSE) Interface Set (CAIS), 12 April 1988

(3) ANSI/X3.159-198x Programming Language "C" Standard

(4) FIPS-PUB-21-3, COBOL Language, (ANSI X3.23A-1989), 12 January 1990

(5) FIPS-PUB-68-2, BASIC Language (ANSI X3.113-1987), 24 August 1987

(6) FIPS-PUB-69-1, FORTRAN Language (ANSI X3.9-1978), 24 December 1985

5.2.1.3 Deployability and Survivability

E&S personnel shall be able to deploy a Future ESIMS computer system without external assistance. The baseline shall support decision making, resource management, and scheduling in a multiuser environment. Deployable applications are being defined and developed by Prime BEEF and Prime RIBS functional experts. These applications shall be exactly same for emergency features and functions as for routine features and functions. The deployable core system must be simply a "peeled-down" configuration of the standard system. The peeled-down version can later be "built up" again (in the field or back at the home base) with software, upgrade kits, and peripheral equipment.

For survivability, the generic workstation and deployable CPC shall include the following features:

(1) Self-contained backup power for the generic workstation, and separately available backup power for the CPC

(2) Ruggedized equipment to withstand rough shipping, heat and cold, dusty environments, and electrical surges

(3) Interface to a deployable voice/data network

(4) Applications, Air Force standard reference tables, and local data deployed on high-capacity, portable storage devices

(5) A minimal number of separate configurations to minimize spares stock and variations in maintenance procedures

5.2.1.4 Paperless Office/Office Automation

Future ESIMS shall incorporate the "paperless office" concept: the request, assignment, statistics gathering, reporting, authorizations, planning, and related operational activities are performed with a keyboard and screen, not with pencil and paper. To support this concept, data applications shall be able to treat word processing documents, graphics files, voice, and video as attachable objects under application program control. Likewise, word processing shall be able to include graphics files, data values, voice, and video as objects with the word processing document. Integrated graphics shall be able to attach word processing documents, other graphics files, voice, and video as objects under graphic application control.

For accounting and financial audit purposes, Future ESIMS shall provide a means of entering, verifying, and validating electronic signatures within documents, graphic images, and data processing records. The algorithm shall match the functionality currently accepted by the Air Force Accounting and Finance Center. By offering an alternative to signed documents as physical hardcopy, this capability will further reduce the need for paper in the office.

The paperless office concept requires that all authorized end-users have a query facility to access information stored in the system. To support novice end-users, the query facility shall retrieve information from the complete suite of file types on the delivered machine. The required system is described in detail as a vendor application in Section 5.2.9.11.

5.2.1.5 Data Dictionaries

Data dictionaries are development tools, and their absence in AMMUS ESIMS is discussed as a development tool shortfall in Section 4. However, they are an essential element in overall system architecture and must be considered much earlier than the tools specified in Section 5.2.8. To make application data files usable in special purpose query and extensions to those data files, Future ESIMS must have a data dictionary describing the format and contents. Furthermore, to permit multivendor platform use of the data dictionary, the system must comply with FIPS-PUB-156, IRDS. The data dictionary shall include the following:

(1) Support of Structured Query Language (SQL) and Relational Structured Query Language (RSQL) queries between the generic workstation and the CPC and between CPCs

(2) A support system with all files defined (It shall include proven source-code examples generated by the vendor-supplied code generators, which demonstrate all features and options provided for accessing and updating the data dictionary. The examples shall include complete documentation, shall be provided in each of the Future ESIMS high-level languages, and shall be capable of being compiled and run without change.)

(3) Ability for the end-user to access data definitions from within vendor-supplied code generators and report generators

(4) Ability for the end-user to define multiple data dictionaries per installation with access across the multiple dictionaries

(5) Demonstrated ability to transfer data elements between the data dictionaries (The demonstration shall include proven source-code examples, generated by the vendor-supplied code generators, using an application written in one of the Future ESIMS source-code programming languages. The examples shall include complete documentation, shall be provided in each of the Future ESIMS high-level languages, and shall be capable of being compiled and run without change. The demonstration shall include all features and options provided for the transfer function.)

(6) A mechanism which allows the end-user, with security permission, to lock and unlock data dictionaries in support of development, prototyping, and controlled release of applications

The data dictionaries can be implemented the following ways:

(1) **Standard Dictionaries** - There is a minimal set of data which will always be transferred from one functional area to other functional areas (e.g., data from E&S to Supply). This set is shown conceptually in Figure 5-2 as the Interface Standard Data Dictionary. It contains the information that each of the interested functional areas has agreed to share across functional area boundaries. (One functional area needs the information which the other has already collected, or has agreed to collect, and the format of the information has been established.) This Interface Standard Data Dictionary can also be defined as the Air Force Standard Data Dictionary, coupled with the DoD Standard Data Dictionary.

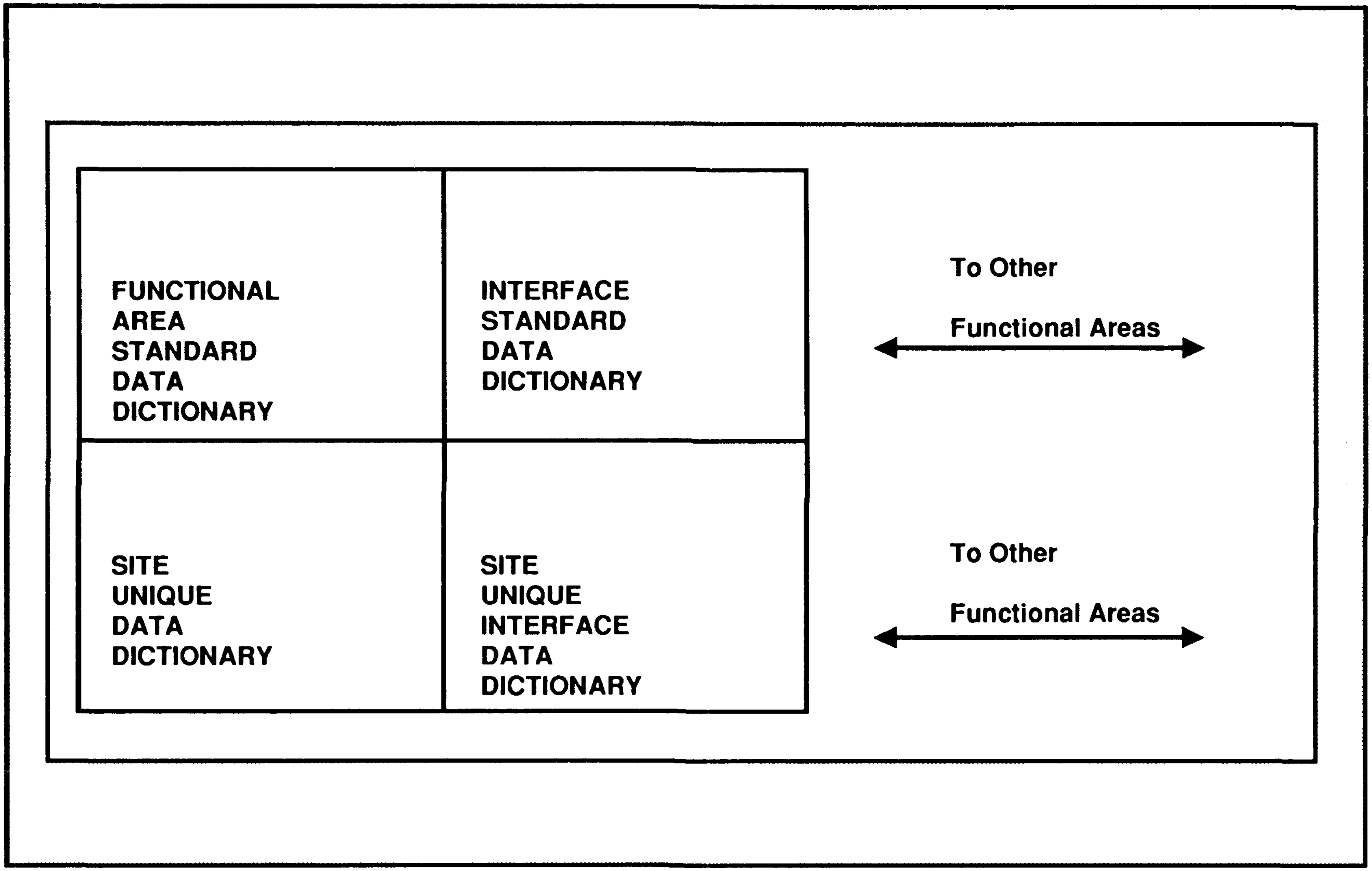

FIGURE 5-2 FUNCTIONAL AREA DATA DICTIONARY CONCEPT

These data dictionaries consist of established data definitions and structures, for which responsible parties have been assigned to maintain. As applications become interoperable through the introduction of SQL query capability, telecommunications, and other technology, the Interface Standard Data Dictionary shall contain the majority of the data definitions and structures used by E&S.

For E&S-specific use, as in the past, the physical Functional Area Standard Data Dictionary shown in Figure 5-3 shall contain only those data definitions and structures which are of interest only within the functional area. This type of data dictionary will be essential during the transition process. Thereafter, as Future ESIMS and other logistics information management support systems become interoperable, the number of data definitions and structures contained in this type of dictionary is expected to diminish dramatically.

(2) **Non-Standard Dictionaries** - In addition to the two standard data dictionaries, two non-standard ones must be defined. Each E&S location
has its own unique mission and goals which must be satisfied. These goals require the collection of data which are not covered by the standard data dictionaries because they have no utility for any other location. As there is a Functional Area Standard Data Dictionary and an Interface Standard Data Dictionary, a case can easily be made for a Site Unique Data Dictionary and a Site Unique Interface Data Dictionary, as shown in Figures 5-2 and 5-3. The Site Unique Data Dictionary allows individual managers to collect the data required to support the specific requirements dictated by their individual circumstances and to support their own management styles, thereby allowing ESIMS to continue to adapt to unique requirements--a concept that has been quite successful in AMMUS. The Site Unique Interface Data Dictionary allows the individual site (or group of sites, such as USAFE or PACAF) to support interface data required only in their respective areas. One of the Site Unique Data Dictionaries shall be used in the development of prototypes. Its access shall be restricted to prototype developers within the query system.

(3) **Query Capabilities** - For a four-data-dictionary model to be effective, the individual developer must be able to query the dictionaries for data definitions and structures which most closely fit the application under development. All data dictionaries, including those of other functional areas that are connected to the network, shall be accessible in one developer query so that the most

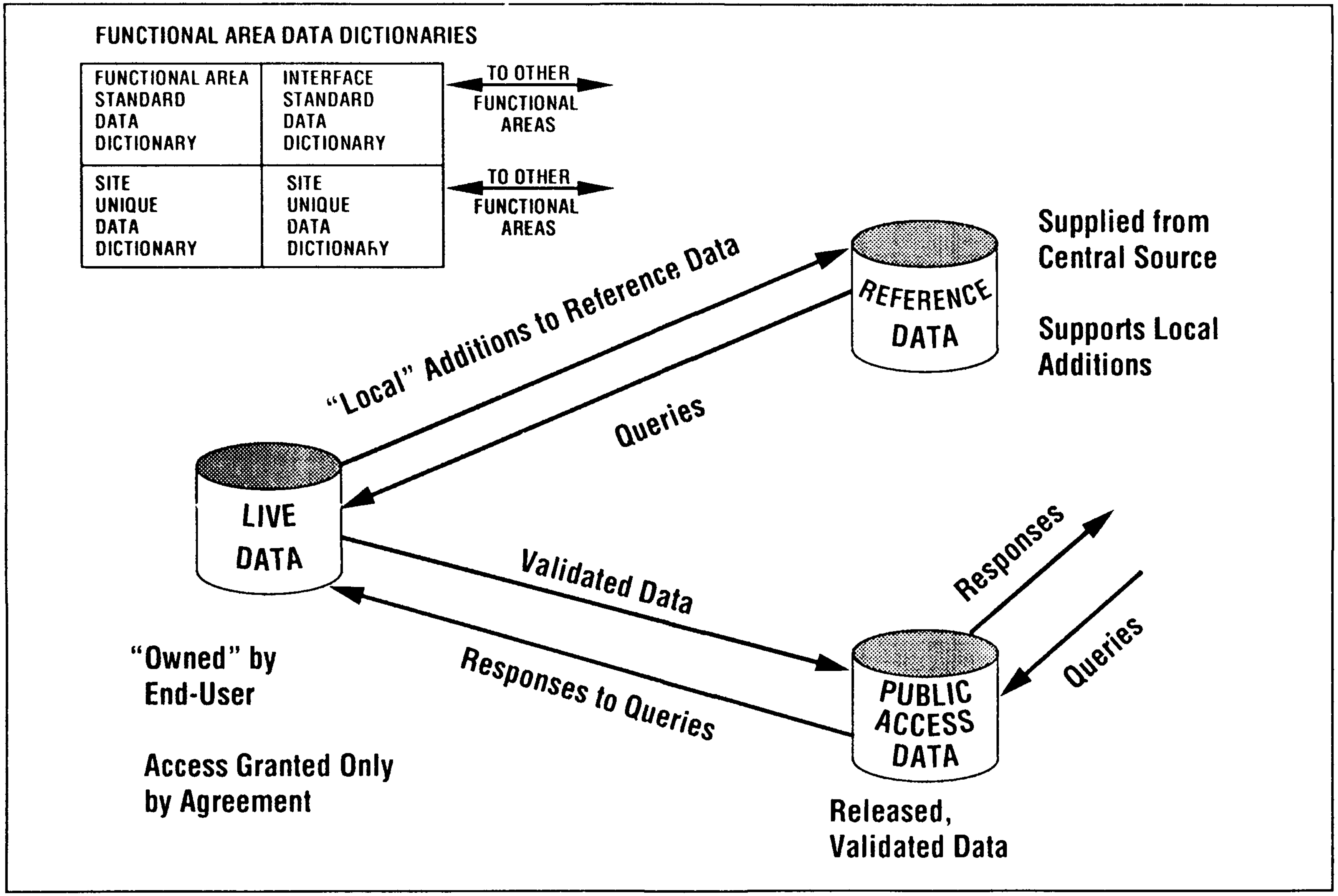

FIGURE 5-3 A PHYSICAL EXAMPLE OF A FUNCTIONAL AREA DATA DICTIONARY

appropriate choice can be found quickly and easily. This will also ease the transition to the Interface Standard Data Dictionary, as it minimizes the "not invented here" prejudice among the developers.

(4) **Reporting Capabilities** - Coupled with the need for the query capability is a reporting capability that cross references the applications that use each data structure. This system is required to allow developers to determine the impact of a change in a data structure to systems other than the one under development.

(5) **Cross-Referencing** - Data structures which are used by more than one application shall move automatically from the Functional Area Standard Data Dictionary to the Interface Standard Data Dictionary. Conversely, when the cross-reference system determines that a data structure is used by only one application, the data structure's definition shall migrate to the appropriate Functional Area Standard Data Dictionary.

In addition, data structures can be embedded within other data structures. The system shall compare the embedded data structures to determine when these hybrid structures can be consolidated into new structures. These comparisons shall be listed in a report to the data manager, who will decide whether the new structure should be added to the Interface Standard Data Dictionary. This cross-referencing capability is required to facilitate building and maintenance of the DoD and Air Force Standard Data Dictionaries with minimal manual support, thereby saving DoD, the Air Force, and E&S millions of dollars in maintenance costs.

(6) **Data Element Ownership** - Proprietorship and ownership of the data, as opposed to the definition of the structure, shall be maintained at the primary data element source location with the ability to lock and unlock data access at the user, functional area, local command, and global levels.

The concept of data management provided by this type of data dictionary system allows standardization of data in the areas where it is most appropriate. This concept also allows site-specific (or group-specific) data dictionaries to exist as separate entities. Additionally, this concept eliminates the problems associated with trying to manage all data at the standards level and allows for innovation and growth where appropriate. It also presents an opportunity to establish a working group to review the Site Unique Data Dictionaries and to decide which data elements have commonality across enough of the functional area to warrant migration to the standard data dictionaries and vice versa. In this way, the four-part data dictionary can support the Air Force requirement to effectively manage the data collected and the systems which support the data collection and reporting process. By uncoupling the databases (as shown in Figure 5-3) and maintaining a standard of data exchange, each of the functional communities is free to change internally as needed to efficiently meet mission requirements while following coordination standards and procedures when an external interface is required.

5.2.1.6 Human-Machine Interface

Future ESIMS shall support a wide variety of end-user skill levels. To meet the needs of a wide variety of end-users, three interchangeable and user-selectable forms of access to programs are required:

(1) POSIX-defined command language text

(2) Menu and PF-key selection, as implemented on AMMUS ESIMS

(3) X-Windows graphical human-machine interface with pointing device support

These interfaces (which are described in detail as software requirements in Section 5.2.7.2) shall be interchangeable and individually selectable by each end-user. For example, a single end-user or different end-users on the same workstation shall be able to select their own interfaces for the same application program or utility. In addition, each end-user shall be able to select a default access mode to be displayed at any generic workstation where the user logs in (as specified in the user profile requirement, Section 5.2.7.3).

The vendor shall provide language extensions for use of menus within programs that dynamically change to accommodate the user profile (i.e., interface type preference). For example, the software must automatically translate the set of application-function mode choices to a command line prompt, function key menus, and graphical menus.

5.2.2 Capacity/Throughput

Most E&S business data transactions will require 8 to 15 files and will read and write approximately six times to those files per transaction per end-user. A management report will generally extract 10,000 records per end-user for summary and reporting. Word processing operations, assuming 100 words per minute, will generate approximately 8 keystrokes per second per end-user. Engineering graphics require approximately 2 line/point/segment definitions per second per end-user.

The workloads at four sizes of ESIMS sites are described in the following subsections. Successful performance of Future ESIMS under each of these workload scenarios is mission-critical in a paperless environment. To ensure the required level of performance, a comprehensive workload test shall be developed using typical E&S end-user programs. It will be the minimum threshold of qualification for bid acceptance. As can be determined by the typical workloads described below, the workload test will also be needed to evaluate the capability of competitive systems to handle workload from the end-user's perspective. The workload test shall include levels of performance across the requirements of reporting, word processing, and graphics applications.

5.2.2.1 Future ESIMS Small Site Workload

A small Future ESIMS site (50 workstations with approximately 5 percent idle) will have not less than:

4 - very high demand requirements
23 - medium-demand requirements
11 - general queries
8 - word processing tasks
2 - graphics tasks

48 - active workstations, with 2 workstations logged on but idle

This workload is representative of activities at any given time during the business day. It is expected that the high-demand and medium-demand transactions will be processed and information returned to the end-user in not greater than one second.

5.2.2.2 Future ESIMS Medium Site Workload

A medium Future ESIMS site (170 workstations with approximately 7 percent idle) will have not less than:

15 - very high demand requirements
73 - medium-demand requirements
20 - general queries
42 - word processing tasks
12 - graphics tasks

162 - active workstations, with 8 workstations logged on but idle

This workload is representative of activities at any given time during the business day. It is expected that the high-demand and medium-demand transactions will be processed and information returned to the end-user in not greater than one second.

5.2.2.3 Future ESIMS Large Site Workload

A large Future ESIMS site (512 workstations with approximately 5 percent idle) will have not less than:

12 - very high demand requirements
276 - medium-demand requirements
28 - general queries
159 - word processing tasks
12 - graphics tasks

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487 - active workstations, with 25 workstations logged on but idle

This workload is representative of activities at any given time during the business day. It is expected that the high-demand and medium-demand transactions will be processed and information returned to the end-user in not greater than one second.

5.2.2.4 Future ESIMS Largest Site Workload

The largest Future ESIMS sites (1,500 workstations with approximately 10 percent idle) will have not less than:

20 - very high demand requirements
200 - medium-demand requirements
245 - general queries
850 - word processing tasks
35 - graphics tasks

1,350 - active workstations, with 150 workstations logged on but idle

This workload is representative of activities at any given time during the business day. It is expected that the high-demand and medium-demand transactions will be processed and information returned to the end-user in not greater than two seconds, including screen update.

5.2.3 Communications

Future ESIMS shall interface with the Energy Monitoring and Control System, which is already in place. This interface consists of terminal emulation (VT-100 and DTS-40), as well as file transfers.

The primary focus of Future ESIMS communications is in two areas:

(1) Communications between the CPC and its workstations and printers

(2) Communications between CPCs

The other important Future ESIMS communications concerns are as follows:

(1) DDN communications

(2) GOSIP communications support

(3) Radio-attached workstation connections

(4) Access to classified communications

(5) Access to commercial packet switched networks

(6) Access to Unix E-mail through Unix-to-Unix CoPy (UUCP)

(7) Support for inbound/outbound facsimile (fax) transmission

(8) ULANA-compatible local area network (LAN) support

(9) Integrated Services Digital Network (ISDN) support

(10) Other communications

5.2.3.1 CPC-to-Workstation/Printer Communications

Between buildings, communications between the CPC and its workstations and printers shall function on Government-provided unconditioned two-wire and four-wire unshielded twisted-pair connections. Within a building, these communications shall be on vendor-specified media. The transmission media shall support the emerging ISDN connections specifications, the LAN standards used in unified local area network architecture (ULANA), and the WAN standards used in the DDN base concentrators. These connections shall be configured as follows:

(1) All dedicated unconditioned signal paths shall conform to the Bell System PUB 43401 or the Bell System PUB 3002, as appropriate. The interface may use dedicated direct wire paths, limited-distance modems, or long-distance modems for connectivity. In some instances, voice grade signalling shall not be required, but in other cases the requirements of Bell System PUB 43401 will apply.

(2) The Government may provide LAN connections for the communications interfaces, and the vendor shall comply with the technical specifications of the connection devices. The common access points will be the Consultive Committee for International Telephony and Telegraphy (CCITT) 802.3, and CCITT 803.5 baseband connections with TCP/IP, using the physical and logical interfaces defined in CCITT 802.1 and CCITT 802.2.

(3) The WAN connections shall comply with CCITT X.25 (FIPS-PUB-100/FED-STD-1041), and the CCITT V.11 (MIL STD-188-114) balanced interface, using LAPB.

(4) To allow the rapid transfer of large files, the data transfer rates between the CPC and the generic workstations shall meet or exceed 4.77 MB per second.

5.2.3.2 CPC-to-CPC Communications

Future ESIMS shall provide the following capabilities for all communications between CPCs:

(1) Automatically updated routing tables, allowing automatic selection and storage, as needed, of communication paths between CPCs

(2) Automatic redirecting of all communications connections during on-line saturation or external communication line failure

(3) Automatic removal of unused destination addresses on demand, with removal from the routing table

(4) Ability to name non-network CPC-to-CPC paths

In addition, Future ESIMS shall provide the following serial communications support for CPC-to-CPC communications:

(1) The following protocols shall be supported in a single modem:

- Bell 103/212A (the original standard for the 0-300 bits per second [bps] and 1200 bps modems, which are still used in some places)

- Bell 208b

- MNP-x (Microcomm Networking Protocol - error correcting protocol for modems), including the following classes:

  - Class 1 — Asynchronous byte oriented half duplex
  - Class 2 — Asynchronous byte oriented full duplex
  - Class 3 — Synchronous bit oriented full duplex
  - Class 4 — Adaptive packet assembly (approximately 20 percent throughput improvement)
  - Class 5 — Enhanced data compression (when combined with Class 4) to approximately 200 percent
  - Class 6 — Statistical Duplexing and Link Negotiation - dynamically allocated bandwidth for optimal throughput (allows CCITT V.29 to emulate full duplex modems)
  - Class 7 — Enhanced data compression to approximately 300 percent
  - Class 8 — Class 7 with pseudo-duplex modems (proprietary)
  - Class 9 — Enhanced data compression and CCITT V.32 technology (approximately 300 percent over the CCITT V.32 throughput)
  - Class 10 — used with variable quality links like mobile radiotelephone

- CCITT V.22 (1200 bps on a commercial voice switched network)

- CCITT V.22bis (2400 bps on a commercial voice switched network)
- CCITT V.24 (CCITT version of RS-232C)
- CCITT V.26 (1200/2400 baud)
- CCITT V.48 (4800 bps)
- CCITT V.29 (half-duplex 9600 bps on a commercial voice switched network)
- CCITT V.32 (full-duplex 9600 bps on a commercial voice switched network)
- CCITT V.42 (MNP-1, MNP-2, MNP-3, and MNP-4 error checking and data compression protocols)
- CCITT V.42bis (approximately 4:1 compression for modem transmissions)
- CCITT V.54 (modem diagnostics)

The CCITT specifications can be found in the CCITT Blue Book, Volume VIII - Fascicle VIII.1, "Data Communication over the Telephone Network," Series V Recommendations, IXth Plenary Assembly, Melbourne, 14-25 November 1988.

