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PHASE TWO  
GIT/EES PROJECT NO. A-2659  
H. Bennett Teates - Project Director

**ADVANCED INFORMATION SYSTEM RESEARCH PROJECT**

By  
Edward J. Shanahan, Jr., Computer Science and Technology Laboratory  
James P. Coleman, Jr., Computer Science and Technology Laboratory

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DEPARTMENT OF THE ARMY  
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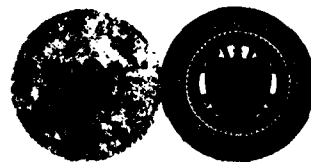
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ADVANCED INFORMATION SYSTEM RESEARCH PROJECT

Phase Two

Final Technical Report

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Edward J. Shanahan, Jr., Computer Science and Technology Laboratory

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GIT/EES Project A-2659  
H. Bennett Teates - Project Director

November 1980

Prepared for

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#### ACKNOWLEDGEMENTS

This report represents the cumulative efforts of several individuals who contributed to the project. In particular, it is worthy to note Donovan B. Young, School of Industrial and System Engineering, who participated in the definition of AEDs, developed the benefit analysis, constructed the survey, and assisted in the final evaluation of Advanced Experimental Demonstrations.

H. Bennett Teates  
Project Director

## ABSTRACT

The Advanced Information System Research Project is a long-term effort to develop a sound technical, economic, and military basis for the study of future (1985+) information systems for the U.S. Army. Phase One of the report identified research issues which must be investigated to assist in the fielding of or future systems. Phase Two designed and developed Advanced Experimental Demonstrations (AEDs) to display a narrow capability with inference of Army-wide use. Thirteen AEDs were established and their benefit and cost measured. The project concluded with a five-year plan consisting of five AEDs and recommendations for implementation.

### Key Words

Information System

Advanced Experimental Demonstration

Combat Service Support

Use-Learn-Development Cycle

Distributed System

Test Bed

Technology Infusion

## EXECUTIVE SUMMARY

Phase One of the Advanced Information System (AIS) Research Project concluded that to develop a sound technical, economic, and military basis for Army Information Systems (IS) of the post-1985 period, AIRMICS should:

- o Adopt the Advanced Experimental Demonstration (AED) method for support of technical investigations and to assure that results are available to users, developers, designers, and appropriate agencies in the post-1985 period.
- o Study identified research issues to determine those with the greatest impact in the Army's need in the post-1985 period.
- o Develop a plan to investigate these issues in depth using the vehicle of AEDs.

The purpose of Phase Two was to conduct an evaluation of potential AEDs candidates which could support advanced information system research issues and demonstrate the utility of new information system concepts and technology; select those demonstrations which indicate the greatest return for the effort; and interlink those selected into a five-year AIS program.

Thirteen AEDs were generated, defined, and evaluated to possibly enhance the Army's knowledge on research issues identified during the Phase One.

These AEDs were reviewed by a group of users and developers to determine those most beneficial to the Army. A benefit to cost relationship was established to rank and select the optimum AEDs.

Benefit of each AED was measured according to five dimensions: (1) direct usefulness to the Army; (2) technical opportunity; (3) generality of the demonstration, (4) relevance of the project to AIRMICS; and (5) life-cycle favorability. Data used in employing these dimensions were primarily derived from user and developer responses to a questionnaire. Other data was obtained by visits to Army installations and interviews with Army decisionmakers and planners. Cost data were obtained by an interactive process of estimating time and monies needed to complete the AED, review of these estimates with peers and project managers of similar projects, and development of further estimations.

A five-level screening process was established to reduce the original 13 AEDs to a manageable set. Criteria used in this process were:

- o AIRMICS relevance;
- o Level of interest of users and developers;
- o Benefit as expressed by the user and developer community;
- o Redundancy; and
- o Low cost to benefit

The employment of this process resulted in the selection of five AEDs for development. These AEDs are:

- o SDD-1 Applied to Army CSS;
- o CSS Information System Availability;
- o Summary Data Base for Corps Commander's Required Information Needs;
- o DBMS for Corps Commander's Required Information Needs; and
- o Division Ammo Requirements DSS.

The level of funding anticipated to complete the AEDs was unknown to the project team. However, three levels ranging from \$1000K to \$2000K over a five-year period were estimated to determine which AEDs should be undertaken. Finally, a model of a five-year plan was postulated for the five selected AEDs based on a \$2000K level of funding.

The effort also keynoted two essential elements of the AIS Research Project: appropriate budgeting and procedures for periodically announcing the results of AEDs. Budgeting is more than obtaining approval to obligate the amount of monies needed to undertake the AEDs. Control of the budget is essential if the AIS Research Project is to meet its goals. AEDs will incur difficulties during the three stages leading to their completion. AIRMICS must be willing and able to terminate those AEDs doomed to failure and add monies to those having problems, but potentially successful.

The purpose of AEDs is to accomplish research on an appropriate subject which has impact on the Army user and developer communities. Procedures must be established to continue the relationships developed with these groups during both phases of the AIS Research Project and to enlarge upon these contacts. Frequent broadcast letters, briefings, visits and other such methods should be used to accomplish this aim.

Based on the study conclusions, it was recommended that AIRMICS should:

- o Obtain funding required to undertake the selected AEDs.
- o Work to establish suitably flexible budget control in order to act, based on sound managerial procedures, to research situations which arise during the implementation of the AEDs.
- o Award contracts, competitively or by sole-source selection, to appropriate universities, contractors and other agencies to assure the development of the AEDs.
- o Continue to develop the contacts established during both phases of the AIS Research Project. In particular, close relations with the Director, Army Research (Dr. Lasser); Director, Army Center for System Engineering and Integration (Mr. Diedrichsen); Combined Arms Center Development Activity (Mr. Mahoney); and personnel at the Defense Applied Research Projects Agency and Army Logistics Center are essential to the success of the AIS Research Project.
- o Establish procedures by which information obtained during all stages of the AEDs can be announced to the user and developer communities.

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# ADVANCED INFORMATION SYSTEMS RESEARCH PROJECT

## Phase Two Final Report

### 1.0 INTRODUCTION

#### 1.1 Background

The Army Institute for Research in management information and computer Science (AIRMICS) is the research arm of the U. S. Army Computer Systems Command. In August 1978, AIRMICS recognized the need to initiate a long-term effort to develop a sound technical, economic, and military basis for the support of U. S. Army information systems (IS) in the post - 1985 period. Phase One of this effort, termed the Advanced Information System (AIS) Research Project, was completed in June 1980. Results of this phase indicate that:

- o Current Army information systems were developed to meet peacetime vice wartime roles. As such, they are not responsive to the requirements of the commander and his staff in combat.
  
- o Perceived needs of Army personnel to meet wartime information requirements on the battlefield can be met by interactive, on-line systems. These systems require flexibility, may have distributed processing and storage schemes, and are highly communications dependent.

- o Information systems are not a replacement for the individual. Rather, they must be developed to support him by relieving him of tedious repetitive tasks and by providing quick, multi-formatted information to support the decision process.
  
- o Current laws, rules, and regulations are not in themselves barriers to effective IS implementation. However, a process more amenable to the necessary evolution of system requirements may be a coordinated program of research, development, test, and evaluation in a use-learn-develop cycle (see figure 1-1). This process can be achieved by the establishment of mini-test beds, termed Advanced Prototype Demonstrations, where design issues can be investigated and results disseminated to appropriate agencies.
  
- o There has been substantial advancement in technology required to meet the needs of future Army information systems. However, numerous issues still must be resolved prior to the fielding of these systems. Such issues are:
  - o System interface between command and control and combat service support;
  
  - o Multiple echelon reporting techniques (organization/operational structure and the techniques to directly access information from its resident area and provide it to the decisionmaker while keeping other pertinent echelons informed);

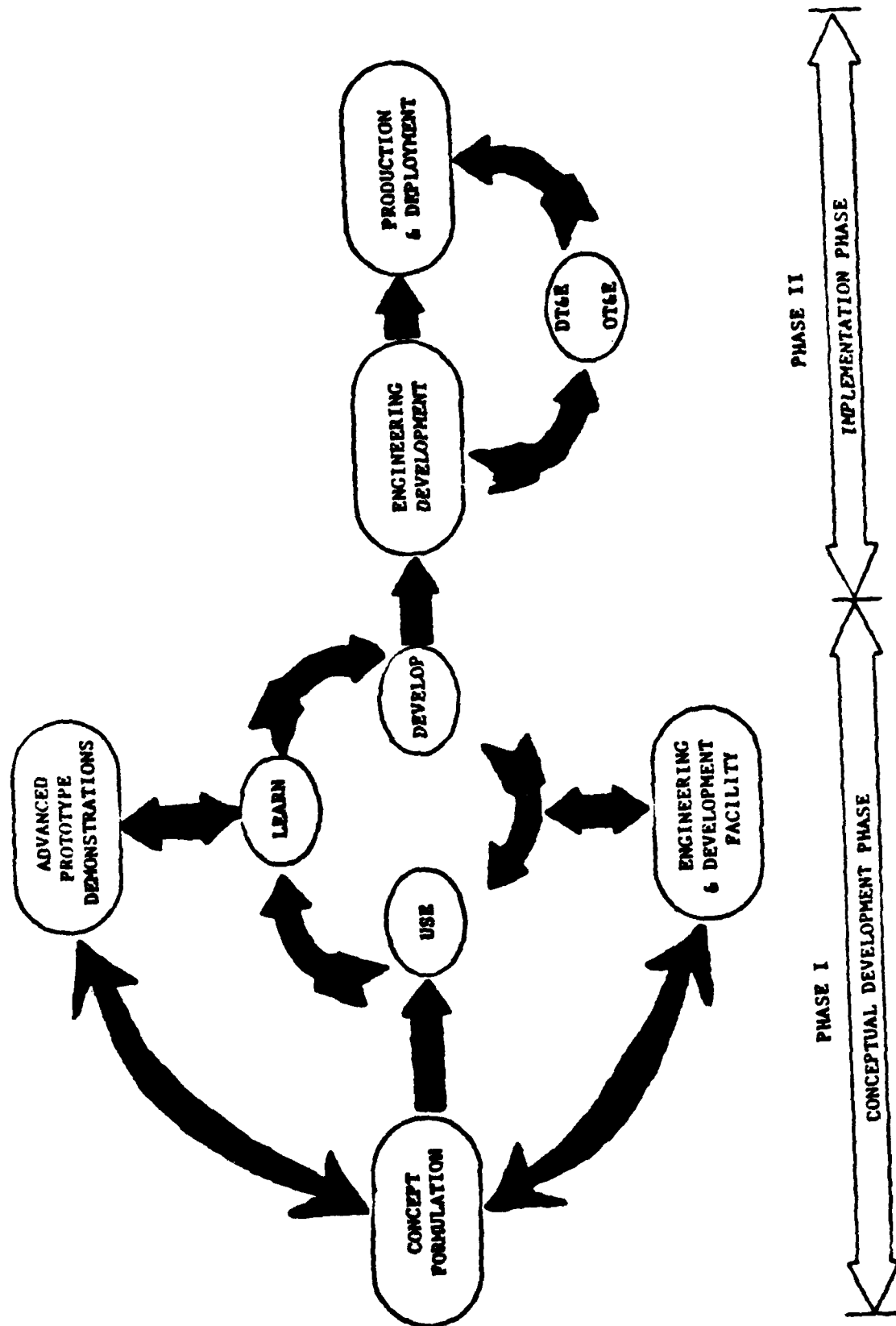


FIGURE 1.1 ADVANCED INFORMATION SYSTEM DEVELOPMENT.

- o Digital communications requirements (nodes requiring digital communications, the size of the links required and the techniques by which information may be transferred from node to node and from user to user);
- o Information system network analysis (topology, degree of distribution, need for and size of storage and the techniques inherent to distributed operating system network control);
- o Network security (data preservation of both data and operating system security);
- o Modern continuity of operations (alternate routing, distribution of data functions, redundancy of data and functions and hardening against shock, temperature and electromagnetic threats);
- o Future data base management systems (types of data, the structure of data files and kind of data retrieval required to support interactive, on-line ISs);
- o Decision support system applications (information, algorithms and presentation needed to support the decisionmaker in real-time battlefield environments);  
and

- o Input/output requirements (techniques for accomplishing input/output as a natural part of job completion with modern devices).

The study concluded that to develop a sound technical, economic, and military basis for Army ISSs of the post - 1985 period AIRMICS should:

- o Adopt the Advanced Prototype Demonstration (APD) method for support of technical investigation and to assure that results are available to users, developers, designers, and appropriate agencies in the post-1985 period.
- o Study the research issues listed above to determine those with greatest impact on the Army's needs in the post-1985 period.
- o Develop a plan to investigate these issues in depth using the vehicle of APDs.

## 1.2 Purpose

The purpose of Phase Two was to conduct an evaluation of potential APD<sup>1</sup> candidates which could support advanced information systems research issues

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<sup>1</sup>During Phase Two, the term "Advanced Prototype Demonstration" or "APD" was changed to "Advanced Experimental Demonstrations" or "AED". This change was caused by the misconception generated by the use of the word "prototype", indicating the original model on which something is patterned rather than the research nature of the project. "Advanced Experimental Demonstration" or "AED" will be used throughout the remainder of this report.

and demonstrate the utility of new information system concepts and technology; select those demonstrations which indicate the greatest return for the effort; and interlink those selected into a five-year AIS program. Collectively, the results of this phase form the foundation for the development of AED functional specifications.

Although not an explicit task of Phase Two, the need to generate, define and evaluate AEDs required an in depth understanding of Army battlefield automation plans and the need to develop a customer base as well as doctrine and technical base for potential AED implementation.

Phase Two of the AIS Research Project commenced in May 1980, with a visit to Fort Leavenworth, Kansas. During that visit, representatives of the Combined Arms Combat Development Activity (CACDA), an agency of the Training and Doctrine Command (TRADOC), (specifically the Command, Control, Communications and Intelligence Directorate) agreed to participate in the development and implementation of AEDs.

### 1.3 Combined Arms Combat Development Activity

The Combined Arms Combat Development Activity (CACDA) is charged with the determination of system requirements for maximizing effectiveness of the Army through development of concepts, doctrine, organizations, and material requirements within the functional areas of combat, combat support, and command and control for organizational echelons of brigade, division and corps.

A current CACDA project is the identification of requirements for the Tactical Army Command and Control System (TACCS). TACCS is the basis of control of ground combat and centers around five discrete areas of responsibility, identifiable by functions performed: maneuver control; fire support; air defense; intelligence/electronic warfare; and combat service support (CSS). Each of the functional areas have operational facilities which manage, coordinate, and process information for their respective areas. A phased plan to develop an integrated TACCS over the next decade has been proposed. The phasing includes placement of standard equipment in test bed configurations, prototype fielding, and finally, objective system fielding.

During Phase One, the functional area of CSS was selected as the area requiring the greatest need for improvement in ISs and the focal point for the generation and definition of AEDs. A major reason for using CSS as the focal point for deriving AED requirements is that the U.S. Army Computer Systems Command, the parent organization of AIRMICS, concentrates its work in this area. Phase Two continued on this thrust by also addressing CSS functions.

One of the key conclusions of Phase One was the identification of the need for interactive, on-line systems to meet wartime information requirements on the battlefield. Thus, the Phase Two development effort to generate and define demonstrations was aimed at meeting this need in support of the CSS function.

#### 1.4 Organization of the Report

This report is divided into the following sections:

- o Research Methodology;
- o CSS Distributed System;
- o AED Identification;
- o Survey Results;
- o Cost/Benefit Analysis;
- o Five Year Plan;
- o Conclusions;
- o Recommendations; and
- o Appendices.

Section 2 addresses the methodology used to progress from the research issues identified in Phase One to the establishment of a Five-Year Plan. The CSS Distribution System, Section 3, is the postulation of an on-line distributed system to support battlefield combat service support functions at organizational levels of corps, division and brigade. Section 4 introduces the AED format and indicates the rationale for the establishment of the set of AEDs. A questionnaire, survey results and data concerning potential AEDs with supporting rationale are presented in Section 5. A cost/benefit analysis is in Section 6, along with the relative ranking of AEDs. The key element of the report is the Five-Year Plan which for AED program support is presented in Section 7. Included in this Section 7 is a discussion on sources of support and life-cycle strategy. Conclusions and recommendations are in Sections 8 and 9, respectively. Appendices A through C contain the set of AEDs, a sample of the questionnaire, and calculations based on the replies to the

questionnaire. Appendix D is survey information on the selected AEDs and Appendix E is the bibliography.

## 2.0 RESEARCH METHODOLOGY

### 2.1 General

Phase Two was divided into four tasks:

- o Research issue selection;
- o AED concepts and selection;
- o Five-year program plan development; and
- o Project management and report.

Methods used to meet the requirements of these tasks were:

- o Visits;
- o Analysis;
- o Rating of benefits;
- o Cost establishment; and
- o Survey techniques.

### 2.2 Visits

During the project, visits were conducted with individuals and groups to derive their opinions concerning the relative importance of research issues, to solicit their comments on the "use-learn-develop" concept which led to the establishment of the AED approach, and to receive feedback concerning draft AEDs. Visits were invaluable as the interchange of ideas

resulted in the generation of many of the AEDs. More importantly, discussions during these visits enabled team members and AIRMICS personnel to become aware of the Army's approach towards developing battlefield IS, particularly TACCS. The following visits and interviews were conducted:

<u>Date</u>	<u>Unit/Agency</u>	<u>POC</u>
28-30 May 1980	U. S. Army Combined Arms Combat Development Activity (Fort Leavenworth, Kansas)	Mr. Dennis Mahoney
18 July 1980	Center for System Engineering and Integration (Fort Monmouth, NJ)	Mr. L. Diedrichsen
11 August 1980	U. S. Army Research Institute for the Behavioral and Social Sci. (Alexandria, VA)	Mr. R. Sidorsky
11 August 1980	Defense Advance Research Project Agency (Washington, DC)	CDR J. Dietzler Dr. V. Cerf
13 August 1980	U. S. Army Signal Center (Fort Gordon, GA)	Col. R. Saunders
28 August 1980	U. S. Army Computer Command Support Group (Fort Lee, VA)	Col. Black
28-29 August 1980	U. S. Army Logistics Center (Ft. Lee, VA)	Mr. H. Wilvert Ltc. R. C. Glidden

### 2.3 Analysis

In order to put the generation and evaluation of candidate AEDs on a sound analytical basis, several analysis efforts were undertaken.

First, it was recognized that a specific baseline or objective IS is needed to be assumed in order to have a framework in which to place AED

candidates in their working environment. An on-line, distributed CSS system for corps, division, and brigade levels was postulated, taking into account the changing procedures in CSS and other TACCS functions, as indicated by Phase One investigations and Phase Two visits to Army requirement generators and system developers. The postulated type system is detailed in Section 3, along with the analytical methods used to establish it.

Next, it was realized that the research issues needed refinement and clarification in order to be useful for evaluating AEDs. Research issues were further investigated as described in Section 2.3.1. The results of further research-issue analysis were not formally used in evaluations, since evaluations were conducted considering each AED on its own merits, but the applicability of each AED to research issues was part of the benefit analysis.

Analyses in support of generation of AED candidates are described in Section 2.3.2 and Section 4.

The cost-benefit analysis which was used to screen, prioritize, and rank AEDs is presented at length in Section 6. Basically, the benefits and costs of each AED were estimated and compared, and finally, in order to derive the five-year plan, portfolio analysis was performed to select the best set of AEDs under various budgetary assumptions, to maximize the total estimated benefit given a budgetary limit.

2.3.1 Research Issues. An orthogonal approach of investigating the research issues was used to clarify the nature and extent to which issues are interrelated and to determine a priority ranking of these issues. The effort

centered on the construction of a matrix where the row entry "is contingent upon" the column entry. Figure 2-1 is an example of the matrix used.

Three iterations were used with the aim of arriving at a presorted list. The first addresses the interrelationship of the issue based on an assessment of whether a logical dependency exists between corresponding row and column items. If issues were found for which no dependency existed, then a state of independence was assumed.

To gain insight into the extent of dependency, a second matrix was constructed to show logically how a system-wide increase in one issue influences the performance level of others.

Finally to prioritize the issues, tradeoffs were made in a pair-wise fashion. The relationship was posed in the form of a question - "Assuming a given amount of funding is a reduction in funding of [row] acceptable if necessary to achieve a commensurate increase in funding [column]?" Results were converted into a cumulative assessment of each issue's perceived importance.

Although this exercise failed to produce a definitive ranking of research issues, the method of investigation was valuable to the project as it required further discussion to resolve differences of interpretation of research issues. Thus, it resulted in a greater understanding of the issues themselves, particularly the potential depth of any issue. Furthermore, it caused the team to concentrate on the AEDs themselves as they were more

	C <sup>2</sup> /CS <sup>2</sup> SYSTEM INTERFACE	MULTIPLE ECHELON REPORTING	DIGITAL COMMUNICATION	NETWORK ARCHITECTURE	NETWORK SECURITY	CONTINUITY OF OPERATIONS	DATA BASE MANAGEMENT	DECISION SUPPORT SYSTEM	INPUT/OUTPUT
C <sup>2</sup> /CS <sup>2</sup> SYSTEM INTERFACE	■								
MULTIPLE ECHELON REPORTING		■							
DIGITAL COMMUNICATION			■						
NETWORK ARCHITECTURE				■					
NETWORK SECURITY					■				
CONTINUITY OF OPERATIONS						■			
DATA BASE MANAGEMENT							■		
DECISION SUPPORT SYSTEM								■	
INPUT/OUTPUT									■

FIGURE 2-1

narrowly defined and easily understood in terms of applied technology and U.S. Army field use.

2.3.2 AED Establishment. AED analysis was based on the need to define a demonstration with a narrow capability with an inference to Army-wide capability. Specifically, the AED definition is the expression of a demonstration of a capability to perform a military function, given a series of constraints, e.g., environment, user, and equipment. Thus, the analysis concentrated on review of documentation on military procedures such as field manuals, concept papers and battlefield automation plans. Section 4 addresses AED establishment in more detail.

2.3.3 Five-Year Plan Development. The five-year plan consists of the interlinking of selected AEDs into a single program with established milestones. Analysis methods were primarily aimed at researching sources of technological and managerial support and determining potential life-cycle strategy, such as performance measurement, contract technique and AED termination procedures.

## 2.4 Benefit Rating

A five dimensional scheme of evaluation was developed to determine the value of candidate AEDs. (See figure 2-2.) An AED can be rated within this framework in terms of: (1) desires of the Army; (2) sensible technical contribution to the overall AIS program; (3) fit with AIRMICS goals; and (4) promise as to a favorable research and development life-cycle; and (5)

Title and description of research feasibility evaluation dimension	Indicators	Controls	Questions
<p>1. <u>Direct benefit to Army.</u> (A beneficial research project must address a desired goal as perceived by informed respondents, as well as provide capabilities actually or potentially needed.)</p>	<p>Survey of desires of potential users, given candidate descriptions.</p>	<p>Consistency of responses between individuals and between redundant indicators. Extent of understanding of descriptions. Army publications.</p>	<p>Do Army sources agree?  Do the issues make sense?  How is the function now performed?</p>
<p>2. <u>Technical opportunity.</u> (A good technical opportunity for research must not have been done before, must now be possible, must not duplicate other effort.)</p>	<p>Independent verification of activity importance.  Professional judgement.</p>	<p>Literature, peer review, military review</p>	<p>Is it analogous to successful efforts? What assumptions indicate success?</p>
<p>3. <u>Generality.</u> (A good candidate may have side benefits in generating results useful in another part of the AIS program.)</p>	<p>Tradeoff analysis among issues (tables of interdependence, etc.). Specific side benefits.</p>	<p>Consistency of responses between individuals and between redundant indicators.</p>	<p>How will the results from this candidate help the entire project?</p>
<p>4. <u>AIRMICS relevance.</u></p>	<p>AIRMICS guidance.</p>	<p>Ability to fit the candidate naturally within AIRMICS program.</p>	<p>How will the candidate's ultimate contribution fit into the future Army?</p>
<p>5. <u>Life cycle favorability.</u></p>	<p>Ability to forecast a probable life cycle outline. Estimation of future benefits.</p>	<p>Peer review, military review.</p>	<p>How will the candidate's ultimate contribution fit into the future Army?</p>

FIGURE 2-2

probable successful integration of new IS elements into Army procedures and operations.