(2) Computer hardware shall support 300, 1200, 2400, 4800, 9600, and 19200 bps transmission and reception data rates in the generic workstation and the CPC. The CPC shall additionally support 64000 bps.

(3) Communications protocols (both on generic workstations and on CPCs) shall include:

- XMODEM
- YMODEM
- KERMIT (Both connection mode and server mode)
- Compuserve B (Host and client modes)

- UUCP (for communications, file transfer, and E-mail service with non-DOD research systems)

- 278x/378x bisynchronous communications (both host and client modes, CPCs only)

- X.25 commercial packet-switched network support (versions compatible with FTS-2000 packet-switched vendors)

(4) Communications facilities shall support auto-answer and auto-dial functions, and the modems and auto-dial units shall be certified for operation in the host country.

(5) For workstations:

A remote workstation shall be able to dial-in to a CPC and emulate a VT-100 terminal or Tektronix 4014 graphics terminal and run all Future ESIMS applications (within the limits of security authorization). While functioning as an asynchronous workstation, file transfer shall be enabled using XMODEM, YMODEM, and Kermit in addition to any vendor-supplied asynchronous file transfers.

Dial-in workstation service shall include VT-100 full-screen support for asynchronous workstations.

All workstation dial-in lines shall be auto-speed-sensing to allow any dial-in service to use 300, 1200, 2400, 4800, 9600, and 19,200 bps without reconfiguring the line. On out-dial, the modem shall initially attempt to communicate at the user-specified speed, then shall automatically select the speed due to modem hardware handshaking or error conditions.

The modem shall include the ability to use the Hayes AT command set for all configuration and actions.

High-speed workstation communications shall provide remote virtual disk service and networking features that allow workstation resident programs to function in a virtual network environment.

(6) For CPCs:

The communication subsystem on the CPC shall be capable of being redefined dynamically, to support in-dial terminal service, outbound communication service, or wide-area network service without interrupting other end-users of the CPC.

5.2.3.3 DDN Communications

Future ESIMS requires Class A, Class B, and Class C addresses, and the full suite of DDN-specified protocols with extensions to accommodate business data processing. The DDN communications protocols are intended for both inter-base and intra-base communications between CPCs. The minimal support suite shall be IP, ICMP, TCP, TELNET, FTP, SMTP, and Domain Name Service. Any vendor-unique services shall be designed using IP and ICMP packet routing. Host TELNET shall be enhanced beyond the DDN specification to use VT-100 control sequences over TELNET protocols in emulation of full-screen, block-mode terminal operation. All routing and addressing tables shall use Domain Name Service Protocol (DNSP) in addition to local updates by the System Security Administrator (SSA) for address table sources. As Domain Name Service identifies new systems and routes, they shall be added automatically to the local tables, and intelligent algorithms shall be provided to automatically purge the unused addresses periodically.

5.2.3.4 GOSIP Communications Support

Future ESIMS shall support GOSIP for hosting VT-S (block-mode, full-screen) and for emulation of VT-S and VT-A (character-at-a-time terminal mode), and shall comply with the GOSIP suite (ISO X.400 and ISO X.500) described in Section 5.2.1.1.1.

5.2.3.5 Radio-Attached Workstation Connections

Radiotelephone-attached generic workstations shall be supported. Using a normal half-duplex radiotelephone circuit, the generic workstation shall provide the audio-out and push-to-talk activation, and the radiotelephone shall provide the audio-in signals.

5.2.3.6 Access to Classified Communications

As defined in current directives, each generic workstation shall support the hardware and software required to allow connection to secure telephone transmission facilities while the generic workstation is physically and electrically isolated from the CPC and in a classified mode.

5.2.3.7 Access to Commercial Packet Switched Networks

The CPC shall have the necessary hardware and software for a dedicated connection to commercial packet switched networks (such as TYMNET and CDCNET), both as host and as a terminal.

5.2.3.8 Access to Unix E-mail Through UUCP

Future ESIMS shall enable transmission and receipt of Unix E-mail through UUCP, which is required to transfer Unix E-mail between different Unix networks, in the same fashion as normal mail through the office mail facility. Directories of UUCP end-users and systems shall be maintained to assist the end-user in addressing UUCP-directed mail.

5.2.3.9 Support for Inbound/Outbound Fax Transmission

Future ESIMS shall support the transmission and reception of fax data both in the CPC and in the generic workstation. Inbound fax shall create an image file that can be viewed on the generic workstation, can be printed on any hardcopy peripheral, and is compatible with optical character reader (OCR) translation facilities. (The requirement for OCR translation applies only to fonts the OCR is capable of recognizing. The intent is to allow simple fax input to be converted to word processing and ASCII text, as selected by the end-user, for all the fonts defined in the OCR specification.) Outbound fax shall be able to accept ASCII text, word processing, graphic, and image files as sources for transmission.

5.2.3.10 ULANA-Compatible Local Area Network Support

Future ESIMS shall support hardware and software connections to ULANA-based networks and to the ULANA protocols: 802.1, 802.2, 802.3, 802.5, TCP/IP, TELNET, FTP, SMTP, and NFS.

5.2.3.11 ISDN Support

Future ESIMS shall support, at the discretion of the SSA, ISDN for CPC-to-workstation communications and for CPC-to-CPC communications.

5.2.3.12 Other Communications

Future ESIMS shall also perform the following communications functions:

(1) Permit designated consoles and designated end-users to broadcast to all workstations and to selected workstations without receiving action from the workstation operator.

(2) Logically connect and disconnect designated devices on demand.

(3) Translate ASCII and EBCDIC character codes.

(4) Provide auto-answer and auto-dial capabilities.

5.2.4 Support for Air Force Architecture

Air Force architecture requires a POSIX interface both in the CPC and in the generic workstation. This interface shall support POSIX command language, the standard "C" library services, and the POSIX utilities required to complete the POSIX command language.

Air Force architecture also requires support for SQL as a resident language and as a remote query language. The requirements for SQL are specified in Section 5.2.9.11.

5.2.5 Security

Future ESIMS shall be certified by the National Security Agency (NSA) for at least the C2 level of protection specified in DoD Directive 5200.28 and DoD 5200.28-STD. The system shall also meet the following requirements:

(1) There shall be a minimum of 54 classes of file class membership, which shall include public access and user exclusive access. A file can belong to one and only one file class. The SSA and the file originator can assign the file class.

(2) An end-user may be assigned read-only, execute-only, and read-write privileges within a file class or group of file classes. The end-users shall be able to concurrently and simultaneously access any files appropriate to their privileges, in any class. Executable files may be assigned the same privileges as an end-user.

(3) Changes to the security system shall not require an initial program load (IPL).

(4) Security support for the file system shall include the ability to encrypt and decrypt using the data encryption standard (DES). The end-user, subject to assigned security privileges, shall have programmatic control over encryption of complete files, records within a file, and selected portions of records within a file.

5.2.6 File Management System

Future ESIMS system software shall support the following file management features:

(1) POSIX-compliant access to the file system (The POSIX standard requirement shall be extended to access relative, indexed, and relational files so that COTS software can transparently access any type of file created by the file management system. The COTS POSIX software shall comply with Air Force C-CS architecture and the E&S file management system. Access to all file structures must be totally transparent to permit mixing of different COTS products from different vendors with end-user-generated applications. Conversely, any end-user-generated program shall be able to transparently access any file generated by COTS software compliant with this requirement.)

(2) Operating system support for indexed sequential access method (ISAM) files with the following requirements:

- The same ISAM definition for all applications and application files
- Embedded or language-extension access to the ISAM files for all source-code programming languages
- Network ISAM access through both Network SQL and NFS
- Transaction recovery and roll-back capability for ISAM files in the file system, under programmatic control, to recover partially completed transaction sets in the event of unexpected processing termination (i.e., when a program determines that the transaction cannot proceed to completion)

(3) A diagnostic and recovery facility in the file system that can automatically detect and repair most structural integrity and single directory errors

(4) A file system backup and restore facility that can save and restore both the data and security features of the files

(5) Resource locking that extends to the record-level lock, allowing multiple read-write processes access to any record not locked by another process

The file system shall be able to perform the following:

(1) Automatically detect and resolve dead-lock conditions without operator or SSA intervention.

(2) Permit a default and a specified timeout on resource locks. (Upon timing out a lock, the file system shall either terminate the process with an error message, or report the timeout to the process as specified by the application programmer.)

(3) Automatically close files left open by a process, and remove any lock placed by a process at either normal or abnormal program termination.

(4) Support at least 16 alternate keys.

(5) Support a maximum record length of at least 2,000 characters.

(6) Group individual files by the user in at least three levels (e.g., files may reside in catalogs, which, in turn, may reside on disk volumes).

The facility for file and catalog names shall accommodate at least eight alphanumeric characters. The facility for volume names shall accommodate at least five alphanumeric characters. The name identifying each file must be unique only within the same catalog. The use of this "catalog and file" concept in no way implies that these catalogs and files are physical implementations; they are logical minimal implementations. The POSIX path-string is an appropriate representation of this concept.

5.2.7 Software

The vendor-supplied software shall adhere to minimum requirements in three categories:

(1) General software

(2) Human-machine interface

(3) User profile capability

5.2.7.1 General Software

Future ESIMS software shall include the following features:

(1) The same source-code language syntax shall be available in the CPC compilers and in the workstation compilers to allow total portability at the source-code level for all of the E&S high-level source-code programming languages.

(2) Automatic print spooling shall be provided on the generic workstation and on the CPC. The end-user shall have the option to redirect printer files to available printers. This technique temporarily stores printer output on a disk rather than printing it, ensuring uninterrupted program execution. In addition, the operating system shall control and queue print requests to ensure efficient printing.

The print spooling feature shall be able to redirect print within a queue designator to any hardware within that designator based on availability. The operator and the SSA shall be able to change priority within the queue, hold a file, reprint a file, begin print from selected pages, and delete a file from the queue.

(3) The operating system shall support "peel-down" architecture through an SSA-specified shutdown script facility.

5.2.7.2 Human-Machine Interface

The human-machine interface is the method used by the end-users to access programs and system support features. It is defined by the user profile and shall be transparent in its implementation to the programs and system support features.

Interface standards have been defined and adhered to throughout AMMUS ESIMS, allowing any end-user to work with the system worldwide without concern for human-machine interface issues. Future ESIMS shall provide the same interface standards enhanced with two additional access techniques: POSIX command text and X-Windows. The human-machine interface shall be simple and consistent in all aspects, and shall have the following features:

(1) Three human-machine interfaces that are end-user selectable in their user profiles: POSIX command text, menu and PF key selection, and X-Windows with a pointing device.

(2) Support in the high-level source-code programming languages which allow the application internal menus to read the user profile and automatically provide the correct human-machine interface

(3) A special user interrupt key for end-users, operators, and SSAs to interrupt running programs and access operating system control features consistent with their security access (This key shall be specially designated and shall be used for no other purpose.)

(4) A generic workstation keyboard containing the minimum following features:

- Not less than 16 reserved program function PF keys available in line across the top of the keyboard and replicated in two columns along the left side of the alphabetic keyboard. The corresponding keys in the two key banks shall issue identical, unique codes. These keys represent 16 separate programmed functions when used alone and an additional 16 separate programmed functions when used with the SHIFT key.

- The alphabetic keyboard shall conform to the QWERTY keyboard convention with a separate numeric keypad and with duplicate Ctrl, Alt, and Shift keys on either side of the central space bar. Dedicated keys shall be provided for Esc, Enter, cursor control, Caps Lock, Tab. Additional keys will be dedicated to Home, End, Pg Up, Pg Dn, Ins, and Del.

The system shall provide a human-machine interface for personnel who, although competent in their fields, have no experience using computers. The interface shall provide five paths to the tools required by the user with provision for enhancements, as discussed in the subsections that follow.

5.2.7.2.1 Command Language Interpreter - The command language shall consist of English statements containing words, mnemonics, and abbreviations which describe the utility being invoked. Future ESIMS shall provide a command language interpreter that supports AMMUS command structures during the transition to Future ESIMS. The command language interpreter shall provide the following features:

(1) Cues or prompts that indicate when the system is waiting for input

(2) Facilities that fully explain commands

(3) Descriptive error messages which contain the name of the system module where the error occurred and the reason for the error

(4) Editing utilities which permit the end-user to correct errors (Specifically, the end-user shall be able to correct errors in an input line before the system processes that line.)

(5) Options to abbreviate commands

(6) Facilities to suppress cues and informative messages at the user's option

5.2.7.2.2 User Interrupt - The end-user shall be able to suspend the currently executing program and perform one of the following operations:

(1) Cancel further execution or enter the debug utility for further control processing.

(2) Allow end-users to look up needed file names for entry in program prompts.

(3) Allow end-users to determine file input/output (I/O) status (open, number of records, mode, etc.).

(4) Display time elapsed and size of program.

(5) Allow execution of the current program to continue from the point of interrupt.

5.2.7.2.3 Operator Interface - The operating system shall detect hardware errors and display the appropriate interrupt message on the system manager's operator console. A system error log shall automatically accumulate error messages and the user's response.

(1) **Operator Console** - The physical console shall be a generic workstation that includes a dedicated on-line, I/O video display with a keyboard for controlling the system during IPL. This console shall have integrated control over all processing functions of the CPC, including logoff control.

The logical operator console may be simultaneously located on any end-user workstation. In addition to the console used for IPL, any number of simultaneous operator consoles may be defined by the SSA to designated end-users and designated workstations.

(2) **Console Functions** - The operator console interface shall be simple enough that a person without prior computer experience can easily learn to operate the system. A full-time operator shall not be required. From designated consoles, designated end-users shall be able to perform the following menu-driven functions:

- Bring up programs after execution of the bootstrap loader, resetting calendar and clock if needed.
- Logically remove and replace individual devices from the configuration without disrupting the continuity of operation.
- Execute the system shutdown sequence.
- Execute any job awaiting execution.
- Suspend and restart any job.
- Terminate any job.
- Display the status of jobs within the system to identify jobs in execution, in suspension, in an execution-pending status, and in output-pending status.
- Change the priorities assigned to jobs awaiting execution and files within the print queue.
- Broadcast to all workstations and to selected workstations.
- Designate up to 32 additional logical operator consoles.
- Designate specific end-users with logical operator consoles at any terminal where they are logged on as part of their security privileges in the user profile.
- Display memory resources in use.
- Display I/O resources in use.
- Display the names of end-users logged onto the system.

Future ESIMS shall use full-screen displays and user-profile-defined accesses for both operating system and application functions. The human-machine interface shall be consistently mediated by menus, prompts, and context-sensitive "HELP" procedures. Interrupt messages shall be displayed on the system operator's console to indicate hardware and software errors and to help the end-users resolve such errors.

__5.2.7.2.4 Support Tools and Functions__ - The following system-level tools and functions shall be provided with the operating system:

(1) **Integrated Functions** - The system shall be a totally integrated: file formats, file storage, language translators, subsystems, utilities, and other system facilities shall be compatible and operate as a single system.

The system shall support and be accessible through the Future ESIMS menus and function keys as defined by the human-machine interface.

(2) **Programmer Application Development** - The system shall include programmer application-development tools that allow programmers to enhance the source code produced by end-users. The following tools shall provided in all of the Future ESIMS languages:

- Debugger
- Text editor
- Context-sensitive "HELP"
- Callable system service subroutines
- Language processors
- Application-development support utilities
- Procedure language/JCL command processor

These tools shall be able to combine modules written in any of the Future ESIMS languages with modules written in any of the others. Future ESIMS shall be able to combine these modules into a single, executable run-time application. This capability will allow Future ESIMS to comply with Ada conversion directives without a total application rewrite. Older source code written in languages other than Ada will require only periodic minor maintenance.

The programmer application-development tools on the CPC shall be identical to those on the generic workstation.

(3) **Peel-Down Support** - To support the power requirements specified in Section 5.2.14.3, the vendor shall provide within the operating system an automated procedure to sense the power-out signal. Upon sensing this signal, this procedure shall notify the SSA and the workstation end-users of the power-out condition, and shall initiate system shutdown. The SSA shall be able to modify this procedure to include installed applications and peel-down priorities.

(4) **Command Processor** - The command processor shall execute instructions from a command file: an end-user program (from any language within the Future ESIMS language suite), or an operating system program (vendor-provided, end-user modified, and end-user created). A command file shall consist of any or a combination of the following types of instructions: operating system calls, utility calls and commands, language functions, language library functions, queries, human-machine interface parameters, instructions to establish and disconnect communications paths, calls to all vendor and end-user supplied programs, and calls to vendor applications with the ability to perform any function within that application.

Command file processing shall support nesting of command files to at least 32 levels.

(5) **Software Support** - Future ESIMS software support shall consist of problem diagnosis, error corrections, modifications, and improvements. It shall be consistent across all processor types (including windows capability) and shall contain the following:

- Support for graphic items
- Calls and procedures to support context-sensitive "HELP"
- Calls and procedures to support end-user error analysis and response
- User-transparent exit from tutorials and applications

(6) **Default "Desktop"** - The default human-machine-interface desktop mode for each end-user shall include the following:

- End-user selectable POSIX command text, PF-key-driven menus, and pointer-driven window menus

- POSIX command text that conforms with the IEEE P1003.2 specification

- Windows-type technology, with all its functionality: multitasking, cut and paste, memory allocation, mouse, pointer, tablet, icons, and fill-in-the-blanks.

- PF-key-driven menus and fill-in-the-blanks

- Accommodation for full-screen, fill-in-the-blanks display for business application display and operations

(7) **Intelligent Context-Sensitive "HELP"** - Future ESIMS shall implement the following HELP functions:

- Monitoring of end-user entry patterns, error conditions, etc., to tailor the initial HELP to the immediate need

- Support of multiple levels of HELP based on the selected mode in the user profile:

  - Explanation of errors

  - Detection of an error pattern and selection of aliases and optional end-user alias as substitutes for the erroneous command (Aliases shall be stored in the user profile as substitutes for the command.)

  - Display of the command syntax, upon command error, and the option to keep the HELP text on the screen while correcting the command

  - Complete explanation of the error with effects and valid responses
  - End-user option to call the appropriate section of the full tutorial or technical reference guide without leaving the application, and the option to keep the HELP on the screen as long as desired while running the application

- Interrupt messages for both hardware and software

• Ability to turn off automatic error messages and correction

(8) **Choice of User Input Devices** - Future ESIMS shall provide the following user input support:

• Standard keyboards

• Pointing devices (mice, track balls, etc.)

• Video input capture

• Interactive video output usable for training

• Screen image capture

• Audio capture

• Microphone with automatic input-level control (handset or hands-free)

(9) **On-Line Tutorials** - Future ESIMS shall contain on-line tutorial execution and creation capability for all standard applications and all end-user applications.

5.2.7.3 User Profile Capability

User profile is a conceptual framework for handling the elements of the human-machine interface and its relationship to the end-user-effected elements of the computing environment. The use of a common user profile for reference shall assist end-users by providing a consistent interface to the elements of configuration and control (e.g., mouse, display, end-user keyboard command assignments, and end-user window display preferences). Regardless of its physical implementation of the human-machine interface on the hardware and software, the Future ESIMS user profile shall make the interface appear as if it were defined individually for each end-user, SSA, and operator.

As part of the user profile conceptual framework, logon and password issues shall be treated in the following sequence:

(1) The workstation shall request a logon user ID and password for use with the CPC in obtaining central resource support.

(2) The user ID shall be used to select the appropriate user profile on the workstation, if present, and to select the appropriate CPC user profile.

(3) The user ID and password shall then be used in combination to log onto the CPC for normal CPC access. Regardless of whether the CPC user ID is present, both the user ID and password shall be requested. (Passwords shall not be stored on any magnetic media on the workstation.)

(4) The logon procedure shall then access the user profile conceptual framework as described in the subsections that follow.

5.2.7.3.1 Partitioned User Profile - The partitioned user profile shall allow selected access to Future ESIMS within the security limits. For the purposes of this requirement, each partition shall be called a profile with a name qualifier. The partitioned user profile shall include the follow profiles:

(1) Technical Support User Profile (TSUP) and Utilities - This profile shall include information about the physical workstation. The TSUP utilities shall include, but not be limited to, the following:

- Automatic generation of physical workstation parameters
- Intelligent TSUP editor template

(2) SSA Support User Profile (SSUP) and Utilities - This profile shall include information about system security and privileges. The SSUP utilities shall include, but not be limited to, the following:

- Intelligent SSUP editor template
- SSA-definable default SSUP, user profile
- SSA capability to set global and selected minimum and maximum defaults
- Emergency global and selected shutdown of privileges
- Emergency shutdown of selected processes and devices
- Automatic reversion to stand-alone mode if network shuts down

(3) **User Identification Profile (UIP) and Utilities** - This profile shall include the default appearance to the end-user of the workstation and the software accessible through that workstation. The UIP utilities shall include, but not be limited to, the following:

- Intelligent UIP editor template
- Peripheral setup routine
- Automatic generation of command files
- Automatic load and execution of end-user's "desktop" on logon

<u>5.2.7.3.2 Storage of User Profile</u> - The storage options for the user profile are as follows:

(1) **CPC Storage** - A central repository at each site of all user profiles shall allow an end-user to function on any workstation with the end-user's personal user profile.

(2) **Workstation Storage** - A copy of the user profile shall reside on the magnetic storage media on the workstation to allow stand-alone operation.

(3) **Removable Electronic Media Storage** - The logon sequence for the workstation shall allow the end-users to provide their own user profiles via removable magnetic storage media.

(4) **Logon Sequence** - During the logon sequence, the end-user shall be required to enter a user ID and password, and shall be allowed to choose one of the following user profiles:

- The end-user's user profile resident on the CPC
- The default user profile resident on the CPC
- The end-user's user profile resident on the workstation
- The default user profile resident on the workstation
- The end-user's user profile read from removable electronic storage media

(5) **SSUP Residence** - The SSUP shall reside only on the CPC, and shall be accessible to the system software that authorizes access to the CPC and enforces the privileges and permissions for that end-user. Only the SSA is authorized to add, update, or delete the information in the SSUP. Accordingly, that information shall not be visible to end-users.

(6) **TSUP Residence** - The TSUP for the workstation shall reside on the workstation. The TSUP for the CPC and communications links to the workstation shall reside on the CPC.

5.2.8 Development Tools

The vendor shall provide, at a minimum, the following set of integrated development tools:

(1) Code-generation software

(2) General purpose source-code language editor

(3) Program combiner (link editor)

(4) Interactive debugger

(5) Compilers

(6) Version/date extraction utility

(7) Source-code version library maintenance facilities

(8) Difficulty and request-for-change support system

(9) HELP text support

(10) Vendor-provided utility library

These vendor-supplied tools are described in the subsections that follow. Each of the tools shall be available to the end-user using the human-machine interface selected in the user profile, with the capability to switch human-machine interfaces at the end-user's option.

5.2.8.1 Code-Generation Software

The code-generation utilities shall allow end-users to create sophisticated programs. Each of these utilities shall use full-screen, fill-in-the-blanks queries with sufficient instructions on the screen to permit the end-user to use the utility without consulting a technical manual.

5.2.8.1.1 Update Program Generation - The end-user shall be able to generate interactive applications that can create, display, update, and delete single records within relative, indexed sequential, and relational files. Additionally, these applications shall be able to create, display, append, and update (but not delete) single records in sequential files. End-users shall select file storage structures both by input and by use of the data dictionary. Provision shall be made to allow tables of valid values, range checking of valid values, access to other files for compatibility edits, and custom full-screen definition.