For each dimension of evaluation, subjective and objective indicators and controls were chosen to measure how well a candidate AED rated along a given dimension.

### 2.5 Cost

Cost estimates were derived based on a top-down method of deriving costs. Items considered in establishing the estimates were hardware, personnel and material items expressed in dollars. Material items included expected purchases by contractors other than computer hardware. Identified, but not costed, were government furnished equipment necessary to conduct an AED. Cost was broken into three time periods: design of the AED; development; and conduction of the demonstration prior to turn-over or extermination.

### 2.6 Survey

To assess the benefits of implementing a candidate AED, a survey was generated. (See Appendix B for sample.) The survey solicited responses from researchers and military personnel with respect to four of the dimensions discussed in paragraph 2.4, namely, benefit to the Army; technical opportunity; generality; and life-cycle favorability. Because of the small sample, non-randomness of the selection of participants and uncontrolled nature of the sampling technique, statistical inference of this survey was not appropriate. On the other hand, it contributed significantly to AED insight

### 3.0 CSS DISTRIBUTED SYSTEM

#### 3.1 General

For the purpose of providing a backdrop for the establishment of AEDs, a distributed CSS system was postulated. Below is a description of a type system rather than the solution to specific CSS requirements. The system was not coordinated with, nor has it received the approval of, either CACDA or the U.S. Army Logistics Center (Fort Lee, Virginia).

#### 3.2 Postulated System

Chapter 6 (Combat Service Support Operations) of Field Manual 71-100 (Armored and Mechanized Division Operations) was the basis for the system definition. Three levels of organization within the CSS domain were examined: corps, division, and brigade. Combat Service Support functions addressed are: arming, fueling, repair and recovery, supply, transportation, service, medical, weapons system replacement, and command and control of CSS functions. Activities of each function are listed in figure 3-1.

An interrelationship analysis of the nine functions was conducted. The relationship was established by answering the question: "Does the function in the row depend on the function in the column?". The results of this effort are displayed in figure 3-2.

Each of the functions at the respective organizational levels were assigned computer configurations corresponding to the discussion in Section

COMBAT SERVICE SUPPORT  
ACTIVITIES FOR AUTOMATION SUPPORT

Combat Service Support Functions	Corps	Division	Brigade
I. Arming	- Ammo supply points	- Ammo supply points	- Ammo supply points
II. Fueling	- Fuel disposition points	- Fuel disposition points	- Fuel disposition points
III. Repair and Recovery	- Collection points - Gen SPT repair units - Class IX parts supply - Corps maint mgmt center	- Collection points - Repair battalion - Missile support - Trans aircraft maint	- Collection points - Forward support units - Class IX parts supply
IV. Supply	- Multiclass supply points - Class I supply pts	- Multiclass supply pts - Class I supply pts	- Multiclass supply pts - Class I supply pts
V. Transportation	- Corps movement control	- Div movement control ofc.	- Not automated
VI. Service	- Not automated	- Not automated	- Not automated
VII. Medical	- Med combat spt hosp	- Medical battalion	- AID station
VIII. Weapons System Replacement	- AG company	- AG company - DISCOM	- Not automated - DISCOM
IX. CSS C2	- COSCOM	- DISCOM	- FASCOM

Figure 3-1

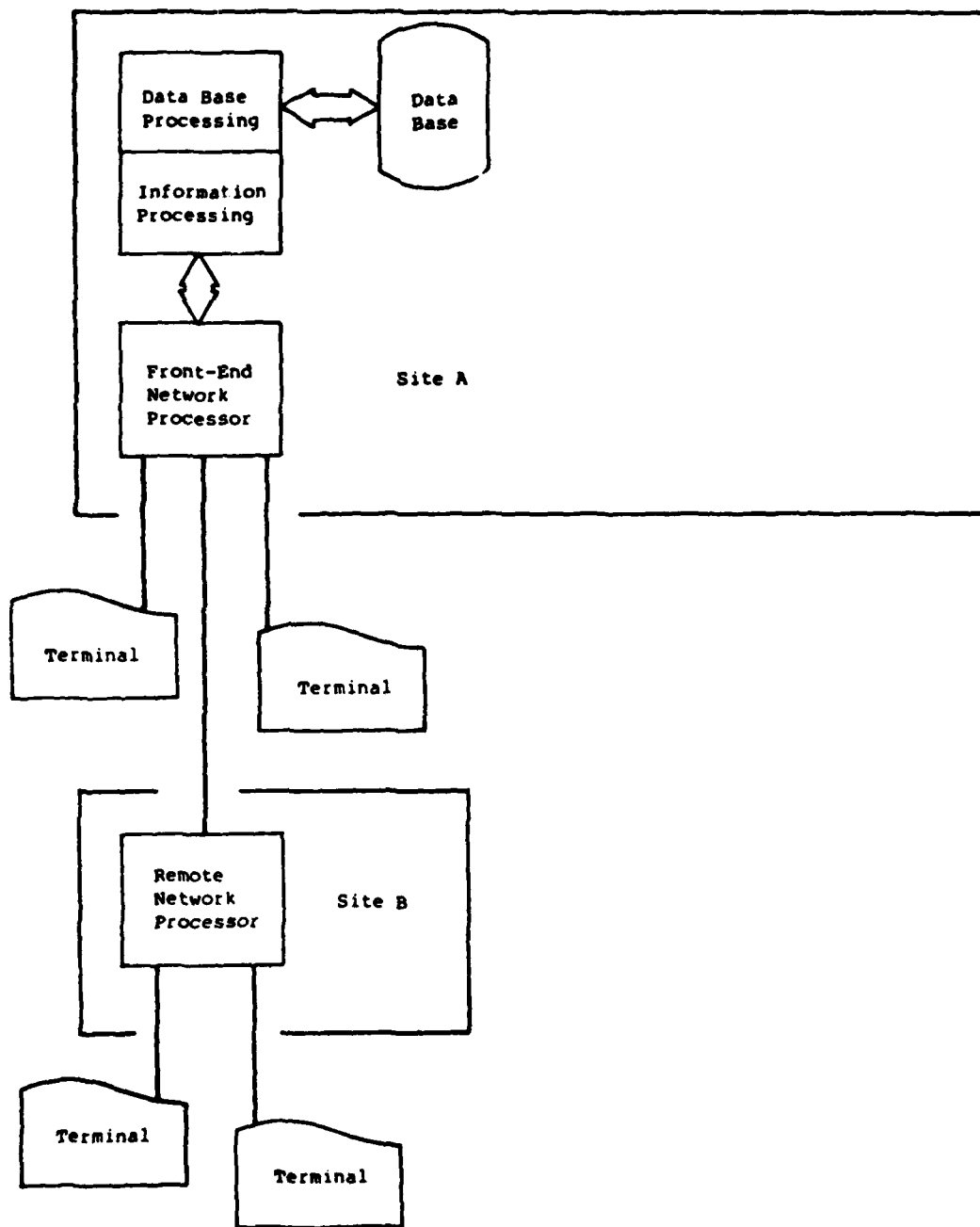
Combat Service Support System - Functions Interrelationship

	Arming	Fueling	Repair and Recovery	Supply	Transportation	Service	Medical	Weapons System Replace	CSS C <sup>2</sup>
Arming		No	No	No	Yes	No	No	No	Yes
Fueling	No		No	No	Yes	No	No	No	Yes
Repair and Recovery	No	No		No	Yes	No	Yes	Yes	Yes
Supply	No	No	Yes		Yes	Yes	Yes	Yes	Yes
Transportation	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Service	No	No	No	Yes	Yes		No	No	Yes
Medical	No	No	Yes	Yes	Yes	No		Yes	Yes
Weapons System Replace	No	No	Yes	Yes	Yes	No	Yes		Yes
CSS C <sup>2</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Figure 3-2

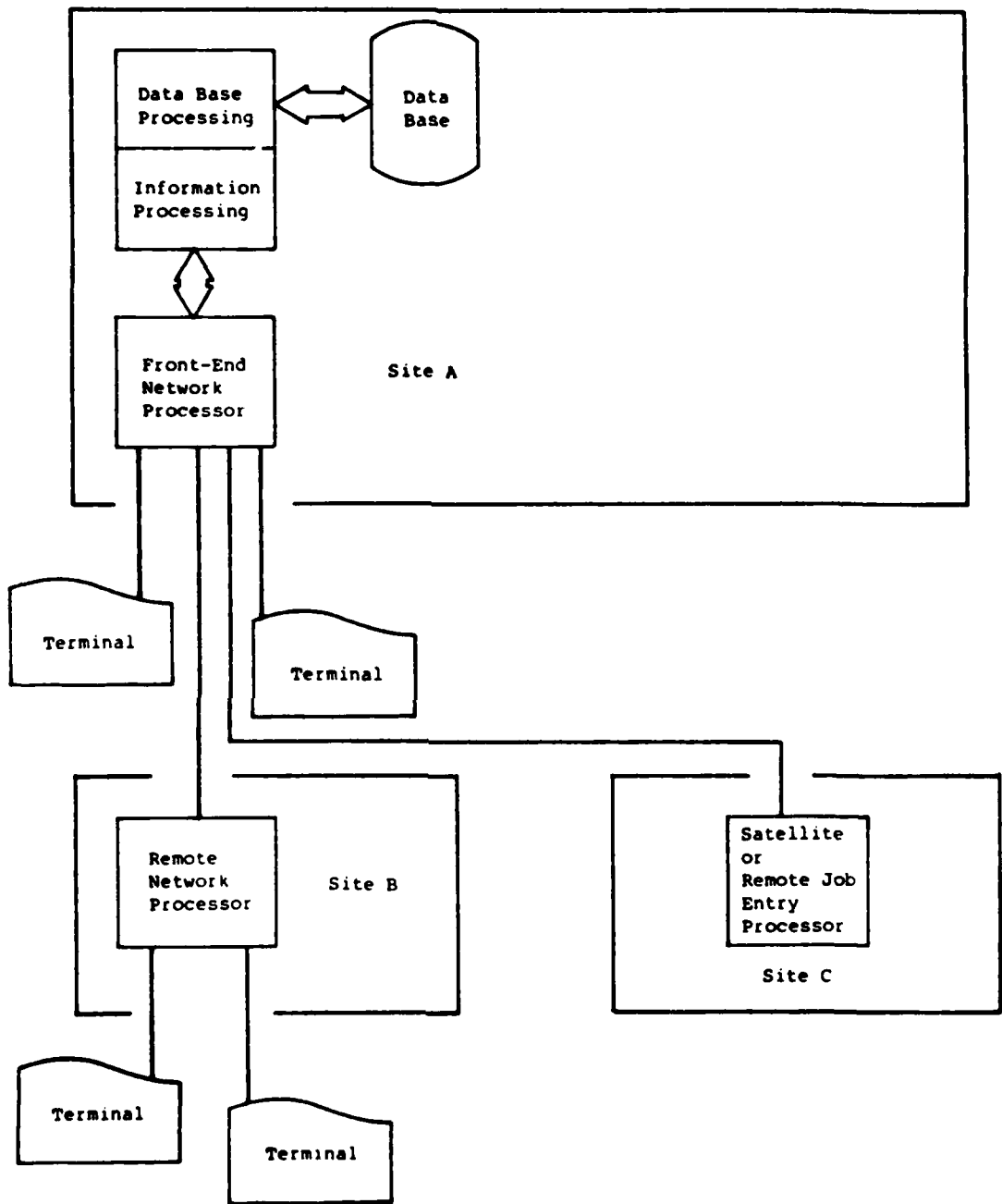
2.0 of the Phase One Final Report. This section uses Becker's description of all automated systems as having the basic functional sets of information processing, network processing, and data base processing. He defines information processing as the manipulation (by application programs) of information to produce the desired results. Network processing is the control of information movement between the various locations (nodes) of the network. Data base processing is the storage of quantities of information in one or more forms available to the network and its users. Using this definition, figures 3-3 through 3-5 illustrates examples of partially distributed, semi-distributed, fully distributed systems.

The postulated CSS distributed system is displayed at figure 3-6. Those functions requiring computer support at corps and division levels are arming, fueling, medical, supply, repair and recovery, transportation, weapon system replacement and CSS command and control (represented as COSCOM and DISCOM.) At brigade level, functions with computer support are arming, fueling, medical, supply, repair and recovery, and CSS command and control (FASCO). The information interrelationship within each level is represented by solid lines. (Note that arming and fueling are basically independent with only a relationship with transportation and CSS command and control functions.) An interlevel connectivity is recognized between common functions at each level but not represented in the figure for clarity. The small numbers at each function represent the type computer configuration expected to support information processing and described in figures 3-3 through 3-5. (In other words, the number 3-5 on the system diagram in figure 3-6 represents a fully distributed system as illustrated in figure 3-5.)



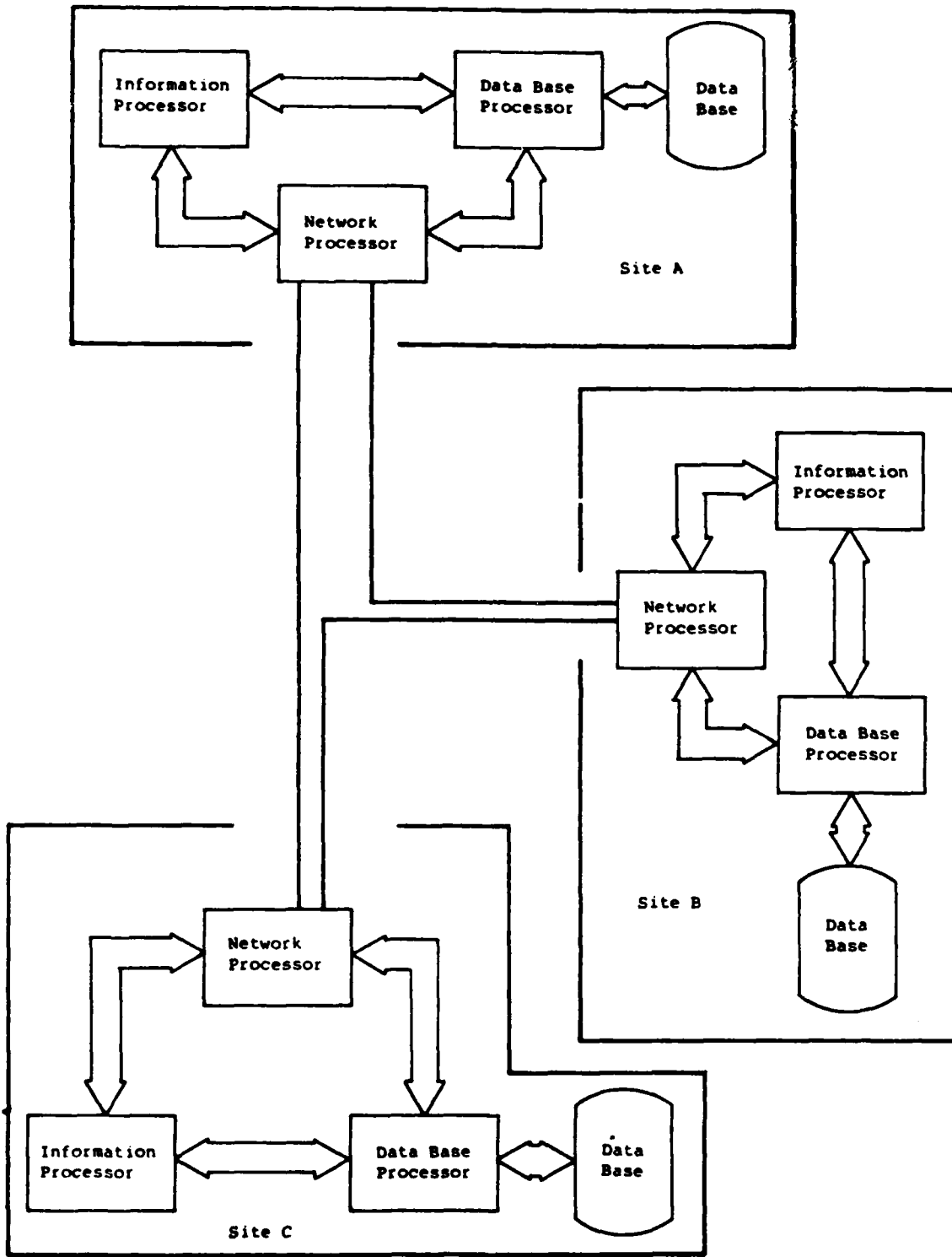
Partially Distributed

Figure 3-3



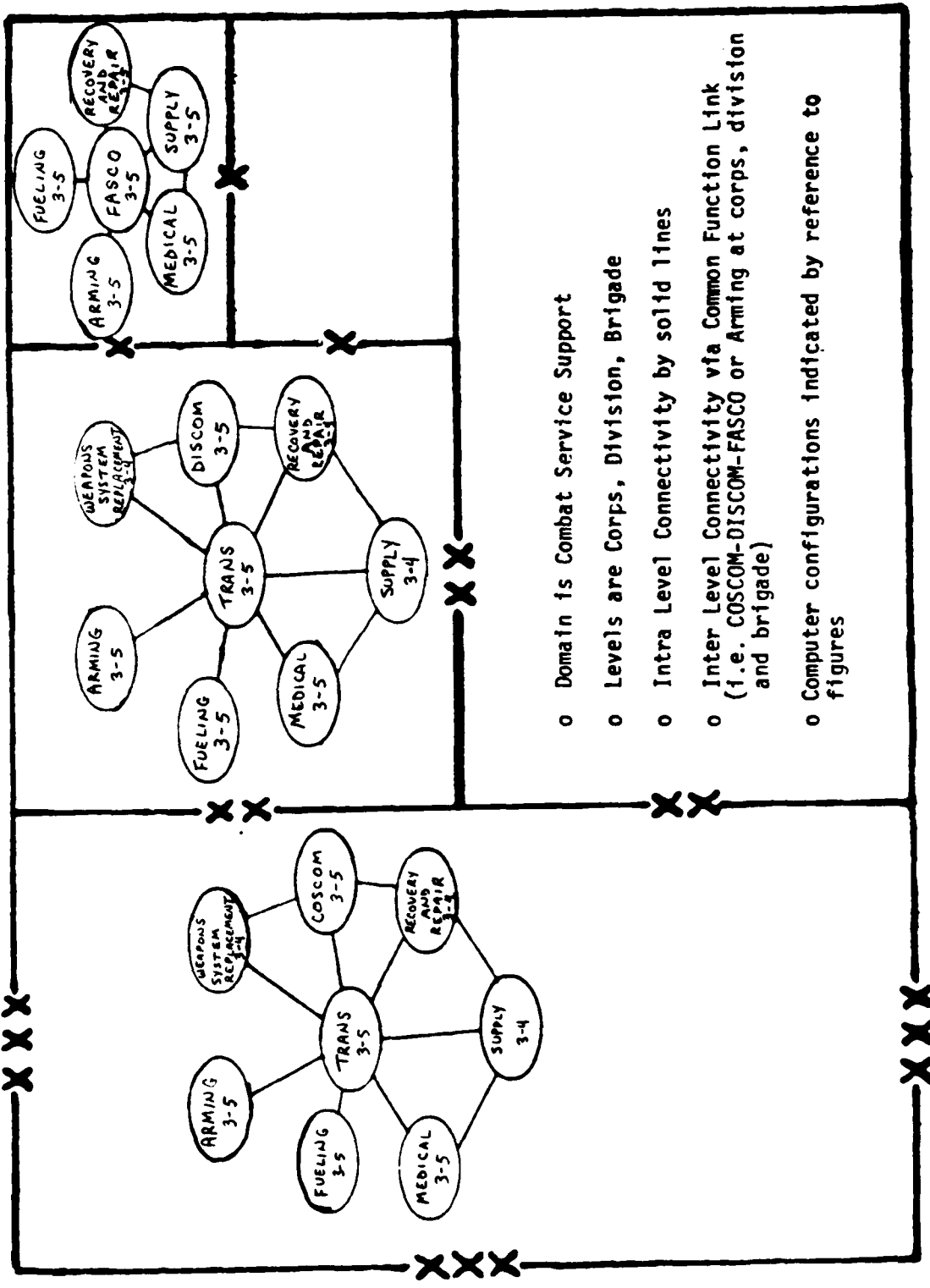
Semi-Distributed

Figure 3-4



Distributed

Figure 3-5



- o Domain is Combat Service Support
- o Levels are Corps, Division, Brigade
- o Intra Level Connectivity by solid lines
- o Inter Level Connectivity via Common Function Link (i.e. COSCOM-DISCOM-FASCO or Arming at corps, division and brigade)
- o Computer configurations indicated by reference to figures

Figure 3-6

## 4.0 AED IDENTIFICATION

### 4.1 General

Identification of candidate AED's proceeded from the governing purpose, "to demonstrate a narrow capability with inference to Army-Wide capability." The AED's were to describe a specific, narrowly defined, need where the demonstrated ability to solve that need paves the way for the solution of related problem. The AED method promises to a speed up of the process of converting ideas to capability; a faster means to technology transfer. The needs and direction of the Army concerning battlefield automation were researched from Army documents, both current and historical; from interviews with members of both the research community and user representatives; and from conferences. The publications used included doctrine from field manuals and regulations, battlefield automation plans, concept papers from a variety of sources, and technical specifications on selected computer and communications equipment. A bibliography of these publications in Appendix E.

Two approaches were used in identifying areas to infuse technology. On the one hand is the application of existing techniques and proven technology to the needs of the Army and, on the other is the identification of functional requirements and application of technology to proposed solutions. A combination of these approaches was actually used with the majority of the AED's resulting from the functional approach.

The functional approach looked at Combat Service Support (CSS) on the battlefield in terms of the Army's baseline doctrine of See, Plan, Allocate,

Fight, and Sustain, along with additional traditional management functions of organizing, direction, and controlling. The question was, "how can information technology be applied to allow CSS managers to improve their ability to perform the basic functions?"

For each of the CSS combat functions, (arming, fueling, transportation, supply, repair and recovery, etc.,) current information flows and procedures were examined at each echelon from corps to batallion. Interrelationships and information exchanges among the various combat functions and between echelons were compared to technological capabilities and, where significant improvement or enhancement was apparent, the concept was converted to a candidate AED.

In describing the AED's, it was often possible to include considerations such as cost factors, compatibility with existing Army programs, and availability of resources. For example, if the AED were to demonstrate ability to interface data between two nodes, the exact information to be passed may specify Class IX parts information. Although a number of other information types would have also tested the interface concept, data bases on Class IX already existed and obviated the need for funding contractor development in that area. Likewise, when a general purpose computer was needed to test a concept, a general purpose computer currently in Army testing or procurement removed the need for acquiring a new computer. By incorporating these and other facilitators into the AED's, a reduction in the time and cost of moving from technological concept to fielded capability can derive.