The end-user shall also be able to selectively create and submit queued transactions for remote updating of replicated files. Furthermore, the end-user shall be able to generate programs for receiving remote update transactions for local file maintenance. This generation compatibility shall produce source code for Ada, COBOL, "C", FORTRAN, and SQL that can be modified and recompiled with the language editors and compilers described later in this section.

5.2.8.1.2 Menu Generation - Future ESIMS shall be able to associate workstation function keys, pointing device indicators, and named commands with selectable menu items displayed on the screen. End-users shall be able to select end-user-created programs, vendor-supplied programs, other menus, and any other executable file that has menu items. The human-machine interface for this utility shall include a "what-you-see-is-what-you-get" (WYSIWYG) menu-creation facility, which shall be able to store, recall, and edit any menu that it creates. The generation compatibility shall produce source code for Ada, COBOL, "C", FORTRAN, SQL, and POSIX command text.

5.2.8.1.3 Report Generation - Future ESIMS shall be able to define reports and other queries. It shall perform the following report-generation functions:

(1) Permit end-user-specified and data-dictionary-specified input files.

(2) Include end-user selection of at least 1 to 16 files in the report and query.

(3) Record selection criteria including the logical links of "and", "or", and "not", and field comparisons using "equal", "not equal", "greater than", "less than", "greater than or equal", and "less than or equal".

(4) Derive fields from the file data with the ability to use them with display and calculations.

(5) Define fields not in any file for use with display and further calculations.

(6) Calculate on numerically compatible fields with the following operators: "add", "subtract", "multiply", "divide", "whole power of", and "fractional power of".

(7) Concatenate data-file fields and end-user-defined fields in any combination.

(8) Order the data with sorting on at least six keys.

(9) Format display fields with zero-suppression and special character insertion (dollar, decimal, comma, and blank).

(10) Use end-user-defined report titles, page headings, column headings, control break identification, and report break identification.

(11) Total/accumulate end-user-selected numeric fields for display and reset at control breaks and end-of-report.

(12) Tally/count for use in control breaks and numeric calculations.

(13) Define computation at each data record, as well as at the control breaks and at end-of-report.

(14) Direct output to the printer and to the workstation display utility for subsequent processing.

(15) Name, store, retrieve, and modify report definitions.

(16) Query workstation operators for key values used in the selection, display, and computations within the report execution. (This allows previously defined reports to be directly executed and to query end-users for specific values to tailor the report.)

(17) Produce source code for Ada, COBOL, "C", FORTRAN, and SQL, in addition to the report characteristics definition. (The source code produced shall be available for modification in the language editor and compilers for enhanced report and query applications.)

(18) Store query results as sequential, indexed sequential, relative, and relational files under end-user specifications.

5.2.8.1.4 Sample Device Drivers - Future ESIMS shall include a device driver and source-code example for each device supplied for use on the CPC and the generic workstation. Each driver shall access and use all the addressable features of its device, and the source-code example shall use one of the Future ESIMS languages. Where possible, the source code for the device driver shall be generated by the code generator.

The driver shall include all necessary interface definitions and calls to make it compatible with the CPC operating system and with the generic workstation operating system.

In addition, working source-code examples (generated by the code generator) of the communications facilities and the application internal communications facilities shall be provided for one of the Future ESIMS languages. These examples shall include all the interface definitions and calls necessary to make the facility compatible with the CPC and generic workstation operating systems. The intent is to enable the technologist to provide communications services to programs and applications on the CPC and the generic workstation as required by mission-related tasks.

5.2.8.1.5 Additional Subroutine Library - Subroutines shall be built and supplied with full source code and context-sensitive "HELP". They shall support the following:

(1) **Date Support** - shall perform the following functions:

- Translate between Gregorian and Julian calendars.
- Calculate the number of days between dates.
- Calculate a date given the number of days from a start date.
- Determine the day of the week for a given date.

(2) **Peripheral Mount and Dismount** - shall logically attach (mount) and release (dismount) peripherals to end-user applications, at the end-user's option.

(3) **Foreground and Background Tasks** - shall submit foreground and background tasks from within an end-user application for execution on the CPC, on the generic workstation, and on both.

5.2.8.2 General Purpose Source-Code Language Editor

The general purpose source-code language editor shall exist on both the CPC and the generic workstation with the same human-machine interfaces and capabilities. The following minimum capabilities shall be supported:

(1) Full-screen editing, using the human-machine interface selected in the user profile, that can switch human-machine interfaces at the end-user's option

(2) Ability to insert, modify, and delete characters, lines, and marked blocks

(3) Ability to copy and to move text from any place in the file to any other place in the file or to any other file

(4) Global search and global search and replace for characters (full ANSI set) and character strings

(5) Resequencing of record numbers in the languages requiring them, with the capability to specify interval range

(6) Automatic warning on exit when changed text is present, with the ability to abandon changes or save as selected by the end-user

(7) Context sensitive "HELP" to be tailored to the language being edited to include direct reference to verbs and operators appearing under the cursor at the time HELP is requested (The HELP shall include sufficient text to describe the feature and include an example of each of its uses.)

(8) Context sensitive "HELP" to be selectively retained on the screen while editing the source text

(9) Tab stops and formats tailored to the source code being edited, with the ability to modify tabs and formats under end-user control

(10) Closely coupled compiler and editor to allow error messages from a compile to identify and locate the source text causing the error.

(11) Ability to compile, link, and execute from within the editor, including debugger sessions; and the ability to compile, link, and execute an executable group while editing any subprogram within the group.

(12) Ability to reference any data dictionary present without exiting the text being edited

5.2.8.3 Program Combiner (Link Editor)

Future ESIMS shall be supported by a program combiner (link editor) that can perform the following functions:

(1) Link object modules from any of the E&S source-code languages/compilers in any combination selected by the end-user.

(2) Build and modify link editor scripts.

(3) Produce a text map containing storage allocation, named entry point and offsets, fully qualified paths to included modules, identification of source library of included modules, version date and version identification of included modules, a list of unreferenced but included data entry and reference points, and a list of unresolved and conflicting references.

(4) Specify the main entry module name and entry point.

(5) Replace object modules in a completed run-time image without completely reformatting the object set.

5.2.8.4 Interactive Debugger

Future ESIMS shall be supported by an interactive debugger that includes the following features:

(1) The interactive debugger shall comply with the C2 level of protection specified in DoD Directive 5200.28 and DoD 5200.28-STD on the CPC. When debugging MS-DOS applications, the debugger shall comply with the D1 level.

(2) The debugger shall have the same human-machine interface and appearance on both the CPC and the generic workstation.

(3) The end-users shall be able to set and reset break points. They shall also be able to select levels of the break points, and to select which levels of break points are to be executed during any pass through the executable code.

(4) The debugger shall display, at the end-user's option, machine registers, object code image, segments of real memory, symbolic assembler representing code being executed, source-code lines, ASCII representation of segments of real memory, previous step, current step, and next step. Data display shall be selectively formatted appropriate to its definition and the end-user's selection. The debugger shall also monitor the output of each step, and the machine-level interrupts on the generic workstation only (keyboard activity, output display activity, disk access, etc.).

(5) The end-user shall be able to execute next step, set break points, change break-point level, execute to next break point, return to previous break point, and one-way return to source-code editor.

5.2.8.5 Compilers

Future ESIMS shall include only the following languages (other than those provided by the vendor) for the CPC and the generic workstation, and shall support a compiler, for use by the end-users and software developers, for each of the languages:

(1) **Ada** - Ada shall be capable of compiling and executing the Ada source code, both in the environment of the language editor specified above and in the Ada Programming Support Environment (APSE), subject to the specifications in FIPS-PUB-119 (ANSI/MIL-STD-1815A-1983), Ada Programming Language, 1987; and DoD-STD-1838A, Common Ada Programming Support Environment (APSE) Interface Set (CAIS), 12 April 1988. Ada shall also have extensions to support function access to full-screen interactive terminal capability, and full file access to relational, indexed, relative, and sequential file structures. Additionally, the program combiner (link editor) shall be able to combine Ada object modules with any other ESIMS languages into complete run-time programs.

(2) **COBOL** - The COBOL language compiler shall comply with FIPS-PUB-21-3, COBOL Language (ANSI X3.23A-1989), 12 January 1990. COBOL shall also have extensions to support function access to full-screen interactive terminal capability, and full file access to relational file structures, as well as the existing indexed, relative, and sequential file structures. Additionally, the program combiner (link editor) shall be able to combine COBOL object modules with any other ESIMS languages into complete run-time programs.

A COBOL interim development facility shall be provided to allow the original Wang-based VS-COBOL to correctly compile and execute on both the Future ESIMS CPC and the generic workstation. This facility shall not be a conversion facility. It shall be a front-end or embedded capability, available through the language editor, that allows the original code to be used as current source code until conversion and redesign is undertaken. The use of this facility shall not cause appreciable performance degradation at source-compile time, nor any performance degradation over the native COBOL compiler object code supplied. It shall have all of the features required to support the combination of multiple language object modules in a single run-time program.

(3) **"C"** - The "C" language compiler shall comply with ANSI/X3.159-198x Programming Language "C" Standard. "C" shall be extended with function access to full-screen interactive terminal capability and full file access to indexed, relative, and relational file structures, in addition to the sequential required by "C". Additionally, the program combiner (link editor) shall be able to combine "C" object modules with any other ESIMS languages into complete run-time programs.

(4) **FORTRAN** - The FORTRAN language compiler shall comply with FIPS-PUB-69-1, Fortran Language (ANSI X3.9-1978) (Complete Set), 24 December 1985. FORTRAN shall be extended with access to full-screen interactive terminal capability and full file access to indexed, relative, and relational file structures, in addition to the sequential required by FORTRAN. Additionally, the program combiner (link editor) shall be able to combine FORTRAN object modules with any other ESIMS languages into complete run-time programs.

(5) **BASIC** - The BASIC language compiler shall comply with FIPS-PUB-68-2, BASIC Language (ANSI X3.113-1987), 24 August 1987. BASIC shall be extended with access to full-screen interactive terminal capability and full file access to indexed, relative, and relational file structures, in addition to the sequential required by BASIC. Additionally, the program combiner (link editor) shall be able to combine BASIC object modules with any other ESIMS languages into complete run-time programs.

(6) **Native Language** - A native language facility is needed to produce the code that is essential for creating device drivers and other special purpose requirements not available in the standard language suite. This facility shall have all the documentation and libraries needed for its use.

Each of these compilers shall be able to place end-user version identification, version compile dates, and source-code language identification in each object module produced. Version information shall, at a minimum, include a version numbering scheme that allows a minimum of 4 numbers separated by decimal points, integer identification, the version compile date, and not less than 20 characters of additional information, and the source-code language identification.

Finally, each compiler shall support the following requirement with standard syntax and vendor-supplied extensions, as appropriate: ASCII decimal with implied decimal point, floating point numbers from 2 to the plus 63rd power to 2 to the minus 63rd power with 7 decimal digits of precision, negative numbers defined with the range of absolute values of positive numbers, and zero. The same data representation shall be used for all language compilers. This requirement is intended to allow numbers to be used in programs containing multiple source-code programming languages without complex transliteration routines.

5.2.8.6 Version/Date Extraction Utility

This utility shall be able to read an object code module or an executable module and extracting version/date, source-code language, and other version identification from each object module in the executable code module.

5.2.8.7 Source-Code Version Library Maintenance Facilities

The Future ESIMS source-code version library maintenance facility shall perform the following:

(1) Retrieve copies of any version of any program catalogued in the library.

(2) Maintain one and only one copy of a version of a file to be checked out of library for update at any one time. (Read-only copies of any version of any file shall be available. When a file is checked out, the library maintenance facility shall identify its locked status and the responsible end-user possessing the update copy.)

(3) Catalog and enter updates to the source program, and maintain unique version numbers and dates for each action.

(4) Remove a version from the library.

(5) Display the status of a file in the library (versions, version dates present, and availability for updates and edit).

(6) Report the end-user-selected version differences and specific identification of text deleted between versions, text added between versions, and text moved between versions.

(7) Maintain a history log (which shall be available for utility display and reporting) of all library file check-in and check-out activity, including end-user identifier, date, time, version number, and comment.

(8) Maintain any end-user-specified number of separate libraries.

5.2.8.8 Difficulty and Request-for-Change Support System

The difficulty and request-for-change support system shall allow the end-user, within any application running on the system, to "grab" a copy of the session logger text for the session. The purpose of the support system is to allow the end-user to locate that part of the Future ESIMS system or application code that failed, and to inform the appropriate support activity where the problem has occurred or where change is needed to support mission-related tasks.

The file containing the session-logger text and end-user annotation shall, at the end-user's option, be saved, canceled, and automatically routed to the end-user selected list of support activities. This list shall be context-sensitive, be modifiable by the SSA, and contain not fewer than 20 options for end-user selection per screen. The SSA shall be able to provide multiple-screen support activity options including routing addresses. The SSA shall have the option to allow routing in turn and mandatory routing addressing. In addition, the support system shall be able to receive and store the annotated file, to perform a step-by-step replay of the screens accessed by the session logger text, to perform a step-by-step re-execution of the session-logger text, and to print the session-logger text and screens accessed.

5.2.8.9 HELP Text Support

Context-sensitive "HELP" for a particular function within an application shall be resident on the generic workstation, on the CPC, and on both, where appropriate. Because not all applications will totally reside on either machine, appropriate HELP shall reside on the same machine as its associated portion of the application.

In the following discussion, **"topic"** refers to a complete HELP text file; **"subject"** refers to titles of collected information within a topic; and **"keyword"** refers to a unique identifier for displacement within the topic and is used as the address within the topic for the text on a subject.

Separate HELP files shall be provided for each HELP topic. These files shall be transportable between the CPC and the generic workstation, and vice versa. From the end-user's perspective, the HELP text maintenance facility human interface shall appear identically on both the CPC and on the generic workstation.

A minimum of three levels of HELP text shall be supported: novice, experienced user, and expert user.

<u>**5.2.8.9.1 HELP Text Maintenance Utility**</u> - This utility shall provide the end-user and application developer with an easy method of generating HELP text. It shall provide the following capabilities:

(1) The utility shall be able to accept ASCII text, word processing text, graphics, audio files, and image files as source documents.

(2) The HELP text generated shall be able to contain keywords which shall uniquely identify text for use in tailoring context usage. These keywords shall be visible only within the HELP text support utility, not in HELP text when it is called within the supported application.

(3) The HELP text shall be callable within any system program, vendor-provided application, or end-user-produced program.

(4) The HELP text shall be able to define which audio and video files are appropriate within the context of the query.

(5) The utility shall provide editing services similar to those provided by the source-language editor, while preserving the keyword features and the audio and video file linkage capability.

(6) The HELP utility shall be able to create ASCII text files and word processing documents from its text, and single frame images suitable for editing from its video files.

(7) On demand, the utility shall generate and print a complete manual from any end-user-specified list of HELP files.

(8) The keyword shall be able to identify the level of HELP being provided by its associated text.

(9) The end-user shall be able to catalog HELP text files as topics with annotated entries.

5.2.8.9.2 Context-Sensitive "HELP" Text Viewer - The end-user shall be able to access any and all HELP text files resident on the system without using an application. The context-sensitive "HELP" text viewer shall provide the following capabilities:

(1) The context-sensitive "HELP" text shall constitute the manual for the application.

(2) The end-user shall be able to access any and all HELP topics in the catalog from the end-user's choice of human-machine interface for viewing and printing.

(3) When entering from the human-machine interface, the end-user shall be presented with an annotated index of HELP text topics and a method of selecting a topic.

(4) After topic selection, the end-user shall have all of the HELP text subjects available, a method of selecting a keyword, a method of scrolling and paging through the topic, and a method of printing end-user-selected text.

(5) The end-user shall be able to change topics any time during a viewing session.

5.2.8.9.3 Context-Sensitive "HELP" Text Implementation - When implemented within the application and called by the end-user, this tool shall automatically locate the HELP text pertaining to the topic on which the end-user is working and shall display that text on the screen. The context-sensitive "HELP" shall then enable the end-user to perform the following:

(1) Edit the default level of HELP selection in the user profile.

(2) Temporarily change the level of HELP without changing the value in the user profile.

(3) Access all of the features available in the context-sensitive "HELP" text viewer.

(4) Mark and copy HELP text from the HELP text screen to the application screen, copy example text into the application, and modify the copied text within the application.

5.2.8.10 Vendor-Provided Utility Library

The vendor shall provide, at a minimum, the following set of integrated utilities:

(1) File display

(2) Sort and merge

(3) E-mail

(4) Office management

(5) File comparison

(6) Data file manipulation

(7) Data transfer

(8) Translation

(9) Backup and restore

(10) File search

(11) Removable media dump

(12) Media consolidation

(13) Cross-language thesaurus

These vendor-supplied utilities are described in the subsections that follow. Each of the utilities shall be available to the end-user through the human-machine interface selected in the user profile, and the end-user shall have the option to switch human-machine interfaces.

5.2.8.10.1 File Display - This utility shall be able to perform the following functions:

(1) Display selected files logically, by record and by block.

(2) Produce ASCII, image, and sound outputs. The ASCII and image outputs shall, in turn, be able to display special purpose characters in symbolic form.

(3) Display output, subject to security permissions, and at the end-user's option, as follows:

- As it would appear in native form (as hexadecimal character pairs)
- In formatted form as normally viewed, as a formatted display of native form (as hexadecimal character pairs and ASCII with special purpose characters in a vendor provided display format)
- In structured format using the structures provided in the data dictionary
- With symbolic characters in their normal positions

(The end-user shall be able to choose between display formats at any time during the session.)

(4) Accept for input any file capable of existing on the Future ESIMS platforms while recognizing the appropriate file structure form the following file types: sequential, relative, relational, and indexed sequential, program object files, and any platform-specific file structures implemented by the vendor.

(5) Provide a method to locate and display a particular record by hexadecimal characters, ASCII strings, image frame numbers, audio time displacement, record number, indexed key, and relational table key, as appropriate for the file structure type.

(6) Produce output for display at a generic workstation, and print a hardcopy.

(7) Allow the end-users to horizontally and vertically scroll contents of the record through the human-machine interface of their choice.

5.2.8.10.2 Sort and Merge - This utility shall be able to order and combine any file from the system, producing a sequential output for further processing. Specifically, it shall be able to perform the following:

(1) Accept input from multiple storage devices and sequential access storage devices, and provide output to all types of storage devices.

(2) Accept and create labeled and unlabeled files.

(3) Accept sort and merge keys for alphanumeric, numeric and special characters in all storage formats.

(4) Sort only and merge only.

(5) Allow ascending and descending collating sequences for each field, independent of sequences for other fields.

(6) Allow the end-user to bock input and output files to the full extent allowable for the block size and record size available on the platform.

(7) Allow processing of multiple noncontiguous fields with a field size of not less than 32 characters each.

(8) Execute as a separate task under control of the operating system in both background and interactive modes, and be callable from application programs.

(9) Allow the capability to control all features of the sort and merge with the POSIX command language and any command language on both the CPC and the generic workstation.

5.2.8.10.3 E-Mail - ESIMS E-mail shall be able to send and receive message traffic to end-user mailboxes. Mail shall consist of messages, as well as packages of messages and collections of any files capable of being stored on the system, subject to security restrictions. The E-mail shall incorporate advanced word processing features and perform the following functions:

(1) Create and send mail to end-users on the same system and to end-users on other systems, including originating end-user identification and a date and time stamp as part of each piece of mail. (An automatic return address shall be included with each piece of mail.)

(2) Provide access to an indexed end-user address list and a personally tailored end-user address list, with facilities for:

- Electronically addressing mail
- Manually addressing mail
- Maintaining a personal address list, special purpose address lists for special interest groups, organizational elements, command elements, and service elements

(The intent is to allow any end-user to appear in as many address lists as required by the mission-related tasks without unduly lengthening each list. Each list shall attach the end-user address to an alias on the master list to allow single entry updates to accomplish global list changes. Any end-user address change shall appear in all address lists within 24 hours.)

(3) Notify the end-user when unread mail is present for disposition.

(4) Automatically reroute, transparently to the end-user, in the event of primary mail path failure.

(5) Permit the mail index list to indicate which messages have been read, and which messages have not been read.

Additionally, the E-mail shall allow the end-users to perform the following functions:

(1) Read, respond to, delete, and forward mail.

(2) Generate certified mail, which must be read prior to deleting or forwarding. (Certified mail shall automatically generate a return mail message to the sender when the certified mail is placed on the destination host system, and generate an additional return mail message when the mail is opened by the addressed end-user. Certified mail shall be uniquely identified to the addressed end-user.)

(3) Print and store delivered mail in the original format, subject to security restrictions. (Original mail stored on the system shall appear as mail that has been read.)

(4) Retain partially completed mail for completion at a later time. (The intent is to allow the end-user to interrupt the mail creation session and return without having to recreate the partially completed mail.)

(5) Generate memos which can be sent independently and as cover letters to other mail being forwarded.

(6) Generate and read telephone messages as part of the E-mail system.

(7) Generate a history log of all transactions for an E-mail package, including:

- The date the package was originated
- The date the package was sent
- End-users who have received, read, and forwarded the package, including time/date stamps
- The current "possessor" of the package
- A list of the recipients of the package

(Access to the history log shall be limited to the SSA and the recipients of the E-mail package.)

Finally, ESIMS E-mail shall allow the SSA to selectively clear, redirect, and delete mail by date and end-user identification. (Certified mail so cleared shall indicate that it has been cleared or deleted without being read in the reply mail to the sender.)

5.2.8.1.9.4 Office Management - This utility shall:

(1) Create project and task lists with priorities and due dates, allowing the end-user to do the following:

- Designate which end-users have access to view and modify the lists.
- Automatically activate an end-user-selected alarm to remind end-users of task due dates and appointments. (Selection of the alarm type and characteristics shall reside in the end-user's user profile, and shall be modifiable on demand.)
- Sort and display the project list by priority and due date, and print the project list.

(2) Display a planning calendar by day, week, month, fiscal year, and calendar year at the end-user's option, allowing the end-user to do the following:

- Input information on the calendar and on other calendars where access has been granted.

- Designate which end-users shall have access to view and modify calendars.

- Print any part of a calendar.

- Provide a mechanism for the SSA to clear all and portions of a particular calendar and SSA-selected groups of calendars.

<u>5.2.8.10.5 File Comparison</u> - This utility shall compare, identify, and list differences between records, data elements, and character strings in a file and in any two files. It shall be able to identify deleted records, inserted records, and modified records relative to the indicated primary file. (This utility shall consider any file on the system a source file.)

<u>5.2.8.10.6 Data File Manipulation</u> - This utility shall permit the end-user to create files and to modify file structures, record structures, field length, and field type. The utility shall be able to perform the following:

(1) Read records from the original files using the original file structure definition, and generate new files based on modifications specified by the end-user.

(2) Pad fields within the record, handle multiple record types and sizes, combine records from different files, and produce reformatted files in any system-accepted size, format, and organization.

The sources of both the input and output data structures shall be a data dictionary entry specified by the end-user and special-purpose definitions not in a data dictionary.

<u>5.2.8.10.7 File Transfer</u> - This utility shall transfer (copy) files and end-user specified groups of files under the following conditions:

(1) From one device to another

(2) From one filename to another filename

(3) From one group of file names to another group of filenames through use of wild-card characters (i.e., single characters represented in MS-DOS by "?" and groups of characters represented by "*"), which shall be consistently implemented across the platforms

(4) From one directory on a path to another directory on a path, as specified in ISO X.500

5.2.8.10.8 Translation - This utility shall provide the following minimum capabilities:

(1) Character transliterations, including ASCII, EBCDIC, and other vendor-provided character sets

(2) Acceptance of any file structure on the system as input and output structures

5.2.8.10.9 Backup and Restore - The end-user shall be able to back up and restore the file system to and from the end-user-designated backup media to protect against accidental destruction of data caused by system malfunction, an operational mishap, or end-user error.

The end-users shall be able to use this utility while they are using the system. The utility shall not interrupt the use of the files that are not being backed up or restored. Backups shall be made to magnetic tape and storage media under end-user selection. Backups and restores shall be media-independent. For example, files backed up from one storage device-type shall be capable of being restored on another storage device-type.