## 4.2 Format

The form of the AED description evolved from two concepts. First, that each AED be detailed enough to define the test, but not so specific that the ingenuity or creativity of a potential contractor would be stifled. Secondly, each candidate AED was defined in terms of its ability "To demonstrate the capability to ...". The intent was to describe the AED in terms of the military user and the environment in which the end product is to be used.

The description format was standardized for ease of comparison among AEDs and to provide a framework for listing all the relevant elements. The format elements and their rationale or description are as follows:

Title: Short phrases that provide the most concise description of the content of each AED.

Extract: An explanation of the AED generally including background information, rationale for conduct of the test, and expected output.

Purpose: A description of the principal that will be demonstrated.

Lessons Learned: A description of the diverse areas into which the test will provide insight. The questions asked fall under the general heading, "what will we learn?" and include such thoughts as:

- How the battlefield information system functions now; how it ought to function in 1985+; and how it will function in 1985+.
- How to accomplish a particular subfunction better?

- User performance characteristics in interfacing with machine.

Environment: The test environment in which the capability to be demonstrated will be used.

User: The specific military operator or user. Generally the user is specified by position, and organizational level or military occupation speciality.

Equipment: Generally described by function or specifically defined current or projected Army hardware. A determination was made as to the basic equipment needed to conduct the test including equipment needed to simulate external functions. The number and type were described along with comments as to the intended use.

Assumptions: Specific limits or conditions forecast for the AED that further defined the level of effort or had a bearing on cost determination.

Special Requirements: Forecast needs such as government furnished equipment or other specific requirements that define the test parameters.

Research Issue: The issue or issues from Phase I of the AIS Research Project that the specific AED would address or provide additional insight.

### 4.3 AED Set

The first AED's were generated and described without being subjected to any evaluation criteria. The goal was to generate as many good ideas as possible; to be later subjected to the evaluation rationale described in paragraph 4.1. From this initial effort, 20 AED ideas were generated and described. These ideas were then addressed in terms of the five dimensions of evaluation:

1. Direct benefit to Army
2. Technical opportunity
3. Generality
4. AIRMICS relevance
5. Life cycle favorability

The five dimensions of evaluation provided a framework for comprehensive evaluation of the candidate AED's. These can be thought of in terms of supply and demand. On the demand side are direct indications of immediate benefits, future benefits, and relevance to AIRMICS goals. On the supply side are indications of the genuineness of the research opportunity, indirect research benefits and research tradeoffs. Any candidate AED that scored high in this five dimensional framework would be highly desired by the Army, be sensible technically, contribute to the overall AIS program, fit into AIRMICS goals, and show a promising research and development life-cycle leading to a probable successful integration into Army procedures and operations.

For each dimension of evaluation there are subjective and objective

indicators that measure how "good" a candidate is along a given dimension. Also for each group of indicators are controls that allow measurement and interpretation of the reliability of the indicators. The task of performing an evaluation is thus broken down into measuring a number of quantities and interpreting the results. The final ranking becomes a matter of subjectively combining the five overall estimates of the strength of each candidate along the dimensions.

Figure 2-2 lists the research feasibility evaluation dimensions, the indicators and controls, and some of the questions asked in measuring the indicators and controls.

The dimensions were applied to the original set of AEDs and a revised list of 13 AED's emerged. These AEDs are listed in figure 4-1. Then the evaluation was used to formulate an evaluation questionnaire which, along with the 13 AED's was distributed to researchers, military users, and doctrine developers for their review, comment and ranking (see Section 5). A full description of these 13 AEDs (in the format described in paragraph 4.2) is included in Appendix A.

## Advanced Experimental Demonstration

<u>Title</u>	<u>Short Title</u>
CSS Information System Availability	CSS Info Flow
Distributed CSS Commodity Management	Commodity Mgt
SDD-1 Applied to Army CSS	SDD-1, Army
Automating the Link Between Battlefield, and Depot or BASOPS	Depot/BASOPS Link
Battlefield Readiness Status	Readiness Status
Division Water Point Location DSS	Water Point DSS
Summary Data Base for Corps Commander's Required Info Needs	Summary Data Base
DBMS for Corps Commander's Required Information Needs	DBMS for Corps
CSS Information Input Using PJH	PJH for CSS
Division Ammo Requirement DSS	Div Ammo DSS
Interlink Between DAS3, TCS/TCT and DLDED	Interlink ADPE
Situation Diagram Graphic Generator	Situation Diagram
Digital Traffic Profile Generator	Traffic Profile

### Abbreviations

ADPE - Automated Data Processing Equipment  
CSS - Combat Service Support  
DBMS - Data Base Management System  
DSS - Decision Support System  
PJH - PLRS/JTIDS (Position Location Reporting System/Joint Tactical Information Distribution System) Hybrid  
SDD - System for Distributed Data Bases  
TCS/ - Tactical Control System/Tactical Control Terminal  
TCT

Figure 4-1

## 5.0 SURVEY

### 5.1 General

A package containing the thirteen AEDs with attached questionnaire was mailed to selected members of the Army research community and to developers and users who have interest in advanced information systems within the CSS domain. Agencies surveyed included:

- o Office of the Director of Army Research
- o Defense Advanced Research Projects Agency (DARPA)
- o Army Research Institute (ARI)
- o Army Institute for Research in Management Information and Computer Science (AIRMICS)
- o Combined Arms Combat Development Activity (CACDA)
- o Computer Systems Command (CSC) - Fort Lee
- o U.S. Army Training and Doctrine Command (TRADOC) - Systems Manager - ADDS/MSE
- o U.S. Army Logistics Center
- o CORADCOM - Center for System Engineering and Integration
- o 4th Infantry Division (Mech)

### 5.2 Evaluation Dimensions and Questionnaire Relationship

Although not evident to the recipient, the questionnaire was divided into six areas; the five evaluation dimensions, and questions designed to enhance the description or eventual implementation of the AEDs.

o Direct Benefit to the Army. Six questions were used in evaluating this dimension:

2. What would be the most important benefit to the Army if the capability indicated by this AED were to be successfully demonstrated?
14. If only a few AEDs could be undertaken, would you advise AIRMICS to undertake this AED based solely on its own merits? What are your main reasons why or why not?
16. (e) 1 2 3 4 5 Military value of potential results
16. (f) 1 2 3 4 5 Wide interest in Army
16. (k) 1 2 3 4 5 Relevance to near-term battlefield information needs
16. (m) 1 2 3 4 5 Match with current CSS procedures and functions.

Question 14 provided insight into more than one dimension and included the respondents' overall evaluation of the AED.

o Technical Opportunity. Four questions were used to evaluate this dimension directly, but many respondents discussed technical opportunity as a part of their other replies. This dimension was scored to a large extent on an overall reading of those replies.

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by, this AED).
8. If the specific capability demonstrated by this AED turns out to be successful, what additional related capabilities ought to be researched and developed? (That is, indicated side benefits of this research.)
9. What organizations within the Army of DoD would be most interested in the results of this AED?

16. (d) 1 2 3 4 5 Scientific value of potential results

o Generality. The final rating for this dimension was a mixture of survey ratings and a separate evaluation by the AIS project team members. The evaluations carried equal weight. Five questions were used to determine survey rankings.

4. How well does the general thrust of this AED match with your own vision of those portions of future battlefield information systems that will support Combat Service Support functions?

11. How valuable, for further development of information systems in general, is the potential scientific information that may be gained by implementing this AED research?

16. (g) 1 2 3 4 5 Wide applicability beyond specific demonstration

16. (l) 1 2 3 4 5 Potential for opening new R&D areas

16. (p) 1 2 3 4 5 Generality of results, assuming success

o Airmics Relevance. The evaluation of this dimension was determined by AIS project team members based on AIRMICS mission, interviews with AIRMICS personnel, interviews with potential sponsors, and review of the questionnaire responses. Two specific questions in the survey plus the responses to question fourteen were included as input to the evaluation process.

16. (j) 1 2 3 4 5 Appropriateness within Army information system research

16. (o) 1 2 3 4 5 Furtherance of AIRMICS research goals

- o Life-Cycle Favorability. This dimension was rated by computing the mean of the numerical responses from each survey respondee. Eight questions related to the determination.

16. (b) 1 2 3 4 5 Direct relevance to future CSS information systems

16. (h) 1 2 3 4 5 Long-term potential in distributed information networks

16. (i) 1 2 3 4 5 Cost effectiveness of initial AED effort

16. (q) 1 2 3 4 5 Potential contribution to battlefield information security

16. (r) 1 2 3 4 5 Potential contribution to decision relevance of battlefield information

16. (s) 1 2 3 4 5 Potential contribution to accuracy and reliability of battlefield information

16. (t) 1 2 3 4 5 Potential contribution to reducing human effort

16. (u) 1 2 3 4 5 Potential contribution to timeliness of battlefield information

- o Developmental Questions. Eleven questions were asked of those surveyed concerning the specifics of the test. These were included to assist in AED description, test design, costing, and follow-on phases of the Advanced Information Systems Research Project. Comments on specific AEDs are summarized and included as part of Appendix D.

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?
3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.
7. How good is the prognosis for success of this AED in terms of the contractors being able to provide a valid, successful demonstration?
10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.
12. Is this AED the smallest effort that would adequately demonstrate the desired capability?
13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.
15. What approximate contractor cost and performance time do you deem appropriate for this initial AED effort?
16. (a) 1 2 3 4 5 Clarity of stated purpose
16. (c) 1 2 3 4 5 Prognosis for success of AED
16. (n) 1 2 3 4 5 Ability of potential contractors to implement AED

### 5.3 Methodology for Benefit Rating

The method used in the rating was to quantify the replies and provide a single measure of central tendency that described the benefit of each AED. Figure 5-1 illustrates the approach used. Replies were first rated by respondent for each dimension of each AED on a scale of 1-5. Applying statistical methods to generalize from the sample proved difficult due to the nature of the data. For example the properties of the data included:

- high variance in number of replies to individual dimensions.
- small sample size.
- varying levels of uncertainty and interpretation of the AEDs.