The end-user shall be able to selectively back up and restore by file name, by a group of files, or by storage media device, and shall be able to view and print the list of files on the backup media.

This utility shall, at the end-user's option, incrementally back up files and groups of files that (1) have not been previously backed up or (2) have been created or modified past a specified date. Additionally, this utility shall, at the end-user's option, unconditionally restore files or incrementally restore files and groups of files that (1) have been created or modified past a specified date, (2) have not been superseded on the destination media, or (3) have been superseded on the destination media with notification to the end-user of an attempt to overwrite an existing file and at the end-user's option to rename or overwrite the file.

5.2.8.10.10 File Search - This utility shall search the file system for the following file characteristics:

(1) File names with the end-user option of using wild-card characters (i.e., single characters represented in MS-DOS by "?" and groups of characters represented by "*"), which shall be consistently implemented across the platforms

(2) File names for any end-user-selected storage media device

(3) File names where the complete access path is displayed for each occurrence of the file name encountered

(4) File names by date (The end-user shall have the option to select files by specified date, before a specified date, after a specified date, a date within a range of dates, and a date not within a range of dates.)

(5) File names by creation date where provided by the file management system

(6) File names by size (The end-user shall have the option to select files by specified size, under a specified size, above a specified size, a size within a range of sizes, and a size not within a range of sizes.)

(7) File names by file type

(8) File names by file attribute

The end-user shall have the option to sort the output of the search by name, path, date, size, type, and attribute, and the option to display the output, to store it as a file, and to print it.

5.2.8.10.11 Removable Media Dump - This utility shall be able to perform a binary read of all binary data stored on any vendor-supplied removable media regardless of format. The intent is to enable the technologist to develop applications for which the known storage structure is missing (tapes, floppy disks, etc. containing information needed to support mission related tasks but provided to the end-user without a known format definition). This utility shall provide, as a minimum, the following features:

(1) Binary read of any input removable media

(2) Hexadecimal output to the screen, a file, and a printer at the end-user's option

(3) ASCII/EBCDIC/ASCII conversion

(4) Identification of the block number relative to the beginning of the removable media, the block size, and special records such as tape marks and deleted sectors

(5) Identification of cylinder, head, and sector on removable disk media

(6) Identification of record length and record number on tape

5.2.8.10.12 Media Consolidation - This utility shall, either automatically or at the end-user's option, physically consolidate the allocated media space and physically locate files contiguously. The intent is to reduce access-arm movement and to improve media-access time. This improved access will ensure acceptable application performance.

5.2.8.10.13 Cross-Language Thesaurus - This utility shall permit the end-user to easily compare similar language structures and verbs in traditionally dissimilar languages. This thesaurus shall assist in the conversion of COBOL programs to the equivalent programs in Ada. This thesaurus shall also help Ada programmers provide minor maintenance on older code in non-Ada languages. Since languages other than COBOL have been traditionally used to support E&S, all languages specified in this document require equal thesaurus support.

5.2.9 Vendor Applications

The vendor shall provide, at a minimum, the following set of integrated general applications:

(1) Engineering graphics

(2) Image vectorization

(3) Statistical and trend analysis

(4) Word processing

(5) Optical character recognition

(6) Business graphics

(7) Audio input, voice recognition, and audio output

(8) Computer-based training (CBT)

(9) System-level computer system analysis

(10) Application-level computer system analysis

(11) Query language

(12) Data-dictionary-level analysis

(13) Automated expert assistance

(14) Electronic remote library creation

These vendor-supplied applications are described in the subsections that follow. Each application shall be available to the end-user using the human-machine interface selected in the user profile, and the end-user shall have the option to switch human-machine interfaces.

5.2.9.1 Engineering Graphics

Computer-aided design and drafting (CADD) shall be provided with the engineering graphics application. CADD includes both the attributes of engineering drawing and the computing capability of analytic design. These tools shall be provided to the CE personnel whose mission-related tasks involve drafting and analytic design. Using Future ESIMS CADD tools, the end-user shall be able to produce and maintain bills of material (BOMs); to read, write, modify, and delete business data files; to maintain standard model specifications and component drawings catalogs; to superimpose an engineering graphics image with a photographic image; and to generate and specify full-size and scaled plots and prints in sizes ranging from "A" through "E" on paper, mylar, and transparency substrate.

The CADD Tools shall have the following minimum features:

(1) **End-User-Modifiable Specialized Templates** - These templates shall be available to each the engineering specialties requiring CADD support, and shall have the following capabilities:

- Contain a scalable vectorized drawing that can be placed within a drawing space.

- Allow the end-user to modify the following components within the template: text, color selection for screen and plotter, line-type description, fill-type description, and tag information.

- Create new templates, modify existing templates, and copy objects within a template into the same template or another template.

(2) **A Minimum of 256 End-User-Named-and-Defined Layers** - The CADD tools shall display, print, and plot one or more layers at the end-user's option. Each layer shall have an end-user-specified default color, which shall be used when no color is specified for individual objects on that layer.

(3) **Two- and Three-Dimensional Viewing Capability** - At their option, the end-users shall be able to view any drawing in two and three dimensions, and shall be able to switch between dimensional views.

(4) **End-User-Selection of Human Interface** - The end-users shall be able to select the CADD human-machine interface that accommodates the special needs of their engineering specialty from the end-user-named selections in the user profile. The end-users shall also be able to create and modify human-machine interfaces to accommodate their special needs, and shall be able to designate the default interface to reside in the user profile.

The following CADD and simulation tools are required:

(1) Computer-assisted mechanical engineering support

(2) Computer-assisted electrical engineering support

(3) Computer-assisted architectural engineering support

(4) Computer-assisted environmental engineering support

(5) Computer-assisted heating, ventilating, and air conditioning (HVAC) engineering support

(6) Computer-assisted civil engineering support

(7) Computer-assisted sanitary engineering support

(8) Computer-assisted industrial engineering support

(9) Computer-assisted audio engineering support for detection and analysis of environmental noise

Specific minimum support shall be provided for each of the following engineering specialties:

(1) Design support for power distribution systems

(2) Design support for control systems

(3) Design support for plumbing/wastewater systems

(4) Design support for HVAC systems

(5) Design support for environmental systems

(6) Design support for fire protection systems

(7) Design support for grading/drainage/earthwork systems

(8) Two-dimensional and three-dimensional wire-frame and solid modeling

(9) Rotational/multiple static views of surfaces

(10) Variable surface shading and variable light source with the capability to add multiple light sources

(11) Variable surface texturing

(12) Access to local, Air Force, corporate element libraries

(13) Rules checking and simulation

(14) Finite element analysis

(15) Linear/nonlinear static and dynamic stress analysis

(16) Multidimensional heat transfer analysis

(17) Fluid flow analysis

(18) Fatigue and fracture analysis

(19) Space and facility planning

(20) Scanning/digitizing input support

(21) Fourier analysis of audio signal input for frequency content, within 15 Hz to 40 kHz and within 10 Db to 130 Db

CADD interfaces shall, at the end-user's option and according to the end-user's definition, accomplish the following minimum set of automatic information transfers:

(1) To/from Base Comprehensive Plan CADD database

(2) To/from non-E&S standard CADD tools

(3) To/from program management tools

(4) To/from the contract management/payment system

(5) To/from the computer-aided publishing system (per MIL-D-28000, IGES)

The CADD tools shall, at the end-user's option, be able to change the drawing formats of the graphics files residing on the system from each of the following four formats back to the native storage format:

(1) Initial Graphics Exchange Standard (IGES)

(2) Computer Graphics Metafile (CGM)

(3) Drawing Exchange Format (DXF), from AutoDesk, Inc.

(4) Standard Interchange Format (SIF), from Intergraph, Inc.

The human-machine interface for selecting changes between drawing formats shall be determined by the default interface specified in the user profile.

Video frame change capability shall be provided as video extension to context-sensitive "HELP". The intent is to provide useful examples to the end-user when working in graphics mode, and to provide support for training activities.

5.2.9.2 Image Vectorization

Conversion from bit-image format to engineering graphic vectorized format shall be supported with two-way translation in the following formats: DCX, PCX, and TIFF (uncompressed, packed bits, and Group 3). This application is needed to complete the facility records of a number of vendor manuals that contain complex drawings that will probably be supplied in bit-image format. TIFF (Group 3) shall allow engineering sketches transmitted from any normal fax machine to be vectorized for direct use.

5.2.9.3 Statistical and Trend Analysis

Future ESIMS shall provide the following statistical and trend analysis tools:

(1) Quality control and trend analysis software:

- Descriptive statistics
- Hypothesis testing
- Regression
- Correlation
- Nonparametric analysis
- Aanalysis of variance (ANOVA)
- Confidence-interval testing

(2) Quality control and trend analysis interface with graphics systems

(3) Simulation languages with features similar to the General Purpose Simulation System (GPSS) and SIMSCRIPT

(4) The following mathematical functions:

- Matrix manipulation
- Fourier transforms
- Differential and integral calculus
- Eigenvalue routine support

- Quadratic equation solvers
- Symbolic manipulation
- Multidimensional graphics generation

These tools shall be integrated within ESIMS to access any data within the ESIMS environment and the products of earlier statistical analysis.

5.2.9.4 Word Processing

Word processing software shall be supported both in the CPC and in the generic workstation using the default human-machine interface as defined in the user profile, but the end-user shall be able to change human-machine interfaces. The word processing display shall be in "what-you-see-is-what-you-get" (WYSIWYG) format, with all supported fonts and graphic images. The following capabilities shall be required:

(1) A spelling dictionary with at least 80,000 words (including all derivatives and inflectional forms of each root word), and a user-specific dictionary and common technical dictionaries that can include up to 80,000 additional words each:

- Each spelling dictionary shall be able to copy words between dictionaries, add words, delete words, search, and display dictionary contents in alphabetical order for any dictionary and selection of dictionaries, at the end-user's option. Additional services required include a comparison utility to identify differences between dictionaries, creation of unidentified word lists from documents, phonetic word searches, and the ability to merge two dictionaries.
- The spell-checking process shall be able to access all dictionaries specified by the end-user, and shall provide a list of dictionaries for inclusion and order of search selection, at the end-user's option.

(2) A thesaurus function, which shall be compatible with the vendor-supplied spelling dictionary, including synonym and antonym functions and the following capabilities:

- Access all thesaurus files specified by the end-user.

- Provide a list of thesaurus files for inclusion and order of search selection, at the end-user's option.

- Copy words between thesaurus files.

- Add and delete words, synonyms, and antonyms.

- Search and display thesaurus file contents in alphabetical order for any thesaurus file and selection of thesaurus files, at the end-user's option.

- Identify differences between thesaurus files.

- Perform phonetic word searches.

- Merge two thesaurus files.

(3) A grammar checker

(4) A File Import function that allows the end-user to copy a data processing file (such as source-program file, a data file, or a printer image file) into a word processing document and copy a word processing document into a data processing file, subject to security permissions

(5) Ability to create, rename, and delete user-specified documents and document catalogs:

- The file-description record shall include, in addition to the file name, a long title (30 characters minimum), a subject index (key word) create and search, account codes, author name, date of creation, date of last update, and a comment field. A default file-type descriptor and default file-storage location shall be provided where appropriate. The file description record shall be accessible for end-user revision in the normal edit mode.

- The document index shall be able to search for the document title, subject key words, and the filename, under end-user selection.

(6) Ability to copy (non-destructively), at the end-user's option, portions of text from one document to any place within that document, to another document, and to another document in another window

(7) Ability to move (destructively), at the end-user's option, portions of text from one document to any place within that document, to another document, and to another document in another window

(8) Global search and replace for a portion of text

(9) Search for a specific page

(10) Selective search and replace for a portion of text

(11) Ability to print a document with and without footnotes, comments, graphics, and tables

(12) Automatic pagination including user-defined line length, header/footer generation, and page numbering with user-defined page number position, starting page number, and user-defined page number format

(13) Identification of text for insert, delete, move, and copy via cursor movement

(14) Display of least 20 lines of text per screen load

(15) Horizontal scrolling of at least 132 characters and vertical scrolling throughout the entire text

(16) Continuously updated page, line, and column position indicators

(17) End-user-selected automatic centering

(18) End-user-selected automatic underlining and highlighting

(19) End-user-selected left and right margin settings

(20) End-user-selected left, and left and right margin justification

(21) End-user-selected automatic screen advance during text entering and display, with ability to scroll a line at a time, a screen at a time, a paragraph at a time, and a page at a time

(22) Programmable tabs with decimal alignment feature, and end-user-selectable default tabs

(23) Cursor movement support (left, right, up, down) with automatic cursor wrap-around on left and right movement

(24) Automatic word wrap-around to next line and automatic word wrap-around to the previous indent with the indent continuing until a hard carriage return is detected

(25) Automatic word hyphenation, at the end-user's option, with control over the range of characters in which hyphenation shall occur

(26) Selective de-hyphenation

(27) Ability to enter text into uniquely identified multiple buffers, and to recall buffered text by its unique identifier

(28) Ability to archive documents to removable storage media

(29) Ability to set print options that are saved with the document, to include number of copies, line spacing, software fonts, and unique printer identifier

(30) Special function keys for indentation, stop printer, note (with the ability to be hidden at the end-user's option, both on screen and on the printout), bi-directional replace, merge, go-to-page, decimal tabbing, page formatting, bi-directional find, screen scrolling, and cancel

(31) Version and modification control and identifiers (including version maintenance) for documents stored

(32) Identification of the end-user making specific changes

(33) Change approval control

(34) Conference document creation and modification (The intent is to allow a conference of local and remote end-users to see the same view of a document as it is being edited. This includes voice conferencing and annotation of documents.)

(35) Forms generation:

- Building of boxes with variable size lines
- Shading capability
- Capability for the end-user to automatically scale the font to allow all text to reside within a box

(36) Standard line drawings using the extended ASCII character set

(37) Integration of text and graphics (i.e., engineering graphic images, business graphic drawings, and digitized photographic images that can display and print gray-scale of not less than 16 levels and a color palette of not less than 256 colors) in the same document with end-user-defined wrap-around text around the graphic-defined space

(38) Definition of a row and a column containing any number of horizontal and vertical character counts for copy and move operations

(39) A virtual page that contains at least 256 characters width and an unlimited length, and that allows on-screen scrolling of the page both vertically and horizontally

(40) Access to the system programmable interrupt functions without exiting word processing

(41) Ability to import and export documents in the following formats: WordPerfect, Microsoft Word, WordStar, DisplayWrite, Wang IWP, Wang WP+, SAMNA, MultiMate, VolksWriter, DEC/DX, Navy Document Interchange Format (NDIF), DCA, and CALS-compliant document interchange:

- The translator shall read the default format parameters for the document undergoing translation and translate to the target word processing format. Upon completion of the translation, no further formatting and cleanup of the translated document by the end-user shall be required. This feature shall be updated within 90 days of the official release date of updates to any of the word processors listed. All variations of the listed word processors and their respective successors shall be supported.

(42) Pointers (to data elements that reside in databases or in spreadsheets) on the network that automatically update the specified information within a word processing document

(43) Option to open a file at the top and then resume editing at the point of last edit

(44) Default and document-embedded scalable font specifications, to include the ability to select named fonts and point size from the list of available fonts

(45) Ability to selectively view the embedded format effectors and special control codes

(46) Ability to embed footnotes with their associated text for automatic insertion in the end-user-specified location:

- The footnotes shall also have WYSIWYG capability. At a minimum, the end-user shall be able to locate the footnotes at the bottom of a page, at the end of a chapter, and at the end of the document.

- The end-user shall be able to establish and modify a default footnote format giving footnotes a separate format from the main text of the document. Included in the footnote format shall be all the features available to the main text (font, tabs, indents, bold, etc.).

(47) The ability to generate, with end-user selectable layout, style and end-user defined page number format, multiple tables of contents (TOC), multiple indices, bibliographic references, and cross-references:

- The end-user shall be to establish default formats giving each of the following a separate format from the main text of the document: TOCs, indices, bibliographic references, and cross references. Each format shall include all the features available to the main text (font, tabs, indents, bold, etc.).

(48) Ability to embed comments in the text that can appear in the TOC, indices, bibliographic references, and cross-references (The end-user shall have several options for appearance of the embedded comments: on the screen only, hidden from the screen, on the printed text, and hidden on the printed text.)

(49) Ability to merge and sort indices, TOCs, bibliographies, and cross-references, as generated by the word processor

5.2.9.5 Optical Character Recognition

This application shall accept input from a scanner or any image file supported on the system. The text conversion shall comply with FIPS PUB 32-1. At a minimum, it shall recognize the following type fonts:

(1) Courier

(2) Prestige Elite

(3) Letter Gothic

(4) OCR-A and OCR-B size 1 character sets as defined in FIPS PUB 32-1

(5) Helvetic

(6) Times Roman

The following typography definitions pertain to the OCR discussion:

- **Leading** - The white space between the descenders from the line above and the ascenders from the line below (i.e., the amount of white space between lines of text)
- **Monospaced Font** - A set of characters of equal width (e.g., typewriter type)
- **Proportional Font** - A set of characters of varying width, based on the character's shape
- **Kerned Font** - A proportional font in which the space between characters is condensed to make the characters appear that they occupy the correct amount of space in relation to the other characters.
- **Column** - One of two or more vertical sections of printed text placed side-by-side on a page separated by a rule or a blank space
- **Point Size** - The height of a character
- **Pitch** - The number of characters per inch of text

Printed matter to be used as input to the OCR shall meet the following typographical requirements:

(1) Text with sufficient leading to clearly distinguish between lines of text

(2) Monospaced fonts for each character fonts listed

(3) Proportional fonts for each character fonts listed

(4) Kerned font for each character font listed with the expectation of errors in recognition

(5) Pages containing two or more columns with both blank space and rules between columns

(6) Point sizes ranging from 6 through 36 for each character font listed

(7) 10 and 12 pitch

(8) Mixed pitch and point sizes for each character font listed

(9) Ability to mix fonts on the same and separate lines

(10) Superscripts, subscripts, and underlined text

At a minimum, the OCR shall perform the following:

(1) Identify characters based upon the shape characteristics of the character ranging from 6 point to at least 36 point, and recognize foreign and mathematical language fonts.

(2) Recognize text, and all levels of contrast, in a contrasting background.

(3) At least 99-percent accuracy in recognizing characters, except in kerned text.

(4) Use the default human-machine interface as defined in the user profile, with the ability to change human-machine interfaces at the end-user's option.

In addition, the OCR shall allow the end-user to perform the following:

(1) Automatically scan the input image separating text from images.

(2) Automatically include the text in a word processing document.

(3) Edit the text image before beginning the OCR process.

(4) Predefine regions of text to be scanned within the text image.

(5) Append text regions to each other, producing one continuous text output.

(6) Distinguish text in a column within the text region.

The OCR, when delivered, shall be complete with source code for use by the human-machine interface in generating end-user applications. All features of the OCR shall be documented with a compilable, debugged source code to access them. The source code shall be generated in one of the E&S source-code programming language suite.

5.2.9.6 Business Graphics

The business graphics application shall be used as an electronic briefing medium and hardware presentation graphics medium. It shall include the following capabilities:

(1) Business graphics and imaging

(2) Acceptance of CADD drawings for expediting reviews and approvals

(3) Technical presentation support (text/graphics/images)

(4) Support for scanners and standard output peripherals

(5) Direct interface to CADD, text, and functional databases

(6) identifiers for at least 8 unique types of data from the same file using colors, shading, or hashing within point graph segments, line chart segments, bar chart segments, and pie graph segments

(7) Calculation of percentages for data displayed

(8) Graphics and video editors with the following additional minimum capabilities:

- Capture of screen images and storage in graphics image files
- Interactive video
- Video capture and editing

- Imaging support
- Sequencing and mixing of multiple audio and graphic tracks

(9) Support for gray-scale of 16 levels and 256 colors in the color palette

Additionally, using this application, the end-user shall be able to perform the following:

(1) Selectively add and delete information from the graphics display.

(2) Develop area charts, column charts, two- and three-dimensional bar charts, point graphs, line charts, scatter charts, pie charts, and combinations thereof.

(3) Specify classifications, title, legend, axis labelling, and end-user comment text.

(4) Display completed charts and graphs in 3 seconds or less on a generic workstation, and print them on any available printer.

5.2.9.7 Audio Input, Voice Recognition, and Audio Output

Future ESIMS shall include a complete audio input, voice recognition, and audio output support system.

The audio input system shall provide the following minimum capabilities:

(1) Recording of audio (voice) input for use at a later date, allowing the computer to serve as an answering machine for the telephone; and attachment of voice messages to E-mail and other documents

(2) Recording of captured sounds used in diagnosing problems and training assistance

The voice recognition system shall support the following:

(1) Multiple generic recognition files to supply the system with generic voice patterns based upon ethnic and geographic backgrounds

(2) The ability to select a generic recognition file as a model for a particular end-user's recognition file

(3) All system keywords and phrases used to control the system

(4) Application-defined keywords and phrases used to control vendor-provided applications

(5) Keywords and verbs used in all of the E&S source-code languages

(6) Any word in any dictionary supported by the spell checker, excluding acronyms which shall be verbally spelled out by the end-user

(7) End-user speeds of 35-to-50 words per minute for input

The audio output system shall support the following:

(1) Replay of voice input at a later date chosen by the end-user, allowing the computer to serve as an answering machine for the telephone; and attachment of voice messages to E-mail and other documents

(2) Replay of captured sounds used in diagnosing problems and training assistance

(3) Ability to produce voice output from text and from stored audio

(4) Replay of any word in any dictionary supported by the spell checker

(5) Voice output speeds of 35-to-50 words per minute

5.2.9.8 Computer-Based Training (CBT) and Administration

CBT authoring and execution tools shall be supplied with the following minimum capabilities:

(1) Ability to generate a system that monitors and reports student progress

(2) Interactive video

(3) Digitized audio

(4) Voice input

(5) Authoring language version for full computer-aided instruction (CAI)

(6) Tutorials callable from HELP within applications

(7) Diagnostics and error analysis with remedial branching

(8) Execution of courses generated without the help of an authoring tool

(9) Video imaging and graphics

(10) Vendor-supplied courses: system security administration, computer operation, and communications

5.2.9.9 System-Level Computer System Analysis

Future ESIMS shall include the following system-level computer system analysis tools:

(1) Configuration Recommendation - This tool shall provide the initial configuration recommendations for a new installation. The end-users shall have configuration information to establish storage requirements, memory requirements, hardware and software components lists, and all other parameters required by the system for its initial operation. Additional information shall be supplied for tailoring the order to the need, as follows:

- Automatic configuration recommendation, with all components required for full installation, based on end-user-provided inputs:
  - Workstation count
  - Printer count
  - User disk requirement
  - Communications
- Recommendation for alternatives based on required performance and price limits
- Ability to make substitutions after initial recommendation, with completeness validation
- Preparation of all system ordering documents

(2) **System Performance and Diagnostics Monitoring** - This tool shall identify programs using system resources and files. The output shall not only identify what is using the system resources, but shall also make recommendations for improving use of these resources in an end-user-readable form.

(3) **System Performance Tuning** - The following features shall be provided:

- File positioning by frequency of access and frequency of change
- Operating system table sizes
- Operating system file-sharing parameters
- Communications system parameters
- File fragment consolidation
- File vacant space recovery
- Physical device reallocation for files

5.2.9.10 Application-Level Computer System Analysis

The end-user shall be able to create graphic representations (such as flow charts and blueprints) depicting computer processes, functions, and other activities. This tool (or tool set) shall depict system process flow, data flow, program flow, and communications connectivity diagrams (physical and logical). The tools shall access data resident anywhere on the system, including but not limited to, the data dictionaries, system configuration files, network topology files, and direct end-user input. Additionally, the tools shall support queries with the facility described in Section 5.2.8.1.3. The intent is to provide the end-users with tools to help them describe complex processes which otherwise might be difficult or impossible to implement.

5.2.9.11 Query Language

Future ESIMS shall support SQL as its resident query language. SQL shall display and print responses to the queries and shall provide simultaneous access to multiple files. It shall also permit the end-user simultaneous access to information in each of the four types of file structures: sequential, indexed sequential, relative, and relational. Additionally, SQL shall be accessible from three different human-machine interfaces: text mode for expert users, menu and fill-in-the-blanks mode for more casual users, and graphical mode using a mouse or other pointing device. (These requirements are shown in Figures 4-4 and 4-5.) An SQL code-generation facility shall be provided to help the end-user build SQL statements.