AED BENEFIT EVALUATION

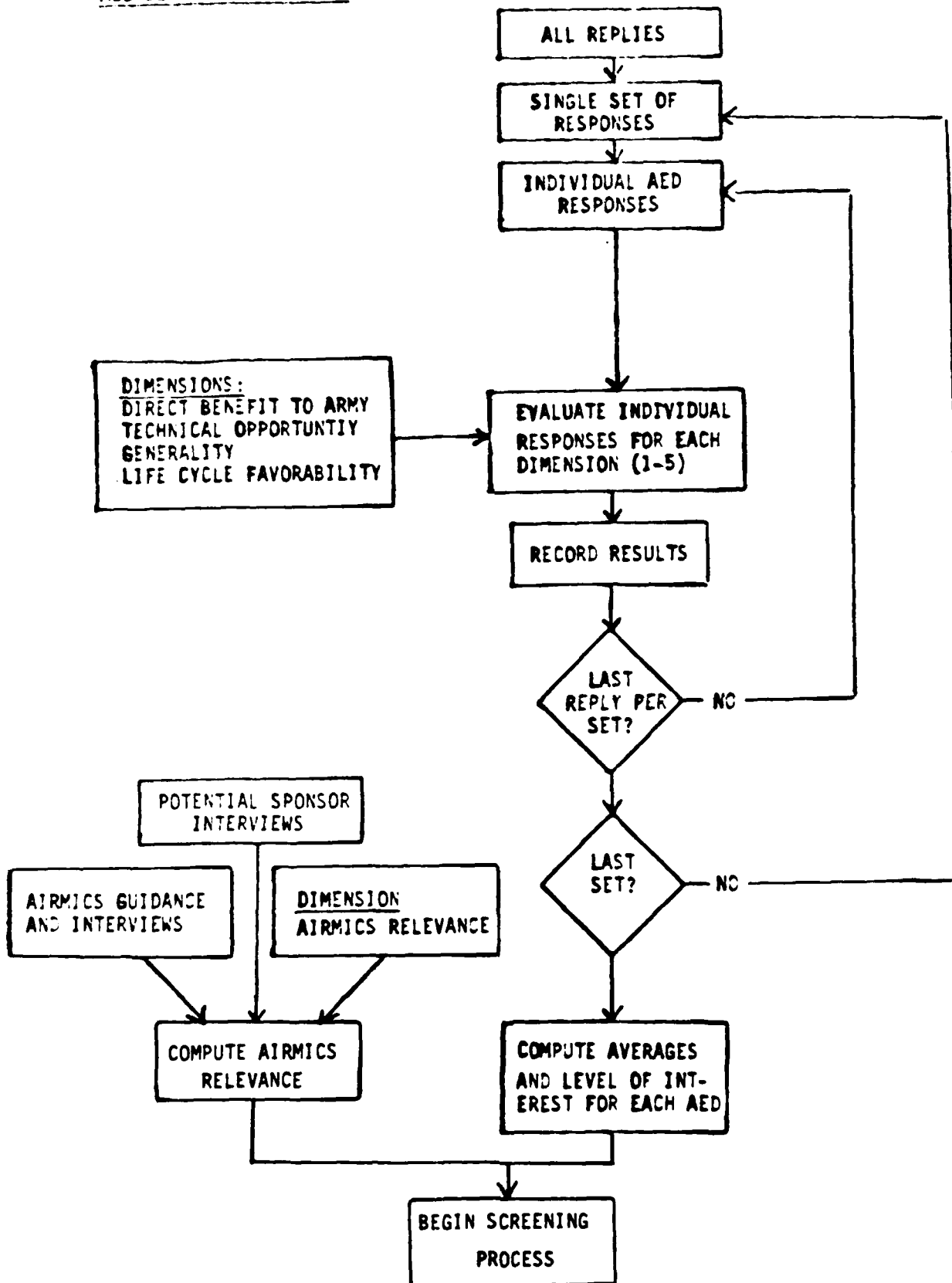


Figure 5-1

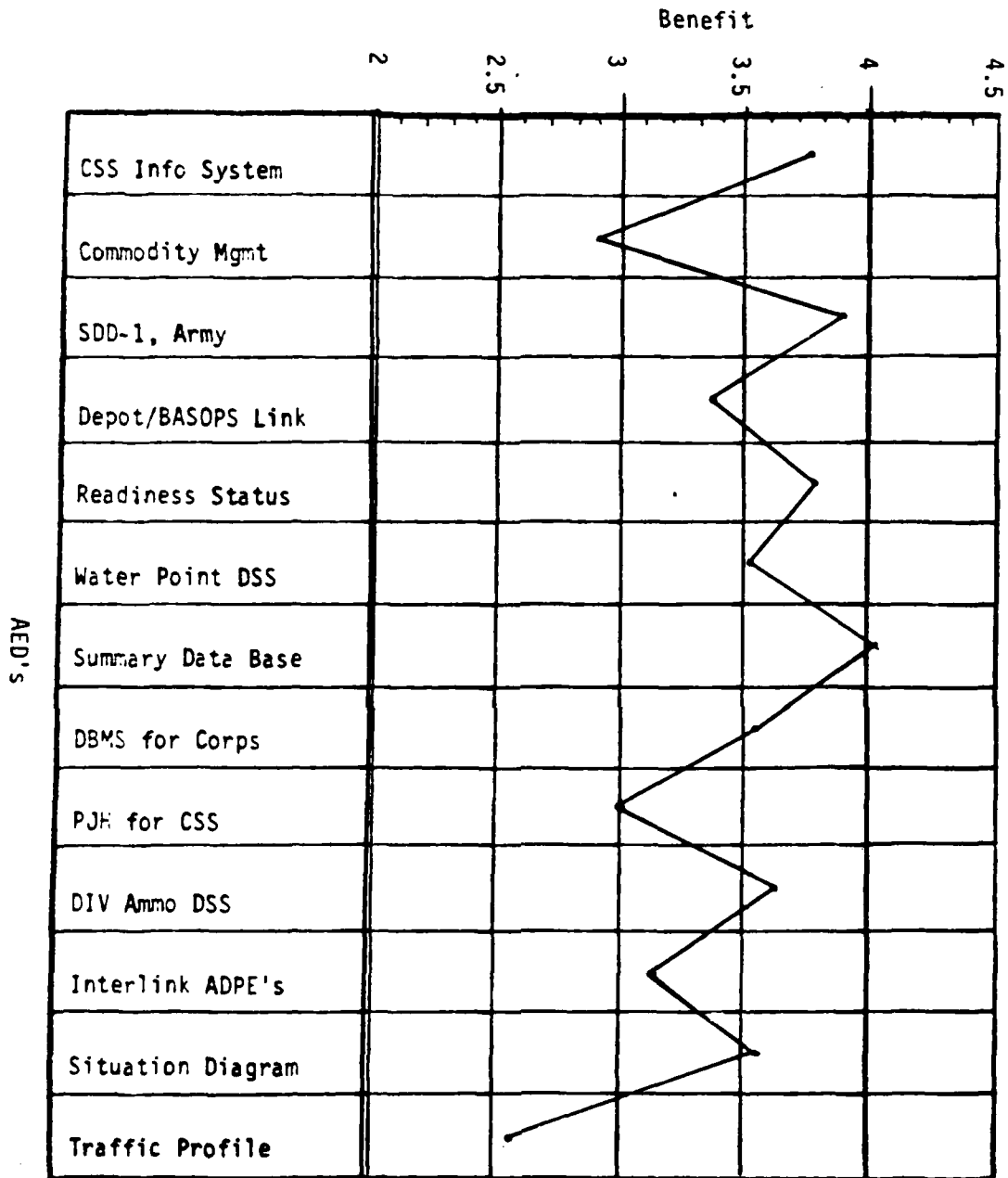
- high variance in normality of distribution of values in a given dimension per AED.

These properties did not allow for determination of certain statistical measures such as confidence intervals, sampling error, and two tail tests in a t-distribution. After graphing data points and examining frequency histograms for sample AEDs and comparing them with various measures of central tendency, it was determined that the arithmetic mean of the data points in the various dimensions provided the least biased indicator.

For those AEDs and/or dimensions where no information or insufficient information was given, an NR for No-Reply was entered. The significance of the NR is explained in Section 5.4. The results of this analysis for each respondent is presented in Appendix C. The results from each respondent's evaluation were then combined for each AED and averaged for each dimension. The unweighted mean of these dimension averages was then computed as the overall indicator of benefit for each AED. Figure 5-2 presents the unscreened results of this methodology. The results are listed in Appendix C which also includes a total of the No-Replies by dimension for each AED.

#### 5.4 Level of Interest

Several respondents chose to only respond to those AEDs that appeared to them to have the most value. Their no-response (NR) was in effect a negative vote for those AEDs to which they didn't choose to respond. In other cases respondents chose to only evaluate certain dimensions of an AED leaving other areas blank. The NRs were, in effect, an indicator of the level of interest



AED Benefit Comparison - Unscreened

Figure 5-2

in the AEDs and taken in total provide a significant indicator of perceived worth of the AEDs.

The level of interest as measured by the number of NRs was computed and ordered. This information is depicted on Figure 5-3.

### 5.5 AIRMICS Relevance

The purpose of this dimension was to identify any AEDs that were not sufficiently relevant to AIRMICS mission and capabilities to warrant further consideration. The primary inputs to the rating of individual AEDs were interviews with AIRMICS personnel, initial project guidance, and the survey results from AIRMICS personnel. To a lesser extent the desires of potential sponsors were included in the evaluation. The results of the rating are included in Figure 5-4.

HIGHEST



LOWEST

Individual AED's

Number of  
No-Replies

SDD-1, Army	10
CSS Info Flow	10
Summary Data Base	12
Readiness Status	16
DBMS for Corps	17
Commodity Mgmt	17
Div Ammo DSS	19
PJH for CSS	19
Depot/BASOPS Link	19
Interlink ADPE's	19
Water Point DSS	20
Situation Diagram	22
Traffic Profile	23

Level of Interest

Figure 5-3

HIGHEST



LOWEST

INDIVIDUAL AEDs

RATING

DBMS for Corps	4.5
SDD-1, Army	4.5
Summary Data Base	4.5
Readiness Status	4.0
Depot/BASOP Link	3.25
DIV Ammo DSS	3.25
CSS Info Flow	3.0
Interlink ADPEs	2.75
PJH for CSS	2.75
Water Point DSS	2.50
Situation Diagram	2.25
Commodity Mgmt	2.0
Traffic Profile	2.0

AIRMICS RELEVANCE

Figure 5-4

## 6.0 COST/BENEFIT ANALYSIS

### 6.1 General

The classic cost/benefit or cost/effectiveness analysis is concerned with three phases of a systems life-cycle: research and development, investment and operations. When applying these techniques to AEDs, the emphasis is on the first or research and development phase of the cycle. The investment and operation phases are considered beyond the interests of AIRMICS, which is a research and development organization. Specifically, the cost determination data for an AED addresses four stages of the phase: concept establishment, design, development and test, and demonstration and enhancement. (These stages are discussed in more detail in Section 7.0.) The current effort being conducted by Georgia Tech is the establishment of the AED in specific terms (the concept establishment stage.) Therefore, no cost data were developed for that stage. This section provides cost estimates for the design, development and test, and demonstration and enhancement stages.

Each of these stages are divided into four categories of cost data: hardware, personal services, material and supplies, and travel. Hardware costs are those obligations caused by the purchase, lease or manufacture of equipment. The assumption is made that in developing an AED that the government would furnish available equipment appropriate to the AED. This assumption is documented in the upper right hand section of the AED cost estimates (see figures 6-1 to 6-13) if applicable to the AED. If equipment is not available, the substitutions must be purchased or leased, increasing the total cost of the AED.

AED: CSS Information System Availability

Government Furnished: TCT/TCS Equipment

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	5 persons for 6 months = 30 m/m \$ 180k	\$ 3k	\$ 3k	\$ 186k
DEVELOPMENT + TEST	NONE	3 persons for 5 months = 15 m/m \$ 90k	\$ 3k	\$ 2.5k	\$ 95.5k
DEMONSTRATION + ENHANCEMENT	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 3k	\$ 15k	\$ 90k

TOTAL: \$371.5k  
17 months

FIGURE 6-1

AED: Distributed CSS Commodity Management

Government Furnished: Scenario orientated  
on CSS

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 1k	\$ 1k	\$ 74k
DEVELOPMENT + TEST	\$ 5k LEASE	2 persons for 5 months = 10 m/m \$ 60k	\$ 1k	\$ 1k	\$ 67k
DEMONSTRATION + ENHANCEMENT	\$ 5k LEASE	1.5 persons for 6 months = 9 m/m \$ 54k	\$ 1k	\$ 8k	\$ 68k

TOTAL: \$ 209k  
17 months

FIGURE 6-2

AED: SDD-1 Applied to Army CSS

Government Furnished: Hardware (DAS3 equipment); Standard Army communications; CSS data base for Class IX (test).