The SQL system shall support queries against graphics, video, and voice files where "tags and attributes" have been implemented. Finally, it shall run queries against the local workstation files, the local CPC files, any other workstation's files that are accessible through the NFS, or any other CPC system accessible through the NFS.

5.2.9.12 Data-Dictionary-Level Analysis

The following definitions shall apply to the data dictionary support:

> **"Data element"** refers to a single concept that is defined by its name, definition, and range. For example:
>
> > Name: MONTH
> > Ver: 1.0.1.0
> > Type: (alpha, 3 characters)
> > Def.: month of the calendar year.
> > Range: JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC
> > [other information and attributes, as appropriate]
>
> **"Record"** refers to a defined collection of Data Elements and filler in a specified order. For example:
>
> > Record: DATE
> > Ver: 1.0.1.0
> > Contains: MONTH, fill( ), DAY, fill(,), YEAR
> > [other information and attributes, as appropriate]
>
> **"Data structure"** refers to a generic title for a Data Element or a Record in the discussion below.

The following data dictionary analysis capabilities shall be supported:

(1) **Query of a Data Structure** - The end-user shall be able to request information on a data structure based on keywords, content values, and keyword in context (KWIC) within comments and definitions.

(2) **Selection of Data Dictionaries for Query** - At the end-user's option, the end-user shall be able to query one, a selected number, and all data dictionaries on the local CPC. In addition, the end-user shall be able to query the end-user's workstation and any other CPC on the network to which the end-user has access and security permissions.

(3) **HELP** - Full context-sensitive "HELP" shall be provided.

(4) **Creation of a Data Structure** - The end-user shall be able to generate new data structures through menu assistance where valid options are not available in any data dictionary queried. Ownership of the new data structure shall be assigned to the creator, and the SSA shall transfer ownership, as appropriate. New data structures shall be assignable to any data dictionary to which the end-user has access and security permissions, at the end-user's option.

(5) **Creation of a New Record Through Concatenation** - The end-user shall be able to generate new, unique records through the concatenation of data structures already existing in one or more data dictionaries, using menu assistance where valid options are not available in any data dictionary queried. All future modifications to the data elements and records shall be automatically incorporated, but not implemented in the software, wherever the modified data structures are used. The next time the software is updated, the developer shall have the option to incorporate the new data structure. The ownership issues involved with the concatenated data structures are the same as those with the newly created structures.

(6) **Cross Reference** - The end-user shall be able to query a data structure, based on any parameter or combinations of parameters defined within the data element definition, for the names of applications using that data structure, versions of that data structure, and the owner of the data structure.

(7) **Updating** - For the data structures owned by the end-user, the updater shall permit the end-user to notify other application creators of an impending change to the data structures. The end-user shall be able to modify a data structure and enter the modified structure in the end-user-specified data dictionary. For data structures owned by another end-user, the data dictionary analysis application shall notify the owner of a request for change to the data structure.

(8) **Version Control** - Each data structure shall be issued a version number in support of software conversion update scheduling. Assignment of a version number allows more than one version of a data structure definition to reside in the data dictionary.

(9) **Naming Convention Checking** - An automated method to check and approve naming convention compliance within any data dictionary shall be provided. This application shall use the owning community's customized compliance rules and shall be subject to security requirements. There shall also be an application to build the customized compliance rules.

5.2.9.13 Automated Expert Assistance

This application shall allow an end-user who is an expert in a particular field to author and execute the questions, answers, and options required to allow other end-users to logically repeat the decision-making process of the expert. The author shall be able to define recursive levels of questions with branching answers determining the next path. At least 2,048 characters shall be permitted in any comment. Persons seeking assistance shall be able to log questions and answers, and replay the decision process at any level in the recommendation process.

5.2.9.14 Electronic Remote Library Creation

Using the system's media creation services, the end-user shall be able to establish remote network libraries and stand-alone libraries in at least read-write storage media, read-only optical disk, floppy disk, and erasable optical disk formats. In addition, the end-user shall be able to create libraries on any distribution media available within the system. These media shall support textual, imaging, audio, business graphics, and engineering graphics, and shall provide the basis for a catalog search and retrieval. These libraries shall be available to all E&S end-users.

5.2.10 System Support

Future ESIMS requires a wide variety of system support functions to adequately manage software and data distribution and updates.

5.2.10.1 Electronic Software Distribution, Update, and Validation

There shall be a facility to electronically gather, ship, and cause time-sensitive implementation for new and updated items in ESIMS. This facility shall, at a minimum, be able to perform the following:

(1) Mass distribute both system and end-user application software through both network and magnetic media, as selected by the distributor or as required by the configuration of the target systems.

(2) Control the version of each element (file and software module) included in the distribution package.

(3) Logically package software for distribution, i.e., in a way that treats all needed files, installation scripts, and electronic documentation as a single deliverable package.

(4) Deliver all vendor-supplied installation scripts in a form which allows Future ESIMS managers to custom tailor the installation scripts to fit each site as implemented.

(5) Receive software and electronic documentation to be installed, and hold them until the distribution source conditions for implementation are met. (At that time, the SSA shall be able to execute the implementation scripts supplied with the software release.)

(6) Operate on both the CPC and the generic workstation. (The distribution facility supports source, executable binaries, libraries, scripts, and documentation for both the CPC and the generic workstation.)

(7) Permit version checks and file integrity checks for all delivered products initially, and upon demand by the end-user, operator, and SSA.

(8) Serve as the original source of distribution, or as an intermediate distribution facility, regardless of servicing platform.

This facility shall include the command languages needed to automatically create installation scripts that contain sufficient information to automatically install the distributed software. The scripts shall use interactive questions and answers to configure the software being installed to match the specific site. The questions and answers shall be defined by the software creators and shall be unique to each delivered software product. The questions and answers shall include all configuration options for the CPC and generic workstation that pertain to the installation and operation of the subject software product (e.g., presence of peripherals, type of display, preferred printer, and disk size). The scripts shall also be able to detect and use any configuration information already present in the vendor-supplied software and Future ESIMS applications.

5.2.10.2 Technical Support

Technical support in the following areas must be constant, consistent, and orderly for optimal results:

(1) **Electronic Question-and-Answer Media** - Because the technical expertise needed to correct problems is often difficult to locate in a timely manner, a store-and-forward (bulletin board) technical support capability is an economical resource. Such a capability will not only provide answers for the person initially reporting the problem, but can also allow others to scan the list of problems and solutions to help themselves.

(2) **Short-Term Workstation Session Logger** - This capability is needed for difficulty reporting to capture as many aspects of software problems as is practical. An accurate session-capture facility that can capture 16 full screens of end-user input, whether in full-screen mode or character-by-character text mode, is needed to accurately and completely communicate the problems experienced in the field to the technical assistant for resolution.

(3) **Electronic Idea Interchange Forums** - These forums enhance general knowledge of specialties and interest groups, enabling them to operate more effectively. These forums are especially useful to personnel who pursue their specialties alone or in remote locations where they lack other opportunities to discuss job-related techniques and problems.

5.2.10.3 Reliability, Repairability, and Maintainability

There shall be a support system that can warn the SSA when the system approaches workload limits, that permits remote field servicing and remote diagnostics, and that can automatically upgrade both the workstation and minicomputer software without interrupting the applications, destroying data, or causing the system to be inaccessible. The requirements for such a system are specified in Section 5.4.5 as part of the Future ESIMS implementation and continuing support.

5.2.10.4 File Translation Services

Future ESIMS shall support all of the required file conversion services between spreadsheets and all of those required between word processing documents. The new system shall also support data interchange format (DIF) and the additional formatting needed for effective data exchange. Finally, Future ESIMS shall comply with the Air Force document exchange standard, NDIF, to permit document exchange with the rest of the Air Force.

5.2.10.5 Network File Sharing

Air Force C-CS architecture requires a network file-sharing system between the Future ESIMS CPC and each of its workstations to allow it to intelligently share data with the workstations. This will allow business data and drawing storage files to reside in the same environment while being accessed by CADD software, making possible the integrated interactive CADD support specified in Section 5.2.9.1.

5.2.11 Central Processing Computer (CPC)

The CPC shall have at least one CPU, which is the minimal stand-alone central computing element to which workstations, storage devices, output devices, and communications elements are attached. For ESIMS nodes requiring more than one CPU, all CPUs shall be connected together electrically to process as one entity from the view of the SSA, operator, and end-user. As shown in Figure 5-1, each CPC shall have communications links with other functional areas (including the other ESIMS nodes) and the option to connect with DDN.

The CPC shall have the following capabilities:

(1) Ability to add and subtract CPUs without interrupting end-user activity

(2) Ability to move files between CPUs and rehost end-users without interrupting the end-user session

(3) Interruption of service to physically rehost the workstation

(4) Ability to be installed, maintained, and configured by the end-user

(5) Mass storage to support the applications provided by the end-users, as well as those files supplied by the vendor in increments of 400 MB to 3600 MB

(6) Ability to continue processing without air conditioning during blackouts, up to the 20-minute limit of backup power for the CPU

(7) Ability to operate at altitudes ranging from 100 feet below sea level to 8,000 feet above sea level

(8) Deployability

- A CPC that is small and light enough when in its shipping case to be carried by two people (Total weight including case should not exceed 140 pounds.)

- Ruggedized shipping cases that protect the CPC from the great atmospheric pressure changes encountered during air transport, as well as any environmental hazards anticipated in a combat zone, such as extreme heat or cold, etc.

- A deployment kit and spares for each computer

5.2.11.1 Compatibility/Architecture

The CPC and its operating system shall comply with all the standards and extensions detailed within this document. Hardware and software features, vendor-supplied applications, and system operations will be supported with on-line documentation and HELP.

5.2.11.2 Processing Capacity

The CPC shall have the appropriate processing capacity needed to effectively support all existing applications and those scheduled for implementation within Engineering Design and Environmental Engineering. In addition, the system shall be able to pass the workload test specified in Section 5.2.2. (The intent of the workload test is to ascertain the processing capacity needed to accommodate the existing workload and 10 years of growth and then use that figure as a standard for evaluating all vendor-proposed systems.)

5.2.11.3 Memory Capacity

The CPC memory shall have the following capabilities:

(1) Memory Allocation for Applications - The hardware and its appearance to the application programs shall provide at least 1 MB of program addressable contiguous memory (virtual, swap, paged, real, or other schema) for each executing program and each background task. Memory shall be dynamically allocated to accommodate the needs of each program. Each program shall have the privilege of addressing 1 MB of program space. The intent is to provide for the existing very large tables in some of the applications, and the exceptionally large executable text on others.

(2) **Error Detection and Correction** - A feature shall be provided to detect and correct all single-bit errors and detect all two-bit memory errors. Main memory shall include hardware or hardware-assisted software memory protection features (used for security and to bound programs within assigned memory space).

(3) **Support of the Workload** - The CPC shall have enough memory capacity to effectively support the workload generated by existing applications (as tested by the workload test) and the additional workload expected during the next 10 years.

5.2.11.4 Peripheral Support

The CPC shall effectively support the following peripheral-related issues:

(1) **Peripheral Activity Independent of the Activity of the CPC** - All on-line application programs shall be able to run without interruption. Windowing capability shall be provided allowing end-users to monitor peripheral activity, to run a foreground task in any window (including the active window), and to initiate and monitor background tasks in any window.

(2) **A Multitude of Ports** - The CPC shall support enough ports to allow physical connection of as many workstations, input peripherals (such as remote sensors, imaging technology, barcoding technology, scanners, voice, etc.), and output devices (such as printers, plotters, tape-drives, etc.) as needed to perform the workload of the particular node.

(3) **Communications Connectivity and Support** - The CPC shall fully support GOSIP, and shall be able to support interfaces with some existing Air Force standard systems. On-line, context-sensitive "HELP" shall be provided to connect and maintain communications between the CPC and its peripherals, other CPCs, and its workstations. A search facility shall be provided to determine which peripherals are active and where they are located, both logically and physically. Automatic rerouting of output to output peripherals shall be provided to minimize delays when an output peripheral fails.

5.2.11.5 Support for Software

To adequately support the functional activities, each CPC needs the following minimum capabilities:

(1) **Support for COTS Software** - COTS software, whether supplied by the hardware vendor or a third-party vendor, shall eliminate the necessity to generate Air Force-equivalent applications, providing the capabilities to the end-user quickly. COTS software shall comply with the existing software standards at the time of acquisition. For those COTS applications that do not comply with the standards but are needed in Future ESIMS, software tools shall be provided to translate their files into files that are compatible with the ESIMS file management system. The files shall be translated automatically by the Future ESIMS translation utility.

(2) **Transition Path/Compatibility with AMMUS** - This capability shall allow easy porting of AMMUS ESIMS applications to Future ESIMS. The 5,000-plus AMMUS applications currently in use shall be migrated from the AMMUS machines without change, preserving the look and feel of the existing systems to minimize the impact of the transition on the end-user.

(3) **Support of Human-Machine Interfaces** - The CPC shall support all three human-machine interfaces for all operator functions, SSA functions, and end-user functions, at the end-user's option, as specified in the user profile (Section 5.2.7.3).

5.2.12 Workstations

Workstations shall be compatible between and within installations to ensure that one workstation can be substituted for another in cases of emergency (such as a crash or destruction caused by an accident, sabotage, or war). For example, if the workstation becomes disabled while the end-user is running an application, the end-user shall be able to port that application quickly to another and continue working.

5.2.12.1 Generic Workstation

One workstation type shall support all of the six functions currently supported by the seven different AMMUS configurations. The generic workstation shall support data processing and word processing with no upgrades. As shown in Figure 5-4, it shall readily accommodate addition (and subtraction) of peripheral devices and

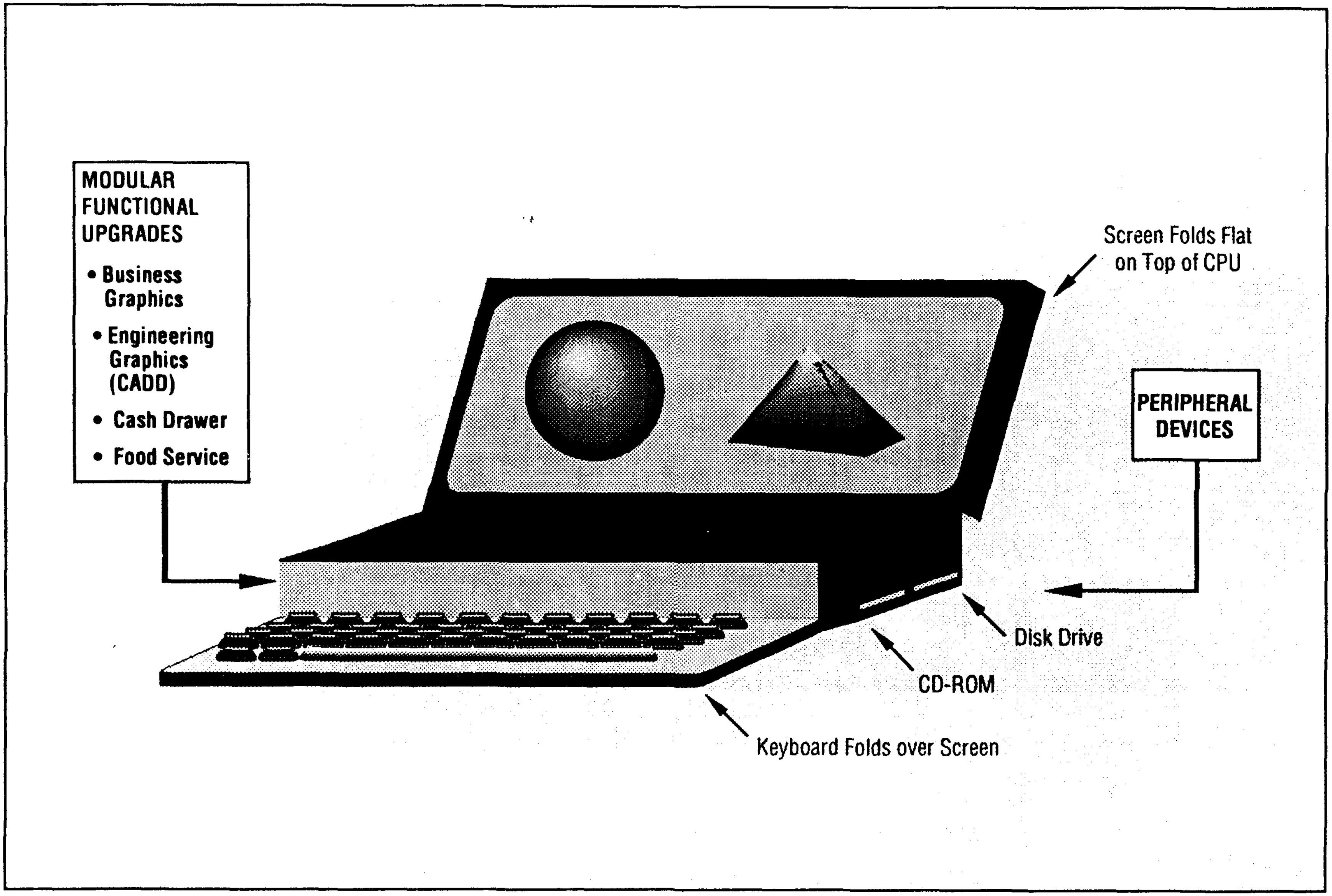

FIGURE 5-4 GENERIC WORKSTATION

modular upgrades to create each of the other four E&S workstations: business graphics, engineering graphics, cash drawer, and food service. The generic workstation requirements fall into seven categories:

(1) **Deployability** - E&S shall be able to take this workstation to war and deploy it at a moment's notice as an everyday workstation. The intent is to eliminate the need to maintain special workstations in storage during crises. To meet this objective, each generic workstation shall have the following features and capabilities:

- **Ruggedized Generic Hardware** - The workstation hardware shall withstand shop environments and hostile natural environments (e.g., extreme hot and cold) encountered at work sites and during combat.

- **Configurability into a Mobile System** - shall support a variety of communications protocols and communications hardware, and run off of vehicle batteries and portable self-contained power sources.

- **Portable, Stand-alone System** - The workstation shall operate in stand-alone mode as a terminal connected to the CPC, shall automatically detect the presence of other workstations and a CPC over any communications media and path available to the CPC, and upon detection, shall automatically identify and connect itself to the CPC transparently to the end-user.

- **Deployment Kits Containing Ruggedized Shipping Cases, Spares, and Supplies** - The kits shall be similar to war-readiness spares kits (WRSK) to minimize loss of service in the field and to support minimal operations (because E&S considers Future ESIMS a weapon system). The shipping cases shall protect the equipment against the hazards encountered in air and surface transportation.

- **Uninterruptible Internal Power** - Internal power for 8 hours of operation without external sources shall be provided.

- **Self-Contained with Basic Display and Keyboard** - The generic workstation shall have a flat-screen, high-resolution color monitor which can be folded forward onto the top of the generic workstation, protecting the flat screen from damage. With the screen in folded forward, the generic workstation shall be able to support the weight of external graphic displays on top of the screen without damaging the monitor. The flat-screen monitor shall have a minimum size of 800 X 600 pixels, shall be capable of displaying 256 colors digitally, and shall support red-green-blue (RGB) input.

The keyboard shall be detachable and replaceable. It shall fold over the generic workstation and the folded monitor, protecting the keys during transport. The keyboard shall also fold over the workstation when the monitor is open for use. (This capability provides temporary storage for the standard keyboard when an enhancement keyboard is being used.)

(2) **Compatibility/Architecture** - The generic workstation shall:

- Allow all workstations to communicate with each other and be interchanged during crisis situations.
- Emulate the BIOS and MS-DOS implementation present on the advertised 100-percent-compatible machines so the workstation can run PC Tools, WordPerfect, MS-Windows, AutoCAD, and similar PC software packages.
- Contain an internal modem, utilizing an RJ-11c jack for outside interface.
- Have error-sensing capability similar to that on the CPC.
- Support generic workstation software, including the operating system and vendor-supplied application software, that can be upgraded automatically without interrupting the applications, destroying data, or causing the system to be inaccessible.

(3) **Processing Capacity** - The generic workstation shall have the appropriate processing capacity needed to effectively support the following:

- All existing generic workstation applications
- The human-machine interface both in stand-alone mode and in conjunction with the CPC
- Shared applications running on both the CPC and the generic workstation

- Applications running solely on the CPC
- The minimum performance required to pass the workload test
- Arithmetic coprocessing required to support vector graphics in real-time (This capability will allow quick substitution of workstations that can run CADD and business graphics applications in support of as-builts in the field and base recovery after attack.)
- Multitasking capability to support the simultaneous execution of multiple tasks from a single generic workstation:
  - Permit "graceful degradation" by allowing two functional activities to be accessible in single-user mode from separate end-user-selectable windows.
  - Permit the end-users to monitor the activities of peripherals while working in another application.
  - Permit the end-user to lift displayed information from one application and drop that information into another application while the applications are simultaneously running.

(4) **Memory Capacity** - Each generic workstation shall have enough memory to maintain high-speed response to end-user actions. The memory must be sufficient to support multitasking, multiple graphic images in memory, worst-case large data applications, and "terminate and stay resident" style applications. Each MS-DOS application concurrently executing will need at least 540 KB in the transient program area (TPA). In addition, keystroke buffering shall accommodate a minimum buffer size of 256 keystrokes.

(5) **Storage Capacity** - Each generic workstation requires sufficient high-speed-access storage to store stand-alone reference data, applications, and local data. The storage shall be accessible to MS-DOS applications, and shall have a minimum size of 500 MB internal to the generic workstation, with the capability to add additional high-speed-access storage.

(6) **Support for Software** - The workstations require the following system software support:

- IBM-compatible MS-DOS 2.xx, 3.31, and later operating-system-supported programs without any apparent decrease in execution speed from the view of the end-user, and existing MS-DOS applications with services to accommodate up to 4 MB of extended and expanded memory
- Multiple independent tasking of not less than eight programs simultaneously
- Wang 2110 terminal emulation mode for transition/migration
- Network connectivity and support
- PostScript interpreter for display and printing
- Interactive video
- Digitized audio
- Voice input
- COTS Software, including the applications available for the native workstation if MS-DOS is running in emulation mode
- Vector/raster display processor

(7) **Support for Peripheral Equipment** - The following peripheral-support features are required:

- An interface capable of supporting external color monitors, as specified in the generic workstation upgrade kits
- An electromechanical keyboard interface that accommodates both the standard keyboard and the food service workstation keyboard
- Two parallel printer ports using the IBM-style Centronics interface
- At least four RS-232C serial port interfaces

- Two external SCSIs
- Internal speaker with volume control
- Headset jack with speaker volume control and automatic volume control for microphone (The automatic volume control shall have an override function that allows the end-user to capture absolute sound levels.)
- Standard audio jacks to support interface to an audio amplifier

5.2.12.2 Business Graphics Workstation

The business graphics workstation shall consist of the generic workstation and the peripherals (from the list in Section 5.2.13) needed to support business graphics activities. The end-user shall be able to easily remove these peripherals, upon demand, and return to the generic workstation configuration.

5.2.12.3 Engineering Graphics Workstation

The engineering graphics workstation shall consist of the generic workstation and the peripherals (from the list in Section 5.2.13) needed to support engineering graphics activities. The end-user shall be able to easily remove these peripherals, upon demand, and return to the generic workstation configuration.

5.2.12.4 Cash Drawer Workstation

The cash drawer workstation shall consist of the generic workstation, a cash drawer, and the other peripherals (from the list in Section 5.2.13) needed to support cash drawer activities. The end-user shall be able to easily remove the cash drawer and other peripherals, upon demand, and return to the generic workstation configuration.

The cash drawer attachment shall be under programmatic control of the workstation and shall have the following features:

(1) Mechanical key lock for manual operation

(2) Electronic lock operable under application software control

(3) Two drawer inserts to facilitate change of cashiers (Additional inserts shall be separately procurable.)

(4) Operation only in CLOSED position (drawer compulsion feature)

(5) Provision for not opening for a credit transaction

(6) Security device preventing opening of drawer when locked

(7) Provision for opening the drawer without recording a customer count or transaction (But there shall be an audit capability.)

Cash drawer workstation communications to and from the host over one line shall include the following capabilities:

(1) Data file transfer

(2) Terminal interaction (transaction processing)

(3) Intelligent programmatic access to the CPC through programs in the electronic cash register (ECR) and the CPC

All of the functions required of a cash drawer workstation already exist in AMMUS ESIMS. Thus, the functional features of the cash drawer workstation shall remain the same as those in AMMUS, listed in Section 3.3.1.2.6. In Future ESIMS, however, a software system will replace the older hardware-oriented functions.

5.2.12.5 Food Service Workstation

The food service workstation shall consist of the generic workstation, a special keyboard, and the other peripherals (from the list in Section 5.2.13) needed to support cash drawer activities. The end-user shall be able to easily substitute the standard keyboard and remove the other peripherals, upon demand, and return to the generic workstation configuration. The special keyboard shall be a membrane-type with replaceable sanitizing covers over the key-labelling cards. The keys shall be organized in a 12 X 10 matrix, spaced sufficiently to allow easy key depression by the human finger. Both the standard keyboard and the food service keyboard shall be plug interchangeable on any workstation.

Food service communications to/from the host over one line shall include the following capabilities:

(1) Data file transfer

(2) Terminal interaction (transaction processing)

(3) Access for intelligent programmatic access to the CPC through programs in the ECR, and the CPC must be provided

All of the functions required of a food service workstation already exist in AMMUS ESIMS. Thus, the functional features of the food service workstation shall remain the same as those in AMMUS, listed in Section 3.3.1.2.7. In Future ESIMS, however, a software system will replace the older hardware-oriented functions.

5.2.13 Peripheral Devices

The following categories of peripheral devices shall be provided:

(1) Data storage and data transfer devices

- High-speed-access, fixed data storage
- Removable data storage

(2) Input devices

- User input
- Image input
- Audio input

(3) Output devices

- Display
- Hardcopy output
- Audio output

(4) Supporting equipment

(5) Sensing and control devices

All peripheral activity shall be independent of the activity of the CPC and the workstations.

5.2.13.1 Data Storage and Data Transfer Devices

The end-users shall be able to store their applications and data on a readily accessible high-speed-access data storage media. The end-users shall also have various types of removable data storage media to transfer information between Future ESIMS and other systems, and to provide backup data storage for on-line media and information.

<u>**5.2.13.1.1 High-Speed-Access Fixed Data Storage**</u> - On the CPC, the fixed data storage requirement is driven by the need to store vendor-supplied system and application software, end-user-provided applications, and end-user required storage for data. The high-speed-access fixed data storage shall be supplied in increments of 400 MB to 3600 MB and shall have the following storage requirements:

(1) Ability to access information quickly enough to support workload test requirements

(2) Ability to connect to the generic workstation for stand-alone workstation access to CPC files

(3) The option for each generic workstation to add high-speed-access storage to store stand-alone reference data, applications, and local data (The optional high-speed-access storage shall be accessible by MS-DOS applications, and shall have a minimum size of 500 MB.)

<u>**5.2.13.1.2 Removable Data Storage**</u> - Removable data storage media to be used as data transfer devices shall include the following:

(1) Master CD-ROM - Future ESIMS shall be able to create a master CD-ROM. The intent is to provide central software distribution sites that can generate software updates for distribution using an inexpensive medium which is lightweight and incurs lower shipping costs than traditional media.

(2) CD-ROM Read-Only Drives - CD-ROM read-only drives shall be provided, complete with drivers, to allow medium-speed access to data. The CD-ROM shall connect to both the CPC and the generic workstation.

(3) Read-Write CD-ROM - Read-write CD-ROM is needed to permit the end-user to store large amounts of data in a compact media, requiring less physical storage space for the media than required by traditional storage media.

(4) Magnetic Data Storage Disk - The CPC shall be able to add, both internally and externally, high-speed-access magnetic data storage disk drives and magnetic disk media that can later be removed from the drives. These removable data disk drives and magnetic disk media shall be available separately to the end-user, and shall support increments of 400 MB to 3600 MB. The storage media shall be able to access information quickly enough to support workload test requirements. The magnetic data storage disk drive shall be able to connect to the generic workstation for stand-alone workstation access to CPC files. File formats for the CPC and the generic workstations shall be totally compatible and transparent to the end-user.

Magnetic data storage disk drives and media for the generic workstation shall include 3 1/2 inch and 5 1/4 inch flexible minidisks in formats supported by MS-DOS machines and the vendor-supplied formats for these two media sizes. The end-user shall be able to add, both internally and externally, removable disk drives to support these formats on the generic workstation.

(5) **9/18 Track Tape Cartridge** - The 9/18 track tape cartridges shall be able to hold all data stored on a single high-speed-access data storage device. The end-user shall be able to add, both internally and externally, tape cartridge drives to the CPC and to the generic workstation.

(6) **Automatic Cartridge Loader** - The automatic cartridge loader shall be able to handle at least 10 tape cartridges for automatic backup, restore, upgrade, and software shipping activities. The end-user shall be able to externally add an automatic cartridge loader to the tape cartridge drives.

5.2.13.2 Input Devices

The input devices required to support the end-user in mission-related tasks are described in the following subsections.

5.2.13.2.1 User Input - The following user input devices shall be provided:

(1) **Magnetic Strip Debit Card Reader/Writer** - This device shall be provided as a peripheral to the generic workstation, complete with drivers and interface. This peripheral shall comply with the magnetic stripe reader standard, ANSI X4.16-1983 (two tracks).

(2) **Credit Card Reader/Writer** - This device shall be provided as a peripheral to the generic workstation, complete with drivers and interface.

(3) **Smart Card Reader/Writer** - This device shall be provided as a peripheral to the generic workstation, complete with drivers and interface.

(4) **Barcode Readers** - Barcode readers shall comply with MIL-STD-1189, Standard Symbology for Marking Unit Packs, Outer Containers and Other Sources. They shall be able, as a minimum capability, to read Logistics Marking and Reading Symbols (LOGMARS) (3 of 9) and UPC barcodes. These devices shall connect to the generic workstation through the RS-232C interface.

Both portable self-contained barcode reader units and stationary barcode readers shall be provided as peripherals to the generic workstation, complete with drivers and interfaces.

(5) **Pointing Devices** - A variety of pointing devices shall be provided as human-machine interfaces to the generic workstation. These shall include:

- Two- and three-button mice
- Two- and three-button trackballs
- Puck and A-size tablet
- Stylus and A-size tablet
- Puck with 12-foot connecting cable and E-size tablet, table mounted

Each pointing device shall be provided with device drivers and shall connect to the generic workstation through the RS-232C interface.

5.2.13.2.2 Image Input - The following image input devices shall be provided:

(1) **Scanners** - Three types of scanners are required:

- **Automatic Sheet Feed Scanner** - shall be able to scan non-digitized images on 8 1/2 X 11 paper. The scanner input tray and output tray shall be able to hold at least 50 sheets of 20-pound paper at one loading. The scanner shall accept paper weights of 18 to 30 pounds and shall detect and interrupt the scanning process when double-sheet feed occurs. The scanner shall be able to separate images into end-user-specified files when scanning multiple-page documents and when scanning single pages. It shall also recognize blank pages as delimiters for the files, at the end-user's option.

- **Flatbed Scanner** - shall be able to scan images from paper of unusual size and weight to a maximum of 11 X 17. The cover for the flatbed shall be flexible and removable.

- **Overhead Scanner** - shall allow the end-user to scan pages placed face-up on a copyboard, in addition to objects placed on the copyboard.

The image resolution for all scanners shall be not less than 300 dots per inch for the finest resolution. Each scanner shall be able to generate image files in color and discriminate at least 256 colors in an image. Each scanner shall also be able to discriminate 100 shades of gray from a black and white image and from a color image.

(2) **Optical Character Reader (OCR)** - The OCR shall be able to recognize a wide variety of character fonts within the same page and within the same line of text. The OCR shall be able to read text on 8 1/2 X 11 paper, 300 dots per inch. Both the input tray and the output tray shall hold at least 20 sheets of 20-pound paper at one loading. The scanner shall accept paper weights of 18 to 30 pounds and shall detect and interrupt the scanning process when double-sheet feed occurs.

(3) **Video Input** - RGB video images shall be provided by video cassette recorder (VCR) and by video camera. The end-user shall be able to view video images frame-by-frame for selection and conversion into digitized form. The video input shall be viewable from the generic workstation using RGB and digital imaging.

5.2.13.2.3 Audio Input - The following audio input devices shall be provided:

(1) **Audio Capture** - The capability of recording audio (voice) input on the computer shall be provided. This capability shall serve as an answering machine for the telephone, and shall be used to attach voice messages to E-mail and other documents. In addition, the end-user shall be able to record captured sounds (non-voice) used in problem diagnosis and training.

(2) **Handset** - The end-user shall be provided with 2 types of handsets: (1) a telephone handset with built-in microphone and speaker and (2) a hands-free headset with microphone and at least one earphone speaker. The handset shall connect to the generic workstation through the handset jack.

(3) **Microphone** - A microphone shall be provided that can detect sounds at a minimum frequency range of 15 Hz to 40 kHz with nominally flat response over the frequency range. The microphone shall allow the end-user to detect a wide range of sounds, regardless of the microphone's frequency characteristics, when performing critical sound measurements.

5.2.13.3 Output Devices

The end-users will need three types of output devices to support their mission-related tasks: display, hardcopy, and audio.

5.2.13.3.1 Display - Display devices shall include the following:

(1) **Standard Size Monitor** - This monitor shall have a diagonal measurement of 14 inches or greater and shall be able to display 80 characters by 25 lines in text mode. The monitor shall provide a high-resolution color display screen for graphics and text.

(2) **Large Format Monitor** - This monitor shall have a diagonal measurement of 19 inches or greater, and shall serve as a double-high, double-wide, high-resolution color display screen for graphics and text.

(3) **High-Resolution, Single-Wide Monitor** - A double-high, single-wide, high-resolution color display screen for graphics and text shall be provided. It shall be able to display a life-size image of a word processing document page.

(4) **High-Resolution Video Graphics Adapter (VGA)** - A graphics screen with supporting interface is required.

(5) **Projector System** - A high-resolution color projector system shall be provided to the end-user for connection to the generic workstation and simultaneous display of the image on the generic workstation screen. The projector system shall have the following minimum specifications and device driver support:

- Capability to resolve a minimum of 1024 X 1280 pixels
- Capability to synchronize up to 1,000 television (TV) lines vertically
- Brightness and contrast of image and focused data sufficient to allow end-user viewing in subdued light when projected on a flat screen, and in normal office lighting when projected on a parabolic screen
- Ability to project a focused image of 5 to 20 feet on the diagonal (Focus shall be under end-user control from the generic workstation.)
- Compensation for pin-cushion and barrel, and keystoning of the focused image under end-user control from the generic workstation
- Ability to focus on a flat-screen, both forward and reversed, and to forward focus on a parabolic curved screen under end-user control from the generic workstation
- Ability to adjust contrast, brightness, and color levels (individually and together) under end-user control from the generic workstation
- Ability to focus each color independently under end-user control from the generic workstation
- Ability to vertically and horizontally center red, green, or blue against the standard color under end-user control from the generic workstation (Red, green, or blue shall be used as the standard color against which the other colors are centered, at the vendor's option.)
- Ability to focus corners and edges independently of the general focus, under end-user control from the generic workstation
- A roll-around stand and wall-mount and ceiling-mount fixtures provided as end-user options for mounting the projector

- A high-gain parabolic curved screen provided as an option for end-user installation, complete with wall-mounting hardware (Optional hardware shall include a roll-around stand and a ceiling mount.)

5.2.13.3.2 Hardcopy Output - Hardcopy output devices shall include the following:

(1) **Printers** - Future ESIMS shall have a variety of printers supporting both the CPC and the workstation. The end-user shall be able to replace all wearable parts. Ink, toner, and any other fluids required to operate the printers shall be resealable to allow movement of the printer without mishap. The printers shall have sufficient memory internally supported to provide temporary storage for two pages of bit-mapped graphics. The following printer types shall be supported:

- **Transaction Printer** - is a small paper-tape printer used similarly to cash register receipt printers at cash sales points. The transaction printer shall have a minimum tape width of 3 1/2 inches and shall include the following capabilities:

  - Print width of at least 40 characters per line
  - Ability to print both customer receipts and audit tapes under device driver control
  - Alpha characters (A-Z) for printing descriptive data
  - Numerics for printing prices, quantity, dates, time, etc.
  - Ability to print voids, overrings and underrings for audit and management security
  - Keyboard buffer that can hold at least 256 keystrokes

- **Page Printer** - shall have the following capabilities:

  - A 96-character ASCII subset on 8 1/2 X 11 single-part paper at a rate of not less than 8 pages per minute assuming 3,000 characters per page, 10 pitch, and 6 lines per inch
  - Ability to print bit-image graphics with a pixel density of not less than 300 pixels per inch

- Acceptance of PostScript, HP-GL, PCL-5, and any other vendor-specific print languages needed to make effective use of Future ESIMS

- Paper trays which can be removed and replaced for refill, and refilled while in the printer (Refilling the paper tray shall not interfere with the printing of the current page, shall suspend printing of the print job until the refilling action is completed, and shall resume the print job after refill. Each paper tray shall hold a minimum of 250 pages of 20-pound nominal weight paper. Two paper trays shall be provided with the printer, with the option to order additional trays. The trays shall be able to hold and dispense 8 1/2 X 11 and 8 1/2 X 14 paper.)

- Printed pages deposited in the printed page hopper that can hold 500 pages

- **Portable Impact Printer** - shall have a vendor- provided ruggedized shipping container. The printer shall be able to perform the following functions:

  - Print on a 4 1/2 X 14 7/8 form with a pressure-feed mechanism and with either a pin-feed or tractor-feed mechanism.

  - Accept a 96-character ASCII subset at a rate of not less than 2 pages per minute assuming 3,000 characters per page, 10 pitch, and 6 lines per inch.

  - Print bit-image graphics with a pixel density of not less than 180 pixels per inch.

  - Accept PostScript, HP-GL, PCL-5, and any other vendor-specific print languages needed to make effective use of Future ESIMS.

  - Clearly print one original, and legibly print (including the last copy) up to five copies with interleaved carbon.

- **High-Speed Printer** - shall have the following capabilities:

  - A 96-character ASCII subset on 8 1/2 X 11 single-part paper at a rate of not less than 15 pages per minute assuming 3,000 characters per page, 10 pitch, and 6 lines per inch

  - Ability to print bit-image graphics with a pixel density of not less than 300 pixels per inch

  - Acceptance of PostScript, HP-GL, PCL-5, and any other vendor-specific protocols needed to make effective use of the delivered Future ESIMS

  - Paper trays which can be removed and replaced for refill, and refilled while in the printer (Refilling the paper tray shall not interfere with the printing of the current page, shall suspend printing of the print job until the refilling action is completed, and shall resume the print job after refill. Each paper tray shall hold a minimum of 1,500 pages of 20-pound nominal weight paper. The trays shall be able to hold and dispense 8 1/2 X 11 and 8 1/2 X 14 paper.)

  - Printed pages deposited in the printed page hopper which shall hold at least 500 pages

(2) **Plotters** - Plotters shall interface with the generic workstation through the parallel port and the RS-232C port. The end-user shall be able to choose the port. The end-user shall be able to load a minimum of 6 pens at a time into the plotter, and under software control, shall be able to load as many pens as necessary to produce a finished plot. All plotters shall accept PostScript, HP-GL, PCL-5, and any other vendor-specific protocols needed to support vendor-supplied software and end-user provided applications. The plotters shall be able to produce plots on paper, mylar, and film.

The following plotter types shall be supported:

- **A-Size** - The end-user shall have the option to select wall-mounted and desktop versions of the A-size plotter.

- **B-Size** - The end-user shall have the option to select wall-mounted and desktop versions of the B-size plotter.

- **C-Size** - The end-user shall have the option to select wall-mounted and roll-around-mounted versions of the C-size plotter, and shall have the option to mount and use rolled paper.

- **D-Size** - The end-user shall have the option to select wall-mounted and roll-around-mounted versions of the D-size plotter, and shall have the option to mount and use rolled paper.

- **E-Size** - The end-user shall have the option to select wall-mounted and roll-around-mounted versions of the E-size plotter, and shall have the option to mount and use rolled paper.

- **Electrostatic Plotters** - These plotters shall have SCSIs and RS-232C interfaces available with a device driver for use with the generic workstation. Each plotter shall have sufficient memory to allow storage of an entire plot during the plotting process.

  Black and white electrostatic plotters shall be able to plot 16 shades of gray, and shall be available in sizes A through E.

  Color electrostatic plotters shall be able to produce a minimum of 256 colors and to plot 16 shades of gray. The color plotters shall be available in sizes A through E.

(3) **Barcode Printers** - The end-user shall be able to produce barcodes on self-adhesive label stock. Barcode printers shall comply with MIL-STD-1189, Standard Symbology for Marking Unit Packs, Outer Containers and Other Sources. They shall be able, as a minimum capability, to read LOGMARS (3 of 9) and UPC barcodes. These devices shall connect to the generic workstation through the RS-232C interface and parallel (Centronics) interfaces, at the end-user's option.

5.2.13.3.3 Audio Output - Audio output devices shall be provided by the end-user.

5.2.13.4 Sensing and Control Devices

Real property installed equipment (RPIE) shall be used for sensing and control operations, and shall be provided by the end-user.

5.2.14 Physical Plant

There are four categories of Future ESIMS physical plant requirements:

(1) CPC site

(2) Workstation locations

(3) Electrical power

(4) CPC/workstation communications installation

5.2.14.1 CPC Site

The CPC site shall be configured as follows:

(1) It shall not exceed 400 square feet of floor space in the largest configuration.

(2) Two types of sites shall be provided: sites with no raised floor and sites with a raised floor.

(3) The temperature shall be between 60 and 90 degrees Fahrenheit, and the relative humidity shall be between 20 and 95 percent, non-condensing.

(4) The end-user shall not be responsible for continuous air conditioning.

(5) The end-user shall not be required to provide special dust control.

(6) The equipment shall function at all altitudes between 100 feet below sea level to 8,000 feet above sea level.

5.2.14.2 Workstation Locations

The workstation locations shall be configured as follows:

(1) The temperature shall be between 60 and 90 degrees Fahrenheit, and the relative humidity shall be between 20 and 95 percent, non-condensing.

(2) No end-user provided cooling shall be provided specifically for the generic workstations and peripherals.

(3) The end-user shall not be required to provide special dust control.

(4) The equipment shall function at all altitudes between 100 feet below sea level to 8,000 feet above sea level.

5.2.14.3 Electrical Power

Because Future ESIMS is going to be implemented worldwide, the types of electrical power available to the system will vary according to location. To maintain deployment capability for Future ESIMS, each CPC and generic workstation shall be provided with a means of connecting to the available power source through an uninterruptible power supply (UPS)/battery backup system.

5.2.14.3.1 Commercial Power Configuration - The Future ESIMS sites shall have access to the following types of commercial power:

(1) 120/240 VAC, single phase, three wire, 60 Hz
(All U.S., Guam, Canal Zone, Korea, Republic of the Philippines, Puerto Rico, and Okinawa)

(2) 120/208 VAC, three phase, four wire with ground, 60 Hz
(All U.S., Guam, Canal Zone, Korea, Republic of the Philippines, Puerto Rico, and Okinawa)

(3) 220 VAC, single phase, three wire, 50/60 Hz
(Turkey)

(4) 208 VAC, three phase, four wire with ground, 50 Hz
(Mainland Japan)

(5) 240 VAC, single phase, three wire, 50 Hz
(All sites other than those listed in requirements 1 through 4, including UK, Australia, and New Zealand, as applicable.)

Each CPC UPS/battery backup system shall automatically detect and be able to accept each of these voltage, phase, wiring, and frequency requirements. The CPC UPS/battery backup system shall convert each requirements into the appropriate voltage, phase, wiring, and frequency needed to provide power to the CPC and its peripherals. Only one of the power requirements shall be present at any one time.

The generic workstation UPS/battery backup system shall be able to detect and use between 100 and 250 volts, single phase, 40 to 65 Hz. Adapters for the power cord shall be available (i.e., stored in the workstation) to make the connection between the power plugs in each country.

Both the CPC and the generic workstation UPS/battery backup systems shall also act as harmonic filters. That is, the UPS/battery backup system shall prevent any harmonics generated by the computer hardware and induced on the voltage from passing through the UPS/battery backup system to the commercial power source. Conversely, this system shall also prevent harmonics generated on the commercial power source and induced on the voltage from passing through to the computer hardware.

5.2.14.3.2 UPS for the CPC - Each CPU in the CPC shall have a UPS/battery backup system that can continuously support the CPU, its peripherals, and the external disk drives attached to the CPU for at least 20 minutes. The end-user shall be able to detach each CPU and its UPS/battery backup system and peripherals from the CPC and ship them to another location. A ruggedized shipping case shall be provided to protect the UPS/battery backup system from the environmental hazards encountered during air and surface transport. The vendor may provide the CPC UPS/battery backup system either as an integral part of the CPU or as a separate unit. With either option, the total unit in its shipping case shall be small and light enough to be carried by two persons; total weight shall not exceed 140 pounds.

The CPC UPS/battery backup system shall:

(1) Filter commercial grade power to the level needed to supply computer grade power to the CPU and its peripherals.

(2) Operate at all altitudes between 100 feet below sea level and 8,000 feet above sea level.

(3) Block 100 nercent of load-generated harmonic distortion on the voltage and current from being passed to the commercial power source side of the UPS/battery backup system.

(4) Protect connected loads from voltage sags below 95 percent and surges above 105 percent of nominal voltages. (Common mode and transverse mode noise shall be reduced to less than 1 percent, as presented to the connected loads.)

(5) Block the effects of lightning from entering the connected loads.

(6) Compensate for the loss of one-phase and two-phase voltages in the three-phase input supply from the commercial power source by reconstructing the lost phases.

(7) Not permit the voltages on all three phases to sag below 95 percent or surge above 105 percent of nominal voltage on any phase on the load side of the system.

(8) Operate connected loads normally within a voltage range of 15 percent above to 10 percent below the nominal voltage requirement for the device. (For example, a 110-volt device shall be able to continue normal operation with voltage between 100 and 130 volts.)

(9) Present a power factor of not less than 0.95 leading or lagging to the commercial power source.

(10) Have a mean time between failure (MTBF) of 100,000 hours for the electronic circuitry and 50,000 hours for the battery subsystems. (The battery subsystems shall be totally sealed and shall have battery acid neutralization kits attached to the outside of the battery compartment, readily accessible to end-users in the event of acid spills and damage.)

(11) Warn the SSA of a power outage, its initiation time, and its duration.

5.2.14.3.3 UPS for the Workstations - Each generic workstation shall contain a UPS/battery backup system. It shall be able to filter commercial grade power to the level needed to supply computer grade power to the generic workstation. This system must have sufficient capacity to continuously support the generic workstation's maximum rated load (which does not include peripherals) and the external disk drives attached to the generic workstation for at least 8 hours. Three electrical outlets shall be provided to support the external peripherals normally attached to the generic workstation so that the peripherals can be used intermittently during a blackout.

In addition, the generic UPS/battery backup system shall:

(1) Block 100 percent of load-generated harmonic distortion on the voltage and current from being passed to the commercial power source side of the UPS/battery backup system.

(2) Protect connected loads from voltage sags below 95 percent and surges above 105 percent of nominal voltages. (Common mode and transverse mode noise shall be reduced to less than 1 percent, as presented to the connected loads.)

(3) Block the effects of lightning from entering the connected loads.The generic workstation UPS/battery backup system shall block 100 percent of load generated harmonic distortion on the voltage and current from being passed to the commercial power source side of the generic workstation UPS/battery backup system.

(4) Not permit the voltages on all three phases to sag below 95 percent or surge above 105 percent of nominal voltage on any phase on the load side of the system.