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	4 persons for 7 months = 20 m/m \$ 168k	\$ 5k	\$ 5k	\$ 178k
DEVELOPMENT + TEST	NONE	4 persons for 10 months = 40 m/m \$ 240k	\$ 5k	\$ 5k	\$ 250k
DEMONSTRATION + ENHANCEMENT	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 2k	\$ 10k	\$ 84k

TOTAL: \$ 512k  
23 months

FIGURE 6-3

AED: Automating the Link between the  
Battlefield and Depot or BASOPS

Government Furnished: Hardware (TCT/TCS equipment);  
communication centers and Autodin  
II link; BASOPS DP Centers.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	3 persons for 6 months = 18 m/m \$ 108k	\$ 2k	\$ 3k	\$ 113k
DEVELOPMENT + TEST	Interface Prototype Estimated \$ 10k	4 persons for 5 months = 20 m/m \$ 120k	\$ 2k	\$ 3k	\$ 135k
DEMONSTRATION + ENHANCEMENT	NONE	1 person for 6 months = 6 m/m to \$ 36k	\$ 2k	\$ 8k	\$ 46k

TOTAL: \$ 294k  
17 months

FIGURE 6-4

AED: Battlefield Readiness Status

Government Furnished: Hardware (DAS3 and TCT/TCS equipments)

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	2 persons for 5 months = 10 m/m \$ 60k	\$ 1.5k	\$ 3k	\$ 64.5k
DEVELOPMENT + TEST	NONE	3 persons for 4 months 12 m/m \$ 72k	\$ 2k	\$ 3k	\$ 77k
DEMONSTRATION + ENHANCEMENTS	NONE	2 persons for 6 months 12 m/m \$ 72k	\$ 1k	\$ 8.5	\$ 81.5

TOTAL: \$ 223k  
15 months

FIGURE 6-5

AED: Division Water Point Location DSS

Government Furnished: Chromatics CG - 1999  
 with 50k bytes of user memory; two floppy  
 disks; two copies of master's thesis addressing  
 previous work.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	2 persons for 3 months = 6 m/m \$ 36k	\$ 2k	\$ 3k	\$ 41k
DEVELOPMENT + TEST	NONE	2 persons for 5 months = 10 m/m \$ 60k	\$ 4k	\$ 2k	\$ 66k
DEMONSTRATION + ENHANCEMENT	NONE	1 person for 6 months = 6 m/m \$ 36k	\$ 2k	\$ 8k	\$ 46k

TOTAL: \$ 153k  
 14 months

FIGURE 6-6



AED: DBMS for Corps Commander's Required Information Needs

Government Furnished: Hardware (DAS3 and TCT/TCS equipment); CSS database of class IX (test).

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	3 persons for 6 months = 18 m/m \$ 108k	\$ 3k	\$ 4k	\$ 115k
DEVELOPMENT + TEST	NONE	4 persons for 6 months = 24 m/m \$ 144k	\$ 3k	\$ 5k	\$ 152k
DEMONSTRATION + ENHANCEMENT	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 2k	\$ 15k	\$ 89k

TOTAL: \$ 356k  
18 months

FIGURE 6-8

AED: CSS Information Input Using PJH

Government Furnished: Hardware (DAS3 equipment);  
PJH communications system.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	3 persons for 6 months = 18 m/m \$ 108k	\$ 3k	\$ 4k	\$ 115k
DEVELOPMENT + TEST	NONE	2 persons for 5 months = 8 m/m \$ 48k	\$ 3k	\$ 5k	\$ 56k
DEMONSTRATION + ENHANCEMENT	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 2.5k	\$ 10k	\$ 84.5k

TOTAL: \$ 255.5k  
17 months

FIGURE 6-9

AED: Division Ammo Requirements DSS

Government Furnished:

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	2 persons for 4 months = 8 m/m \$ 48k	\$ 2k	\$ 2k	\$ 52k
DEVELOPMENT + TEST	LEASE \$ 5k	2 persons for 3 months = 6 m/m \$ 36k	\$ 2k	\$ 3k	\$ 46k
DEMONSTRATIONS + ENHANCEMENTS	LEASE \$ 5k	1 person for 6 months = 6 m/m \$ 36k	\$ 3k	\$ 10k	\$ 54k

TOTAL: \$ 152k  
13 months

FIGURE 6-10

AED: Interlink Between DAS3, TCT/TCS,  
and DLDED

Government Furnished: Hardware (DAS3, TCT/TCS,  
DLDED equipment); CSS Data Base for Class IX; Communicatio  
equipment for interface.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	3 persons for 6 months = 18 m/m \$ 108k	\$ 2.5k	\$ 6k	\$ 116.5k
DEVELOPMENT + TEST	Prototype of Interface \$ 5k	4 persons for 6 months = 24 m/m \$ 144k	\$ 3k	\$ 4k	\$ 156k
DEMONSTRATION + ENHANCEMENT	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 2k	\$ 12k	\$ 86k

TOTAL: \$ 358.5k  
18 months

AED: Situation Diagram Graphics Generator

Government Furnished: Chromatics CG - 1999  
with 50k byte of user memory; with digitizer pad.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	3 persons for 6 months = 18 m/m \$ 108k	\$ 2k	\$ 3k	\$ 113k
DEVELOPMENT + TEST	NONE	2 persons for 6 months = 12 m/m \$ 72k	\$ 2k	\$ 4k	\$ 78k
DEMONSTRATION + ENHANCEMENT	NONE	1.5 persons for 6 months = 9 m/m \$ 54k	\$ 2k	\$ 10k	\$ 66k

TOTAL: \$ 257k  
18 months

FIGURE 6-12

AED: Digital Traffic Profile Generator

Government Furnished:

Message profile indicating expected message traffic.

COST DATA

STAGE	HARDWARE	PERSONAL SERVICES	MATERIAL + SUPPLIES	TRAVEL	TOTAL
DESIGN	NONE	2 persons for 4 months = 8 m/m \$ 48k	\$ 1.5k	\$ 1.5k	\$ 51k
DEVELOPMENT + TEST	DEC Vax + Terminals (Lease Time) \$10k	2 persons for 5 months = 10 m/m \$ 60k	\$ 2k	\$ 2.5k	\$ 74.5k
DEMONSTRATION + ENHANCEMENT	DEC Vax + Terminals (Lease Time) \$10k	1 person for 6 months = 6 m/m \$ 36k	\$ 2k	\$ 5k	\$ 53k

TOTAL: \$ 178.5k  
15 months

FIGURE 6-13

Personal service costs are those directly attributed to the time contractors devote to the project. Results of this time could be software, project management, analysis, and other similar products or services.

Material and Supplies costs cover document reproduction, equipment repair and servicing, professional services, and other items of this nature.

Travel costs are those resulting from the transportation of personnel and equipment. Included under the category of personnel costs are per diem payment while traveling, air tickets, auto rental, tolls, etc. Equipment costs would be the charges for transporting items such as computers or displays which personnel would bring to the demonstration area.

## 6.2 Costs

The costs for each AED were developed based on an interactive process of estimates and peer review, and comparison with similar projects. Figures presented are best estimates of the time for personal services and the dollars required to purchase material or services based on the technical difficulty of the project, amount of travel anticipated, availability of data and anticipated cooperation of the sponsor. A key element in tempering the initial set of estimates was comparison of the AEDs with similar projects. This information was obtained through interviews with directors of these projects and by responses from those who participated in the survey. The initial set of cost data was based on complete understanding of the demonstrations and were following a "best-case" scenario. Optimism was dimmed by interviews with those who have experience in design, development and

fielding a demonstration. In addition, the initial set of estimates ignored the requirements for enhancements recommended by the user community during the demonstration stage. These changes, while not significant enough to await a new AED, appear to be important to the success of the AEDs. These inputs resulted in the raising of the dollar estimates.

### 6.3 Cost Assumptions

This paragraph documents the assumptions which were made in compiling the cost estimates.

(a) No cost data were developed for government personnel. Therefore, while an AIRMICS project officer is required, the monies to provide his services are not reflected in the personal service category.

(b) The figure of six thousand dollars per man/month was used for computing personal services. This estimate was not changed over the course of the design development, and demonstration stages to reflect inflationary trends of the economy. Rather, six thousand dollars is considered a valid average over the life-cycle of the AED.

(e) Often, discounting techniques are used in developing cost-benefit analysis to reflect the time value of money. Because of the short duration of the AEDs, small amount of monies involved, and the lack of a true trade-off between the private and public sectors of the economy, this procedure was not used.

(d) Normally, computer hardware and communications equipment are assumed to be furnished by the government. This fact is noted in the upper right hand of each AED cost-estimate figure. If this equipment is not available, costs of substitution equipment must be added to the estimate.

(e) The demonstration period of an AED is estimated to be six months in duration. Interviews with project directors of similar programs indicates that a longer (possibly 12 month) period is required. Six months was used as a representative figure for AIRMICS funding. If an AED is accepted by the user community, alternative funding options should be employed after the six month period.

#### 6.4 AED Cost Estimates

Figures 6-1 through 6-13 provide the cost estimates for each AED. Each figure is divided into the three stages described above and subdivided into the cost categories of hardware, personal services, material and supplies, and travel. Total costs are expressed in dollars and time in the lower right corner.

#### 6.5 Relative Ranking

The relative ranking of AEDs was determined by using multicriteria analysis to screen the set of 13 demonstrations. Specifically, the following levels of criteria were used to filter the best AEDs to predominance:

- o Adequate AIRMICS relevance;
- o Level of interest to users and developers;
- o High benefits to the Army as perceived by users and developers;
- o Non-duplication of other efforts underway elsewhere; and
- o Low costs in relation to benefits.

Figure 6-14 displays this screening process.

Adequate AIRMICS relevance was determined by review of the replies to the questionnaire, information gained during visits and interviews, and professional judgement of members of the study team. Results of this filter was the elimination of the following AEDs from the set of 13:

- o Distributed CSS Commodity Management;
- o Division Water Point Location DSS;
- o Situation Diagram Graphics Generator; and
- o Digital Traffic Generator.

Reasons stated for these AEDs being judged irrelevant ranged from the opinion that they were beyond the bounds of AIRMICS' charter to the expression that they did not have enough research "flavor".

The remaining nine AEDs were reviewed to determine level of interest of the respondees to the questionnaire. The number of non-replies to the dimensional criteria was used as an indicator of rejection by those who completed the survey. The range of non-replies by AED were presented in figure 5-3. The screening process used greater than 19 non-responses as an