(5) Operate connected loads normally within a voltage range of 15 percent above to 10 percent below the nominal voltage requirement for the device. (For example, a 110-volt device shall be able to continue normal operation with voltage between 100 and 130 volts.)

(6) Present a power factor of not less than 0.95 leading or lagging to the commercial power source.

(7) Have a mean time between failure (MTBF) of 100,000 hours for the electronic circuitry and 50,000 hours for the battery subsystems.The generic workstation UPS/battery backup system shall present a power factor of not less than 0.95 leading or lagging to the commercial power source.

(8) The MTBF for the generic workstation UPS/battery backup system shall be 100,000 hours for the electronic circuitry and 50,000 hours for the battery subsystems.

(9) Warn the SSA of a power outage, its initiation time, and its duration.

5.2.14.4 CPC/Workstation Communications Installation

The end-users shall be responsible for installation of communications lines from the CPC to the workstations. The vendor shall provide connector configuration information to the end-users.

5.3 SIZE AND CAPACITY REQUIREMENTS

To ensure sufficient quantities and types of equipment that have the architecture and capacity to support E&S functional requirements into the next century, Future ESIMS must include a means of measuring workload as part of the requirements process. This section describes the process for establishing and using end-user-related function-based metrics, and then describes the metrics that must be used as a baseline for Future ESIMS performance.

5.3.1 Future ESIMS Workload Test Process

The purpose of the workload test is to establish functional standards that the Air Force can use to evaluate all vendor-proposed systems. To obtain a responsive system with capacity to grow, the Air Force shall use the E&S end-users' requirements for throughput as the baseline for system throughput testing; a simple comparative test without a minimum standard is not sufficient. Although a variety of solutions may be possible, this method tests the end-user's requirements against the candidate platforms.

The developers of the workload test must ensure that the test is not modified or optimized in any way that unfairly biases the results of the testing process. Specific objectives of the workload test program include the following:

(1) Establish the types and characteristics of system processing requirements that meet the E&S end-users' transaction response time requirements. (For example, report requests, database generation and updates, and graphics generation and updates each generate different types of workloads, and the mix and quantity of these requirements must be established for typical base sizes and E&S function mixes on those bases.)

(2) Ensure compliance with system throughput, response time, and data storage requirements, and detect modifications of evaluated equipment against the equipment proposed.

(3) Ensure that candidate systems conform with the Air Force open architecture, and are compatible with each other and with current Air Force C-CS equipment.

(4) Provide a basis for identifying and evaluating proposed equipment configurations so that evaluation equipment configurations can be integrated into final procurement specifications.

(5) Contribute to cost-benefit analyses of Future ESIMS by providing workload, workstation, and worker quantities.

The process to develop and use the workload test and to evaluate its results consists of 12 development, deployment, and evaluation procedures:

(1) Analyze Software and Workload - Collect usage data under conditions of current actual use, current fully trained use, projected use with addition of software applications currently in development, and projected use with addition of software on the Future ESIMS full operating capability (FOC) requirements list. Determine workload mix, data storage, data transfer, display, acquisition, and processing requirements for these applications and system functions, for four typical Air Force base sizes (small, medium, large, and largest) and the deployable configuration of each by separating them into two components). The deliverable for this step shall be a feasibility report that includes the workload mix and capacity requirements.

(2) **Reduce Software Functions to Computer Operations** - For the software functions identified in step 1, identify the critical computer operations from an end-user's viewpoint (typical end-user problems shall be the basis for the work tested, with typical access requirements creating the workload) and the peak demand for each, to represent the workload mix in quantifiable computer response terms. Codify the way E&S functional end-users use the computer system to perform their tasks into a test which accurately tracks the demand on the computer and its software suite for the number of end-users required. The deliverable for this step shall be a system requirements specification that describes the workload test.

(3) **Program the Workload Test Software** - Program the workload tests to meet the approved test software requirements determined as a result of steps 1 and 2.

(4) **Develop Test Data and Establish Minimum Test Criteria** - From workload mix data, develop a set of test data that accurately reflects end-user workload and that tests the ranges of processing and feature capabilities required. Establish minimum performance criteria, from the end-user's perspective, that will support the current and projected Future ESIMS workload and feature suite.

(5) **Benchmark Against AMMUS Equipment** - Determine which subtests from the workload test suite can be run on AMMUS ESIMS, and run them on typical AMMUS configurations to establish baseline test performance data.

(6) **Fine Tune and Adjust Tests and Criteria for Typical Future ESIMS Configurations** - Based on baseline test results and other review guidance, enhance the test suite for accurate representation of function profile and workload mix in the five workload profiles (i.e., the four sizes and in the deployable configuration).

(7) **Assemble Prototype Test Kit** - Build prototype test kits consisting of the test software suite, test data sets to represent the five workload profiles, installation script, and test script.

(8) **Validate Test Integrity and Security** - Issue prototype test kits to vendors, allowing them to configure proposed systems and validate their performance. (The test shall be changed for live test validation prior to acceptance, Step 12.)

(9) **Revise Test Software and Data for Release** - Using the results of the previous task, modify the test software to make it more generic for competitive release to potential vendors.

(10) **Build Workload Test Kits** - As part of the request for information (RFI)/request for information (RFP) process, produce enough workload test kits to satisfy expected demand from candidate vendors.

(11) **Distribute Workload Test Kits to Candidate Vendors** - Distribute workload test kits as indicated by the RFI/RFP process, and provide E&S on-site observers as needed.

(12) **Evaluate Test Results** - Observe and document tests (at vendor sites). Provide detailed documentation of the configurations tested. Compare test results and certify those proposed systems that pass minimum requirements.

Note: If other Air Force functional communities, other military branches, DoD, and other Government agencies wish to be included in the evaluation, the workload can be modified and upgraded to accommodate their specific needs.

5.3.2 Future ESIMS Workload Metrics

The functional metrics applied to both the CPC and the generic workstation comprise the performance characteristics to be included in the workload test.

The following metrics shall be applied to the CPC:

(1) Data search and response using E&S applications and vendor-provided software

(2) Massive shared data file update using E&S applications

(3) Graphics (both engineering and business graphics) update and re-display from the CPC on a generic workstation

(4) Compilation, loading, and execution of a benchmark file (to be supplied by HQ AFESC/SC) which represents a typical end-user-customized application in the CPC/generic workstation environment

(5) Data search and response from host CPC to another CPC whose configuration is unknown but whose logical address has been identified, through the use of dedicated leased line to the nearest DDN node and over the DDN

The following metrics shall be applied to the generic workstation:

(1) Local data file access and reporting

(2) Remote data file access and reporting

(3) Combination multi-data-file requests

(4) Business graphics using remote data

(5) Engineering graphics

(6) Video imaging from CPC and from the generic workstation data file

(7) Audio production from CPC and from the generic workstation data file

(8) Remote system logon, file transfer, interactive applications, and E-mail

(9) Validation of remote non-vendor system access

The workload test shall also be applied to the metrics for the CPC-to-workstation communication link. Measurement of transaction completion times shall be initiated at the last keystroke of a transaction request and terminated at the end of screen refresh after transaction processing.

5.4 FUTURE ESIMS IMPLEMENTATION AND CONTINUING SUPPORT

Implementation of Future ESIMS involves transition at each site from AMMUS equipment and other systems to the new environment. Installation concerns also include retirement and disposition of the AMMUS hardware, continuing the use and support of the Future ESIMS platform through its planned life cycle, and retirement and disposition of the Future ESIMS platform. This section describes the requirements for installation and support throughout the life cycle of Future ESIMS.

5.4.1 Major Milestones

The following milestones reflect distinct phases of the Future ESIMS approval, procurement, deployment, and retirement life cycle:

(1) **Establishment of the need for Future ESIMS**, as described in Sections 2 and 4 of this document and in the 1989 AFMEA study of WIMS and SIMS

(2) **Refinement and approval of the Future ESIMS concept**; the technical solution described earlier in this section forms the basis of the Future ESIMS concept

(3) Participation of industry in **RFIs** and in conferences with prospective bidders

(4) **Quantifying** the Future ESIMS requirement (number and type of CPCs, workstations, peripherals, and communications) for each site, by function

(5) **Procurement** of the Future ESIMS platform that is appropriate for each site

(6) **Site surveys** to determine methods and improvements for installation access, electrical power, HVAC, grounding, cable routing, and physical space requirements

(7) **Site preparation** to make modifications as determined in the site survey and to provide installation access, electrical power, HVAC, grounding, cable routing, and physical space for the Future ESIMS equipment

(8) **Equipment delivery** to the site

(9) **Installation** of equipment and system software:

- The end-users shall install Future ESIMS with the full support and guidance of the vendor's installation team, followed by system configuration and installation of ESIMS application software by the E&S ESIMS installation team.

- Installation of the Future ESIMS platform shall not interfere with the activities supported by the AMMUS platform.

- Upon the completion of the Future ESIMS installation and upon acceptance by the E&S ESIMS installation team, the AMMUS hardware shall be removed from the site by the vendor for disposition. The vendor shall reimburse the Air Force all monies received from the disposal of the AMMUS hardware, less expenses incurred.

(10) **Support and Upgrade** of the equipment and software during its service life

(11) **System Retirement** after Future ESIMS becomes functionally obsolete or cannot be supported economically, and transition to the successor system:

- The Future ESIMS vendor shall transfer all software licenses to the next owner of the system without a relicensing fee.

- The Future ESIMS vendor shall transfer all maintenance contracts to the next owner of the system without increasing the maintenance charges for the first period of each contract.

5.4.2 Pre-Installation Planning and Training

Installation and initial operation at each site will be smooth only if the site support and the installation process are planned and if the personnel operating the system are trained. The following subsections describe these pre-installation steps in detail.

5.4.2.1 Determination of Equipment Requirements

For each site, several requirements will determine the amount of equipment ordered, including the following:

(1) CPC and central data storage, communication interfaces, and CPC peripherals

(2) Number of generic workstations and upgrade kits required for each E&S functional area

(3) Number and type of peripheral equipment required to support functional areas

Each site shall receive the full suite of vendor-furnished systems software and utility software. This uniform delivery will ensure consistency of support, enable continuation of end-user application development, and provide for continuity of operations support between systems.

5.4.2.2 Site Survey

Each site receiving Future ESIMS equipment shall conduct a site survey to plan the location of equipment, pre-installation preparation requirements, and installation methods. After all Future ESIMS vendors are selected, Air Force and vendor staff must establish a site survey method and checklist. Typical site survey considerations include the following:

(1) Physical location of, and room modifications required to house, the CPC

(2) Physical location of each workstation and each item of peripheral equipment

(3) Cabling from workstations to the CPC (topology, routes, lengths, connectors, etc.)

(4) Power, HVAC, and air quality requirements

(5) Physical security arrangements for the CPC and critical peripheral equipment

(6) Physical access route for bringing the equipment from the receiving dock to the selected computer operation area and for moving it quickly out again for deployment

(7) Fire protection (review of risks, local building code requirements, etc.)

5.4.2.3 Installation Schedule

After initial requirements have been set and specific equipment has been ordered, the remaining milestones must be scheduled around the equipment delivery date. The contract must include the appropriate language to commit the vendor to delivering the full set of ordered equipment to the site by the stated date, and should include penalty charges and liquidated damages per day for late deliveries. Once installation teams are scheduled, late deliveries cost time and money.

5.4.2.4 Site Preparation

Most sites will require a moderate amount of site preparation. The minimum acceptable environment for the CPC and for the generic workstation must be determined in cooperation with the vendors after award of Future ESIMS equipment contracts. Typical site-preparation tasks include the following:

(1) Cabling

(2) Power and HVAC

(3) Partitions, carpentry

(4) Telecommunications, DDN

(5) Fire protection equipment

5.4.2.5 Pre-Installation Training

To ensure that Future ESIMS equipment will be used productively as soon as possible after installation, the SSA and key application support personnel must be trained before the equipment is installed. This training should focus on the concepts needed to configure and implement the system, new capabilities that involve interface to outside resources, security, emergency planning, deployment planning, establishing contacts for support and service, and other areas that may involve long lead times. Equipment-specific parts of this training shall be provided by the vendor, while Air Force unique parts of the training should be developed and delivered by HQ AFESC.

5.4.3 Installation

Installation of initial Future ESIMS equipment at each site requires synchronization of the vendor's installation team, the Air Force installation supervisors and trainers, site readiness, and arrival of the equipment.

The installation cycle consists of the following tasks:

(1) Equipment unpacking, physical placement, and configuration

(2) System software installation and configuration

(3) Installation of converted SIMS, WIMS, and other application software and data loading

(4) Test operation of new system, both to test the new system and to train end-users in all applications

(5) Acceptance of the new system and start of "live" operation

(6) Removal and disposal of old system

A COBOL compiler front-end shall be provided as part of the installed system software. The front-end shall support the complete suite of Wang COBOL syntax as implemented at the time of transition and shall allow compilation of the AMMUS ESIMS applications written in Wang COBOL, without change, using the vendor-supplied compiler suite. Compilation of the AMMUS application source code with the front-end shall take no more than twice the time required for a similar compile with the native vendor's COBOL. Execution time of the AMMUS applications shall show no degradation to the end-user in execution and performance on the Future ESIMS platform.

5.4.4 Support Requirements

Several critical ongoing tasks must be supported to ensure success of Future ESIMS throughout its life cycle:

(1) System security administration

(2) E&S application technical support

(3) System technical support

(4) E&S template application software development and support

(5) System and application training

(6) Hardware and software maintenance

(7) Provision of supplies, materials, and spares

(8) Supervision of system-related activities and concerns

To allow the end-users to focus solely on their mission-related functions, E&S shall assign these tasks to the appropriate specialists when the system is installed.

5.4.4.1 System Security Administration

Each Future ESIMS CPC shall be supported by a trained SSA, assigned half-time for a small system and full-time for a large system. SSA duties include the following:

(1) User account creation, password security, and access privilege authorizations

(2) Data integrity responsibilities, including checking the condition of databases, periodic backups, and as-needed restores

(3) Data security responsibilities, including controlling access to sensitive data and software, controlling physical access to critical equipment, and controlling modem and network access to the system

(4) Installing and configuring new application software and updates

(5) Configuring and enabling workstations, peripheral equipment, and communications interfaces

(6) Monitoring diagnostics and system performance indicators to anticipate problems

(7) Primary technical support for end-user questions regarding application and system software

5.4.4.2 E&S Application Technical Support

HQ AFESC shall provide the following types of support for E&S applications through normal MAJCOM channels. Future ESIMS requires the following technical support:

(1) **Voice and Data Communication Channels for End-Users** - In addition to normal telephone service, these channels shall include open-access 800 numbers for end-user queries.

(2) **Configurator Software** - This support will assist in the generation of orders for hardware and software for new systems and for enhancements, including features, upgrades, and options. The configurator software should be able to recommend the least-cost alternative for any ESIMS configuration proposed, and should recommend the most economical hardware/software configuration based on minimum end-user input. In addition, the configurator should allow modification of each configuration record to reflect later changes and to maintain an "as built" or an "as delivered" record of each system, including versions of each product.

(3) **Continuing Application Training** - This training shall include new end-user orientation and introduction to self-study and computer-aided instruction (CAI) resources and to specific problem solving and answering of application questions.

5.4.4.3 System Technical Support

System-level problems are design faults, as opposed to product failure, within vendor-provided hardware and software that field service technicians cannot correct because the solutions are not documented in the vendor's field service procedures. For example, keyboard breakage is a field service problem while keyboard incompatibility with specific software is a system problem. A solution to the system problem might include replacement of the keyboard's processor or read-only memory or modification of the keyboard's software driver.

E&S shall validate user-reported hardware and software problems before submitting problem reports to the vendor. When there are repeated problems involving a single elusive fault that cannot be resolved within 3 days by telephone consultation with the end-user and the end-user's SSA, the MAJCOM point of contact shall intervene. Emergency problems shall merit immediate MAJCOM support, with a goal of solution within 24 hours.

The vendor shall provide technical support and problem resolution for all hardware and software problems that have been validated by Air Force support personnel. The vendor may request a reasonable number of points of contact, but not less than one for each MAJCOM, HQ AFESC, SSC, and HQ USAF.

When a valid software problem is presented to the vendor technical support point of contact, the vendor shall propose a solution within 24 hours, devise a work-around within 48 hours, and distribute an acceptable correction within 30 days.

When a valid hardware problem is presented to the vendor technical support point of contact, the vendor shall propose a solution within 24 hours, devise a work-around within 5 business days, and distribute a correction within 60 days.

When the vendor does not agree that the reported problem involves a true system problem, the vendor shall dispatch one or more expert field service engineers to the site to render an opinion. If the engineers decide that the task being performed is within the functional requirements and that the equipment is installed according to the vendor's site preparation and installation documentation, the vendor shall resolve the problem to the satisfaction of the local end-user, SSA, and MAJCOM technical support personnel.

5.4.4.4 E&S Template Application Software Development and Support

To ensure continuous support for end-user application development, the MAJCOM E&S technical support personnel and HQ AFESC must provide the same level of developer technical support and software standards currently provided for AMMUS ESIMS. This support consists of development and distribution of template applications, assistance to functional specialists as they adapt the templates to the needs of specific bases, and collection and standardization of user-developed applications (to be distributed as templates). This application-development method (which is shown in Figure 3-1) has been a key factor in the success of ESIMS and an economical way to develop many useful applications.

High turnover and widely divergent proficiency levels will require much more attention to the human-machine interface, including absolutely consistent commands across applications, robust sets of context-sensitive "HELP" and tutorial programs, and an array of training and support.

5.4.4.5 System and Application Training

The training approach must preclude knowledge loss during staff turnover. Typically, initial training knowledge is not passed on from first-order trainers to second-order trainers and from trained personnel to their replacements. The selected training approach must provide for fast cross-training and introduction of new personnel to functional positions and the ESIMS support for those positions.

The vendor shall provide initial training for operators and SSAs (and alternates) that includes E&S-specific items (such as file naming conventions, data file organization, communications naming conventions, etc.) upon installation of the system at each site. The training shall also include "peel-down" training, i.e., hands-on experience or training in partitioning, reconfiguring, and removing ESIMS for deployment.

A training and certification process is required for follow-ons and existing personnel, in accordance with standard commercial policy. The certification needed for military and civilian personnel system training records shall also be provided.

5.4.4.5.1 Training Objectives - Both for vendor-provided training (equipment and system software) and Air Force developed training (E&S applications, deployment, crisis operation, and disaster recovery), three general levels of proficiency are required:

(1) **Supervisory** - capabilities, interfaces, problems, metrics, and tasks (sufficient to understand and manage the process without hands-on use of the application)

(2) **Quick Start** - the quickest path to typical use, basic concepts, and critical procedures (introductory information for new troops, cross-training, and crisis operation)

(3) **Proficiency** - use of all features, alternate methods, shortcuts, side effects, and customization for all regular application end-users

In addition, system-wide training and practice is required in disaster recovery, crisis operation, and deployment of ESIMS. Deployment drills should include continuity of operations assistance to another base, adaptation of workstations from one upgrade configuration to another, preparing a deployable ESIMS equipment set for E&S operations at a new base, and deployment to OCONUS conditions. The purpose of the modular and deployable design of the system will be defeated unless all E&S troops are trained to use its features.

Vendor-supplied training shall include the following:

(1) Combination of job-procedure and ESIMS training

(2) Job-related skills training

(3) Basic skills training

5.4.4.5.2 Appropriate Use of Training Methods - Several different training methods are available, each of which has advantages and disadvantages depending on the purpose of the training, its timing, and the number of participants. Common examples follow:

(1) **Platform Instruction or Briefing** - This is the best way to introduce groups to a concept, to provide an overview of capabilities, or to provide policy direction. It can be delivered several times, but becomes uneconomical if it must be delivered many times to small groups. If the presentation must be repeated over time at different locations, videotape, audiotape/slide, or computer slideshow presentations will probably be more economical than sending a

training specialist to each presentation. Use of these media ensures consistency in presentation, but sacrifices flexibility and ability to tailor the presentation to specific audiences.

(2) **Laboratory/Workshop Instruction** - This method is best for developing competency in operations and procedures, especially when use of tools (including application software) or problem solving is involved. Although some lab situations can be reduced to computer-based simulations for use at the end-user's workstation, this type of instruction is usually presented in a facility that has been equipped with the tools and equipment to be used. Expenses include equipping the lab, travel of participants to the lab, and instructor time.

(3) **Individual and Small Group Coaching** - Previously trained end-users can show new end-users how to do specific tasks. The experienced end-users can also help the untrained personnel gain proficiency by guiding them through sets of instructional problems. This method is cheaper and more versatile than sending each end-user to a lab class, but it sacrifices consistency. Any misunderstanding or oversight is propagated through the chain of coaches and new end-users.

(4) **CAI and Interactive Video** - The vendor shall provide CAI for all system hardware, operating system commands, system software and utilities, and vendor-provided applications consistent with the HELP support specified in Section 5.2.8.9.

All training methods selected shall include a choice of media for each skill to accommodate the widest combination of learning styles. They shall include a convenient and inclusive means to record participation in and successful completion of courses, to provide skill needs diagnosis based upon error analysis, and to recommend supporting course work to satisfy the skill needs identified for individuals and groups.

5.4.4.5.3 Training Delivery Architecture - The shape and structure of the Future ESIMS training resources shall be optimized to two levels: (1) initial proficiency for all personnel at each site and (2) ongoing training as people change jobs and require more skills. A mix of the aforementioned training methods is advisable, especially for initial proficiency training. For ongoing training during the Future ESIMS life cycle, however, training must be available for individuals as needed, without prior arrangement, at the individual's workstation. Only this type of individual training can economically meet the requirement of timing, number of participants, and purpose.

5.4.4.6 Hardware and Software Maintenance

The contract with each Future ESIMS vendor shall include a provision for automatic field upgrading of hardware and software products to current technology levels.

5.4.4.6.1 Equipment Upgrades - Each Future ESIMS vendor shall notify HQ AFESC of equipment upgrades when they become available. Notification shall include pricing, ordering details, delivery schedule, and installation schedule. Pricing of upgrades shall be an agreed percentage of the original procurement price.

Upgrades to hardware shall be delivered to HQ AFESC for initial acceptance testing. Upon acceptance, HQ AFESC shall authorize the vendor to notify Future ESIMS sites that the new equipment is available. The SSA shall be responsible for ordering the upgrades, with guidance and support from HQ AFESC.

5.4.4.6.2 System Software Upgrades - Each Future ESIMS vendor shall notify HQ AFESC 90 days in advance of the availability of system software upgrades, including pricing and ordering details. Upgrades to system and application software shall be delivered to HQ AFESC for acceptance testing and distribution. Software upgrades shall require no vendor support for installation and implementation, and any end-user shall be able to install them. Pricing of upgrades shall be an agreed percentage of the original procurement price.

5.4.4.6.3 Software/Data Distribution - System software upgrades shall be delivered to HQ AFESC for distribution to all Future ESIMS sites. The upgrades shall include:

(1) Availability and distribution

- Accessible material and resource inventories
- Software support for reconfiguration of databases
- Expanded processing power and storage capacity

(2) Support for Updating

Each software update shall be documented and tested by the vendor/developer, on systems consisting of a current ESIMS hardware configuration and software suite, for side effects and to validate the installation procedure. There shall be at least two types of updates:

(1) **Required** - fix any problem in the originally delivered software suite as described in the RFP and the vendor's proposed system, e.g.:

- Fixing a problem that generates a fatal error in the typical system

- Fixing a problem that occurs with a specific combination of application software, peripheral equipment, and hardware configuration

(2) **Optional** - enhance performance or improve a documented feature.

5.4.4.7 Provision of Supplies, Materials, and Spares

The vendor shall provide all cables, connectors, and supplies needed for initial operation. The cables that the vendor must provide are those that are not field-installed components of the building or structure. They include cables between the generic workstation and its peripherals, cables between the CPC and its peripherals, and cables between the CPC and the communications interfaces continued within the same room. Field-installed components include cables between the generic workstation and the CPC and cables between the CPC and the communications interfaces not present in the same room.

Other supplies needed to support Future ESIMS operation include continuous form paper, printer supplies, diskettes, etc. In general, these supplies shall be obtained from the General Services Administration (GSA).

5.4.4.8 Supervision of System-Related Activities and Concerns

The following issues will be ongoing concerns throughout the life cycle of the system:

(1) Logistics

(2) Manpower

(3) Engineering support

(4) Security

(5) Technical data

(6) Circuits

5.4.4.8.1 Logistics - Logistics issues include support of equipment at current sites and support of deployable ESIMS during exercises and crises. The vendor shall provide on-site support to all CONUS Future ESIMS sites.

Maintainability requirements include timely response by field service technicians, per the following criteria:

On-site field service:

CPC: 8 hours CONUS; 24 hours OCONUS

Workstation and workstation peripherals:
12 hours CONUS; 24 hours OCONUS

For battlefield service:

The Logistics community shall be able to provide component replacement/repair within 4 hours of reported breakage. The battlefield service is a combination of capabilities in the deployable kit, the Air Force logistics support system, and the vendor response time.

5.4.4.8.2 Manpower - Future ESIMS will require two supporting part-time positions: SSA (whose duties are listed in Section 5.4.4.1) and operator. Upon deployment of Future ESIMS, individuals requiring automated support during deployment shall disconnect their workstations from the home system, deploy, and reconnect at the new site. The SSA will be responsible for disconnecting an appropriate number of CPUs from the CPC for deployment at the new site. The SSA at the new site shall be responsible for installing the new CPC and any and all peripherals, including workstation connections.

5.4.4.8.3 Engineering Support - Future ESIMS shall include a facility to assist the SSA in configuring an ESIMS site as described in Section 5.2.9.9.

5.4.4.8.4 Security - Security for the system shall be at least the C2 level specified in DoD Directive 5200.28 and DoD 5200.28-STD. The major exception to this requirement is capability for the SSA to protect the system from modification, unauthorized access, and destruction of an audit trail to the applications, data, and hardware. The SSA shall be able to perform the following, within the audit trail function:

(1) Select identification and authentication mechanisms.

(2) Trace file opens, program initiations, and deletion of files.

(3) Trace actions taken by the end-users, computer operators, and the SSA.

5.4.4.8.5 Technical Data - Technical data for Future ESIMS equipment and system software includes the following:

(1) User reference and tutorial manuals

(2) Installation, diagnostic, and maintenance manuals

(3) Software conversion, interface, and maintenance manuals

(4) Depot-level repair procedures, illustrated parts breakdowns, and bench diagnostic software

One complete set of technical documentation for all ESIMS equipment and software shall be supplied with each CPC. Each end-user shall be provided with one set of workstation end-user equipment and software manuals, and shall be able to order additional sets or individual volumes. If any technical data is furnished in on-line form, access means shall be provided so that the end-user can retrieve needed information when the system is not operating and can carry documents away from the site of the equipment for separate study.

5.4.4.8.6 Circuits - Communication circuits between ESIMS CPCs and remote workstations are provided through DDN. Backup communications shall be provided through private packet-switched networks and commercial voice-grade telephone lines. Intra-base communications between workstations and CPCs on a site shall be provided by the local area network or other cabling method that is part of this requirement. The vendor shall not be required to supply this cabling.

5.4.5 Reliability, Repairability, and Maintainability

Reliability, repairability, and maintainability form three parts of the equation for system uptime (i.e., availability). **Reliability**, measured in mean time between failures (MTBF), indicates the quality and proper engineering of the equipment. **Repairability**, measured in mean time to repair (MTTR), indicates the degree to which the equipment was designed to enable quick access to, diagnosis of, and replacement of any faulty part. **Maintainability** indicates the degree to which the equipment was designed to enable preventive maintenance and ongoing fault detection to anticipate problems as they develop and to permit detection and correction before the problem causes a system failure. **Availability**, which is the result of high reliability and proper design for repairability and maintainability, indicates the percentage of time the system is available for application use (as opposed to being down for repair or locked up in failure mode). Availability, then, describes the true benefit of the system resource, as reflected in the quality of its design and manufacture.

5.4.5.1 Reliability Requirements

All Future ESIMS shall be tested and validated to the following reliability standards:

(1) Electronic modules (CPC and workstations): 10,000 hours MTBF

(2) Disk drives and other electromechanical storage devices: 50,000 hours MTBF

(3) Printers:

- 500,000 pages between mechanical failures
- 5,000 pages between ribbon or toner change
- 30,000 pages between other end-user consumable component change

(4) Power supplies that comply with the requirements in Section 5.2.14.3

5.4.5.2 Repairability Requirements

Future ESIMS shall optimize MTTR (using an economical size of replacement modules) for all subsystems in the CPC, workstations, and peripheral equipment. For replaceable components, any part of the system shall be accurately diagnosed and replaced by one typically trained field service technician in no more than 2 hours, within the requirements specified in Section 5.4.4.8.

5.4.5.3 Maintainability and Field Service Requirements

Field service consists of preventive and corrective maintenance. It shall be performed in CONUS by vendor field service technicians, but Air Force personnel shall be trained to repair the equipment in an emergency or on a deployment. Training materials shall be provided for Air Force classroom training and vendor-supported training.

The vendor shall provide one-call field service dispatching for both hardware and vendor-supplied software. That is, the SSA shall call one service representative, who will verify the nature of the problem and dispatch the appropriate skill level of technician equipped with the proper tools and spares to solve the problem. The vendor shall take the responsibility for integration, interface, and fault isolation between any and all items of Future ESIMS hardware, regardless of manufacturer.

Field service is intimately related to technical support and end-user training. The vendor shall satisfy the following field service requirements:

(1) A system-provided warning for the SSA when the system approaches workload limits

(2) A communication channel for end-users (trouble reporting), including access to the vendor through 800 number service (The intent is to establish a path for the end-user to clearly communicate the problem to the vendor.)

(3) Remote maintenance monitoring/diagnostics with remote system programming access for reconfiguration, operating software fixes, and other corrective measures

(4) A minimum spares inventory, consisting of standard parts and upgrade kits, located at each E&S site and accessible both by vendor field service technicians and authorized trained Air Force personnel

(5) Field replaceable modules to include every component in the system

(6) Ability to cannibalize/convert modules between workstation types

(7) Sufficient Air Force staff trained to maintain the system during an emergency (Civilian repair technicians are acceptable in non-deployment and non-crisis situations.)

(8) Sufficient training materials and visual aids to train the entire E&S community during deployments in module replacement, setup, problem recognition, etc.

(9) Error-sensing capability, e.g., storage devices and processors (Statistics on these devices shall be maintained for use by service technicians to diagnose problems.)

(10) Planning for extensive Future ESIMS maintenance

(11) Field Replaceable Unit approach to field service procedures, spares, and training

(12) Optimum mean time to repair

(13) Maintenance of one or more depot repair facilities to keep serviceable spares in working condition and to avoid a backlog of unusable modules

5.4.6 Transition Strategy

The transition to Future ESIMS shall be graceful. To minimize cost, Future ESIMS shall use the AMMUS source code and software architecture in its original state. To minimize the impact of the transition on the end-user, the 5,000-plus applications currently in use must be migrated without change, preserving the look and feel of the existing systems. After the migration is completed, the existing applications can take advantage of the Future ESIMS architecture feature set as modifications and enhancements are made.

To implement the precepts described in Section 1, the transition to Future ESIMS shall be guided by the following program objectives:

(1) **Maintain Current ESIMS Effectiveness** - The functionality and performance of Future ESIMS shall be equal to or, preferably, greater than AMMUS ESIMS. The end-users must be able to transition to the new environment with minimum retraining.

Future ESIMS shall preserve and support the end-user programming concept: the cornerstone of the success of AMMUS ESIMS.

Future ESIMS shall provide a consistent platform for all levels of command in the Air Force. The same platform used at base level shall be used at the MAJCOM and HQ levels, allowing E&S personnel at all levels to use the information in a consistent manner.

(2) **Enhance Current Capabilities** - ESIMS enhancements shall provide the benefits and economies of the technologies that will be available at the time of installation. In all cases, the functionality, performance, and compliance requirements specified for the mid-to-late 1990s shall meet, as a minimum, the Air Force hardware, software, and communications standards in force at that time. All additional functionality, performance, and compliance that can be economically provided by COTS products shall be required for delivery with all system installations.

(3) **Constrain the Impact of Transition** - Each implementation shall be planned and designed such that the transition to Future ESIMS will not compromise the mission-effectiveness of the unit or otherwise impair its war-fighting capability. The current and new environments shall operate in parallel at each location long enough to demonstrate the integrity and reliability of the enhancement.

(4) **Promote Orderly System Evolution** - Future ESIMS shall use an open system architecture that will also accept existing software to ease the transition effort. Additionally, the open system concept, with its defined interfaces, shall allow third-party software access to operating system and communication components. Third-party access shall encourage competitive bidding, thereby reducing overall cost.

(5) **Increase System Survivability** - System survivability requirements include reliability and maintainability (R&M). All C-CS equipment have interchangeable parts to permit easier servicing and upgrades, more in-house maintenance, and higher-quality and lower-cost commodity parts. The generic workstation described in Section 5.2.12.1 defines a single basic workstation to meet minimum specified performance and feature requirements. As specified in Sections 5.2.12.2 through 5.2.12.5, all special-purpose upgrades to the generic workstation shall be reversible expansions of the generic workstation. This modular configuration shall minimize maintenance requirements, maximize use of standard components, and allow interchange of workstations and components during emergencies and shortages.

(6) **Support Deployment and Crisis Operation** - In addition to use of a fully functioning system, ESIMS shall perform reliably under crisis conditions. The system shall be deployable in stand-alone and networked configurations, and shall support "peel-down" architecture, "graceful degradation," and redundancy.

5.4.7 Funding

The selection of hardware for Future ESIMS is expected to take 4 to 6 years after the release of RFI documents. The acquisition and implementation is expected to take place over 5 years. The average cost of this system/configuration is expected to be $500,000 per site, or approximately $100,000,000 for all of E&S. This cost shall be spread over the 5-year implementation, requiring $20,000,000 per year for new equipment.

5.4.8 System Retirement

The vendor shall remove and dispose of the AMMUS hardware, as specified in Section 5.4.1 (11). The Future ESIMS hardware is expected to be obsolete by the year 2010, and shall be replaced at that time. When the system is turned over to its new owner, the software licenses for the vendor-provided software shall be transferred without charge to the new owner, as specified in Section 5.4.1 (11). In addition, the new owner shall receive the first period of maintenance at the same rate paid by E&S, as also specified in Section 5.4.1 (11).

5.5 IMPACT IF DISAPPROVED

ESIMS is a mission-critical information system concept for all of E&S. The component information systems are used at every Air Force site. Effective and efficient E&S operations improve the effectiveness of every other Air Force operation. The most important effect of disapproval of Future ESIMS from the wider Air Force perspective is the impact on support to other units, protection and maintenance of Air Force assets, and responsiveness to regulatory and Congressional requirements.

Contributing to these wider effects are the following specific functional effects within E&S:

(1) Insufficient workstations to support E&S functions

(2) Inadequate processing and storage capacity

(3) Untrained personnel

(4) Incomplete integration of E&S data resources

(5) Continued lack of interface and interoperability with other Air Force organizations

Failure to approve the C-CS requirements outlined in Section 5.2--coupled with the reductions in E&S personnel, expiration of the AMMUS contract, and increasing demand for information from the base, MAJCOM, HQ USAF, DoD, state, and Federal levels--will result in mission failure by the E&S community.

Appendices

APPENDIX A: LIST OF ACRONYMS

AAFES	Army-Air Force Exchange Service
ACOS	Automated Commissary Ordering System
ACU	Automatic Calling Units
ADCCP	Advanced Data Communications Control Procedures
ADP	Automated Data Processing
AFB	Air Force Base
AFCOMS	Air Force Commissary Services
AFLC	Air Force Logistics Command
AFMEA	Air Force Management Engineering Agency
AFESC	Air Force Engineering and Services Center
AFP	Air Force Pamphlet
AFR	Air Force Regulation
AFRCE	Air Force Regional Civil Engineers
AFSC	Air Force Systems Command
AIS	Automated Information Systems
AITI	Automatic Interchange of Technical Information
ALACS	A La Carte Food Management System
ALC	Air Logistics Center
AMMUS	Air Force Minicomputer Multiuser System
ANOVA	Analysis of Variance
ANSI	American National Standards Institute

APR	Airman Performance Reports
APUDAS	The Automated Post-attack Utilities Damage Assessment System
ARPANET	Advanced Research Project Agency Network
ASCII	American Standard Code for Information Interchange
BAQ	Base Airmen's Quarters
BCAS	Base Contracting Accounting System
BCE	Base Civil Engineer
BEAMS	Base Engineer Automated Management System
BLMPS	Base-Level Military Personnel System
BOM	Bills of Material
BOQ	Base Officers' Quarters
BPI	Bits per Inch
BPMM	Bits per Millimeter
BQ	Base Quarters
CAD	Computer-Aided Design
CADD	Computer-Aided Design and Drafting
CAI	Computer-Aided-Instruction
CAIS	Common APSE Interface Set
CALS	Computer-aided Acquisition & Logistic Support
CAM	Computer-Aided Manufacturing
CAMNET	Commissary Acquisition Management Network
CBT	Computer-Based-Training

CCITT	Consultative Committee on International Telephoney and Telegraphy
C-CS	Communications-Computer Systems
CD-ROM	Compact Disk Read Only Memory
CDCNET	Control Data Corporation Network
CE	Civil Engineering
CEMAS	Civil Engineering Material Acquisition System
CEMIRT	Civil Engineering Maintenance Inspection and Repair Team
CGM	Computer Graphics Metafile
CLNP	Connectionless Network Protocol
COCESS	Contractor Operated Civil Engineering Supply Store
CONUS	Continental United States
COTS	Commercial off-the-Shelf (Software)
CPC	Central Processing Computer
CPI	Characters per inch
CPM	Critical Path Method
CPMM	Characters per millimeter
CPU	Central Processing Unit
CSAD	Computer Systems Authorization Directory
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
CSRD	Communications-Computer Systems Requirements Document
dB	Decibels
DCA	Document Communication Architecture

DCX	AutoCAD External Representation File - Exchange Format
DCS	Deputy Chief of Staff
DDAS	Data Dictionary Analysis Support
DDN	Defense Data Network
DFMS	Data File Management System
DIF	Navy Document Interchange Format
DLA	Defense Logistics Agency
DMS	Wang Data Management System
DNSP	Domain Name Service Protocol
DoD	Department of Defense
DPSC	Defense Personnel Services Center
DTS-40	Data General Terminal
E&S	Engineering & Services
EBCDIC	Extended Binary Coded Decimal Interchange Code
ECD	Estimated Completion Date
ECR	Electronic Cash Register
EDI	Electronic Data Interchange
EEIC	Element of Expense and Investment Code
EGA	Enhanced Graphics Adapter
EIA	Electronics Industry Association
E-Mail	Electronic Mail
EMCS	Energy Monitoring Control System

EPS	Air Force Engineering Performance Standards
ESD	Electronics System Division
ESIMS	Engineering & Services Information Management System
Fax	Facsimilie Transmission
FDDI	Fiber Distributed Data Interface
FED-STD	Federal Standard
FIPS	Federal Information Processing Standard
FTAM	File Transfer, Access, and Management
FTAS	Firefighter Trans-attack Assessment System
FTP	File Transfer Protocol
FTS	Federal Telephone System
GKS	Graphical Kernel Set
GOCESS	Government Operated Civil Engineering Supply Store
GOSIP	Government Open Systems Interconnection Profile
GPSS	General Purpose Simulation System
HAZMAT	Hazardous Materials
HDH	HDLC Distant Host
HDLC	High-level Data Link Control
HQ AFESC	Headquarters, Air Force Engineering & Services Command
HVAC	Heating, Ventilating, and Air Conditioning
IAS	Immediate Access Storage
ICMP	Internet Control Message Protocol

IEEE	Institute of Electrical and Electronics Engineers
IGES	Initial Graphics Exchange Standard
IGS	Integrated Graphics System
IMP	Interface Message Processor
I/O	Input/Output
IP	Internet Protocol
IPL	Initial Program Load
IRDS	Information Resource Dictionary System
ISAM	Indexed Sequential Access Method
ISDN	Integrated Services Digital Network
ISO	International Organization for Standards
ISODE	ISO Development Environment
IWP	In-service Work Plan
JCL	Job Control Language
JCS	Joint Chiefs of Staff
KB	Kilobytes
kHz	KiloHertz
KWIC	Keyword in Context
L&E	Logistics & Engineering
LAN	Local Area Network
LAPB	Link Access Protocol - Balanced
LGSX	Logistics Information Systems Division

LOGMARS	Logistics Marking and Reading Symbol
MAJCOM	Major Command
MB	Megabyte
MBPS	Megabit per second
MFH	Military Family Housing
MHS	Message Handling System
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
MNP	Microcomm Networking Protocol
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NAFFMO	Non-Appropriated Funds Financial Management Office
NAFMIS	Non-Appropriated Funds Management Information System
NCA	Network Computing Architecture
NFS	Network File System
NIST	National Institute for Standards and Technology
NMS	Network Management System
NSA	National Security Agency
OCONUS	Outside Continental United States
OCR	Optical Character Reader/Recognition
ODP	Open Distributed Processing
OER	Officer Evaluation Reports

OJT	On the Job Training
OLVIMS	On-Line Vehicle Interactive Management System
OPR	Office/Officer of Primary Responsibility
OSI	Open Systems Interconnection
P&AG	Planning & Architectural Guidance
PACAF	Pacific Air Force
PC	Personal Computer
PCL	Printer Control Language
PCX	PC-Paint Graphic Exchange Format
PDC	Program Design and Construction System
PDN	Public Data Network
PF key	Programmable Function key
PHIGS	Programmer Hierarchical Interactive Graphics System
PMEL	Precision Measurements Electronics Laboratory
POSIX	Portable Operating System Interface
PPBS	Planning, Programming, and Budgeting System
Prime BEEF	Prime Base Engineering Emergency Force
Prime RIBS	Prime Readiness in Base Services
QAE	Quality Assurance Evaluation
RCL	Reservation Control Log
RDA	Remote Database Access
RED HORSE	Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineer

RFI	Request for Information
RFP	Request for Proposal
RGB	Red-Green-Blue
RHIMS	RED HORSE Information Management System
RPIE	Real Property Installed Equipment
RSQL	Relational Structured Query Language
SAS	Site Automation System
SBCS	Survivable Base Communications System
SBSS	Standard Base Supply System
SCSI	Small Computer System Interface
SDLC	Synchronous Data Link Control
SDNS	Secure Data Network Service
SIF	Standard Interchange Format
SIK	Subsistence-in-Kind
SIMS	Services Information Management System
SMTP	Simple Mail Transfer Protocol
SON	Statement of Operational Need
SQL	Structured Query Language
SSA	System Security Administrator
SSAN	Social Security Administration Number
SSC	Standard Systems Center
SSUP	SSA Support User Profile

SV	Services
TAC	Tactical Air Command
TCP	Transmission Control Protocol
TDY	Temporary Duty
TELNET	Terminal Network Access
TIFF	Tagged Image File Format
TPA	Transient Program Area
TSUP	Technical Support User Profile
ULANA	Unified Local Area Network Architecture
UIP	User Identification Profile
UPC	Universal Product Code
UPS	Uniterruptible Power Supply
USAFE	United States Air Force - Europe
UUCP	Unix-to-Unix CoPy
VAC	Volts - Alternating Current
VGA	Video Graphics Adapter
VNTSC	Volpe National Transportation Systems Center (Cambridge, MA)
VT-A	Virtual Terminal - Asynchronous
VT-S	Virtual Terminal - Synchronous
VTOC	Volume Table of Contents
WAN	Wide Area Network
WIMS	Work Information Management System

WORM	Write Once Read Many
WRM	War Reserve Materiel
WRSK	War Readiness Spares Kits
WSN	Wang Systems Networking
WYSIWYG	"What-You-See-Is-What-You-Get"

APPENDIX B: GLOSSARY

AMMUS contract	The contract under which the Wang hardware and software used for existing ESIMS was purchased.
Central processing computer (CPC)	A computer that accommodates multiple CPUs and provides central processing, memory, and disk storage to a local network of workstations. It is the central processing configuration required for Future ESIMS
Central processing unit (CPU)	The minimal stand-alone central computing element to which workstations, storage devices, output devices, and comunications elements are attached.
Compatibility	The ability of hardware and system software used for on application to electronically communicate with hardware and software used for cther applications.
Customers	The individuals and organizations who use the support services furnished by E&S: Air Force Headquarters (HQ USAF); the tenant organizations (i.e., the Wing Commander, et al.); the other Logistics functions (i.e., Supply, Munitions, Maintenance, and Transportation) at the base, MAJCOM, and HQ levels; and all of the permanent and transitory personnel and visitors on a base.
Data dictionary	An on-line information source that describes data elements in terms of several categories, e.g., file, file structure, name, format, and data type.

Deployability	Computer hardware that can be transported from its current location to a forward operating location, i.e., portable workstations and central computers, enclosed in shipping cases, that can be carried by two persons and transported in a jeep. This capability is essential during wartime.
End-users	E&S personnel who use ESIMS to perform their mission-directed functions and to satisfy the demands of E&S customers.
ESIMS	The umbrella concept that encompasses the various information systems used by E&S personnel.
ESIMS node	The basic ESIMS organizational hardware element. It includes a central processing resource (a super minicomputer in AMMUS ESIMS; a CPC in Future ESIMS) that serves networked workstations in a local star configuration and has communication links to other functional communities. Each installation has a node for each of its E&S functional communities: CE, SV, and MAJCOM.
Generic workstation	A stand-alone terminal with independent processing capability, memory, and disk storage that can perform data processing, word processing, business graphics, engineering graphics, and cash transactions by merely adding or subtracting hardware and/or software applications.
Graceful degradation	The ability to continue essential computer functions when hardware is damaged by transferring the functions to other available equipment or by reducing the level of performance while preserving the essential functions. Hardware being used for less essential functions can be used as replacements for damaged equipment or to

	restore processing performance. This capability is essential during wartime.
Interchangeability	The ability to exchange hardware items that are used for different functions by adding or subtracting peripherals or software. Interchangeable hardware is needed for graceful degradation.
Interoperability	An information system's ability to electronically exchange information with other information systems. This capability is essential during wartime.
Open architecture	A computer systems design where all of the component application systems are interoperable and all system hardware and software is compatible.
Peel-down architecture	The use of modular computer hardware that allows users to gradually remove less critical loads while maintaining necessary functionality. This capability is essential during wartime.
Ports	Connections on a central processing computer for workstations, printers, and other devices.
RED HORSE squadrons	A highly mobile, rapidly deployable force of heavy engineers who install critical utility and support systems needed to initiate and sustain operations in remote and often hostile locations.
Redundancy	The ability to replicate data files across separate systems (i.e., duplicate databases and multiple communication channels), ensuring data currency if the system is taken off line. This capability is essential during wartime.
RJ-11C	A remote jack with common telephone 6-pin wall receptacle definition.

RS-232C	EIA electrical specification for attaching serial devices to data communications equipment (9-pin and 25-pin).
Ruggedized hardware	Hardware that can withstand extremes in temperature, humidity, and other environmental forces. Ruggedization includes insulated, shock absorbent carrying and storage cases for all computer equipment. All hardware used during wartime must be ruggedized.
Super minicomputer	The AMMUS computer that provides central processing, memory, and disk storage to a local network of workstations. It accommodates only one CPU.
Technologists	The E&S hardware, operating system, system applications, database, and communications experts who select and implement technology to provide the appropriate quality of service, transparency mechanisms, information storage, application portability support, network structures, security mechanisms, and user-access facilities.
Tagged Image File Format	The compression algorithm for bit-image graphics. Group 3 is the fax format.
TYMNET	A commercial packet network service used as a substitute for DDN, particularly in communications with Great Britain AFRCE.
Uninterruptible power supply (UPS)	An alternate source of power that is independent of the standard commercial electrical power supply. It is activated during power brownouts and outages to ensure a continuous power supply to prevent interruptions in computing. UPS is essential during wartime.
Unix-to-Unix CoPy (UUCP)	A set of support programs that permit transfer of Unix E-mail between different Unix networks.

APPENDIX C: INDEX

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