Screening Process

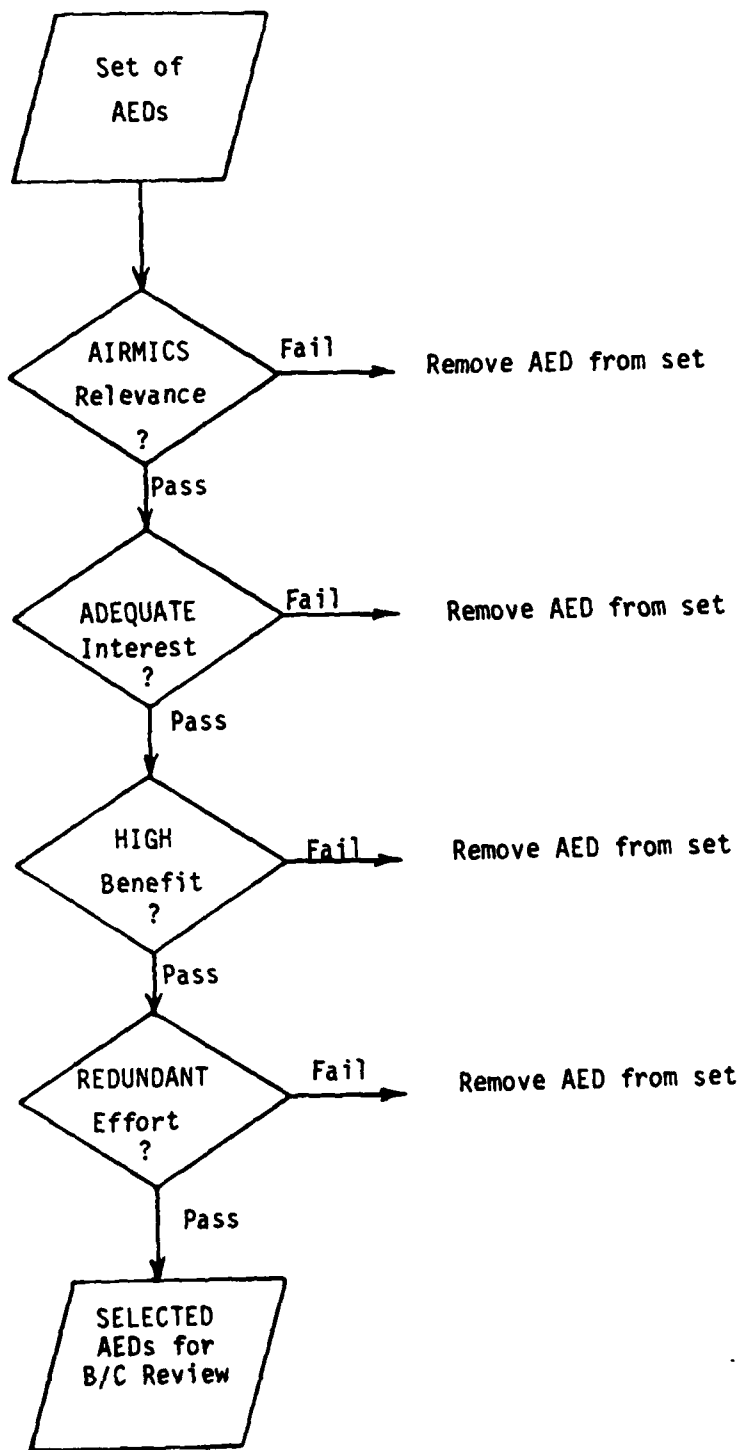


Figure 6-14

indicator of lack of interest in the AED. No additional AEDs were removed from the nine which passes the previous screen. However, using the "level of interest" criteria, it should be noted that the following AEDs previously removed by the AIRMICS relevance screen also failed this test:

- o Division Water Point Location DSS;
- o Situation Diagram Graphics Generator; and
- o Digital Traffic Generator.

Using the compiled survey results displayed in Section 5, a filter using high benefit was applied to screen the remaining AEDs. Benefits were expressed in four dimensions of direct impact on the Army; technical opportunity; generality; and life-cycle favorability. Numeric values for each dimension were developed based on responses to questionnaire. These values were summed for each respondee and a mean derived for each AED. The range of the benefit AEDs was from 2.92 to 4.03 on a maximum scale of five. Using the criteria of equal to or greater than 3.5 as an indication of high interest, the following AEDs were eliminated from further consideration:

- o Automating the Link between Battlefield, and Depot or BASOPS;
- o CSS Information Input Using PJH; and
- o Interlink Between DAS3, TCS/TCT, and DLDED.

AEDs addressing commodity management and digital traffic eliminated by the previous screens also failed this test.

The redundancy test was established to account for information developed during the study, but not formally reported in the results of the

questionnaire. During a visit to Fort Lee, the project officer for the Standard Army Maintenance System (SAMS) indicated this system was developing a unit readiness reporting capability similar to that of the AED entitled "Battlefield Readiness Status." Because it appeared that the development of this AED would only repeat the SAMS effort, this AED was removed from consideration.

The results of the total screening process are presented in figure 6-14a.

The final criteria of low-cost to benefit is applied to the remaining AEDs:

- o CSS Information System Availability;
- o SDD-1 Applied to Army CSS;
- o Summary Data Base for Corps Commander's Required Information Needs;
- o DBMS for Corps Commander's Required Information Needs; and
- o Division Ammo Requirement DSS.

Figure 6-15 indicates the AED short title, estimated cost, benefit, and benefit to cost ratio for the five remaining AEDs. The amount of monies available to AIRMICS to fund AEDs is not known by the project team; therefore, three levels of funding were assumed and recommendations of which AEDs should be undertaken were developed.

At a five-year budget level of \$2000K (\$400K per year) all five remaining AEDs should be developed. The results would be a cost of \$1693K (\$338.6K per year) benefit of 18.83, and a cash surplus of \$307K (\$61.4K per year); see figure 6-16.

Screening Process Applied

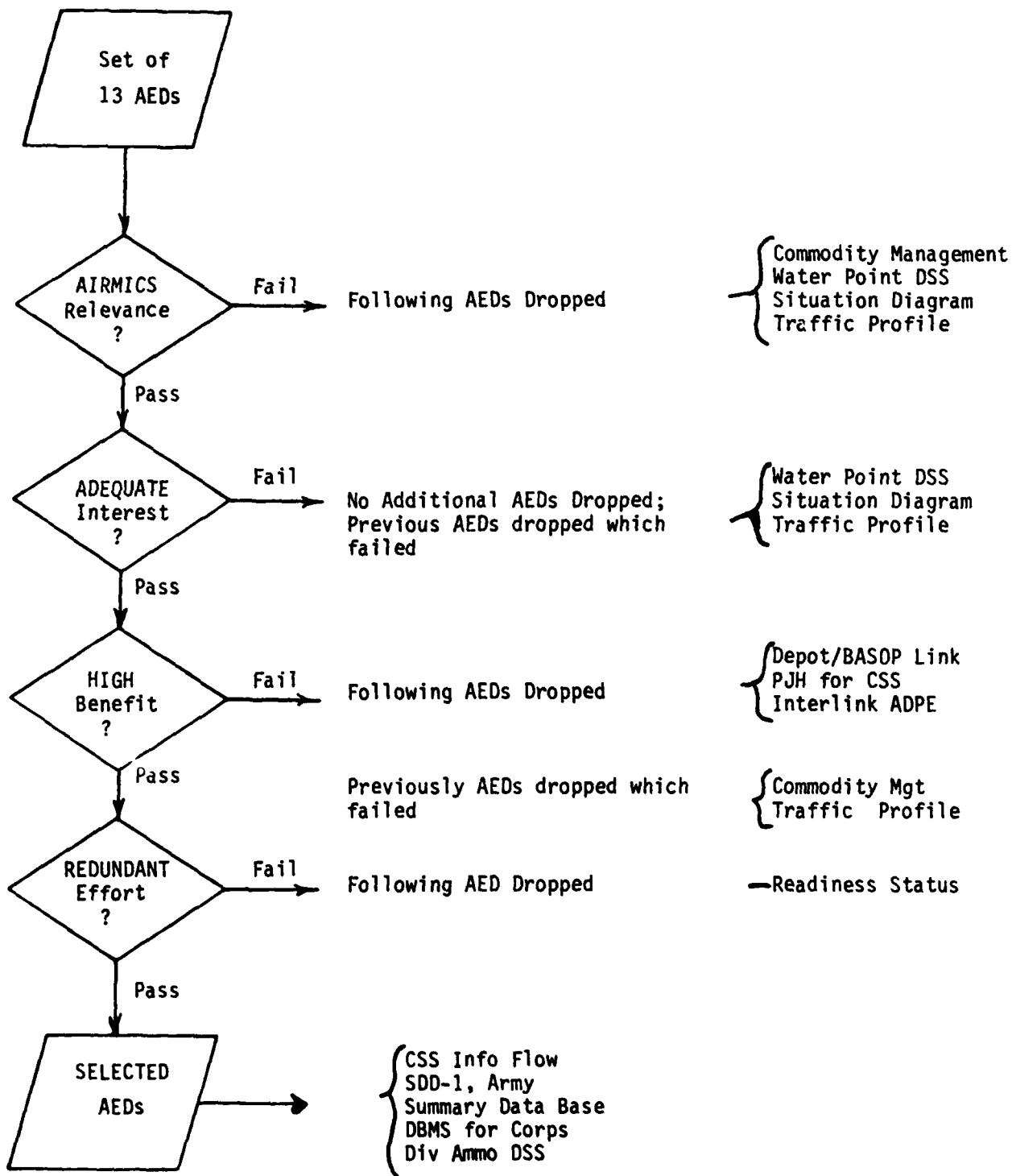


Figure 6-14a

SELECTED AEDs  
(in order of benefits)

<u>Number (i)</u>	<u>Short Title</u>	<u>Est.Cost(C)</u>	<u>Benefit (B)</u>	<u>B/C(X100)</u>
1	Summary Data Base	\$301.5K	4.03	1.33
2	SDD-1, Army	512K	3.87	0.75
3	CSS Info Flow	371.5K	3.75	1.00
4	Div Ammo DSS	152K	3.63	2.38
5	DBMS for Corps	356K	3.55	0.89

Figure 6-15

RESULTS OF \$2000K ANALYSIS

Projects Undertaken:

<u>Short Title</u>	<u>Est. Cost (C)</u>	<u>Benefit (B)</u>
Summary Data Base	\$301.5K	4.03
SDD-1, Army	512K	3.87
CSS Info Flow	371.5K	3.75
DW Ammo DSS	152K	3.63
DBMS for Corps	356K	3.55
Total	\$1693K	18.83
Cash Surplus	\$ 307K	

Figure 6-16

With a budget of \$1500K (\$300K per year), the entire set of recommended AEDs could not be completed because of a shortage of funds. The selection of which of the five AEDs to fund is based on an analysis of the benefit/cost (B/C) ratio. AEDs which pass the criteria are those returning the most benefit for the cost with the total not exceeding the constraint of \$1500K. Therefore, the following AEDs which indicated the best B/C ratio were initially selected:

<u>AED</u>	<u>Cost</u>	<u>Benefit</u>	<u>B/C(x100)</u>
Div Ammo DSS	\$152.0	3.63	2.38
Summary Data	301.5	4.03	1.33
Base			
CSS Info Flow	371.5	3.75	1.00
	<u>\$825.0</u>	<u>11.41</u>	

The choice between the remaining two AEDs was determined by selecting that AED which returned the largest benefit. Therefore, the AED with a short title of SDD-1, Army and a cost of \$512K and benefit of 3.87 was selected over the last AED with a benefit of 3.55. See figure 6-17 for the set of selected AEDs at the \$1500K level which resulted in an expenditure of \$1337K, benefit of 15.28 and a surplus of \$163K.

At the \$1000K (\$200K per year) level, the same consideration of maximizing benefit subject to a cost constraint was used. However, because of the reduced budget, a "branch and bound" method<sup>1</sup> as displayed in figure 6-18 was used to assist in the decision. Again, starting with the AED with the highest

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<sup>1</sup>Daellenbach, Hans G. and George, John A., Introduction to Operations Research Techniques, Allyn and Bacon, Inc., (1978), Chapter 12.

RESULTS OF \$1500K ANALYSIS

Project Undertaken:

<u>Short Title</u>	<u>Est. Cost (C)</u>	<u>Benefit (B)</u>
Summary Data Base	\$301.5K	4.03
SDD-1, Army	512K	3.87
CSS Info Flow	371.5K	3.75
Division Ammo	152K	3.63
Total	<u>\$1337</u>	<u>15.28</u>
Cash Surplus	\$163K	

Figure 6-17



B/C ratio, a decision was made to propose either undertaking or rejecting the Div Ammo DSS (Number 4 in figure 6-18). If it is developed, there is an expenditure of \$152K with a return of 3.63 in benefits. The cost is subtracted from the beginning sum of \$1000. At the second level, the next best AED in terms of B/C ratio was considered with the results compiled as indicated in figure 6-18. This process was continued in the next level by reviewing the CSS Info Flow AED numbered 3 in figure 6-15. The results of this step were calculated with a cumulative benefit of 11.41 and a remaining cash value of \$85K. No other AED could be funded for the remaining cash value; therefore, the resulting benefit was compared with all other legs in the diagram. Since it was the maximum benefit, the selected set of AEDs at the \$1000K level are as indicated in figure 6-19. The "branch and bound" technique was deemed more appropriate to the problem at hand than a dynamic programming technique. However, dynamic programming could be used based upon the objective function and constraints expressing figure 6-20.

RESULTS OF \$1000K ANALYSIS

Project Undertaken:

<u>Short Title</u>	<u>Est. Cost (C)</u>	<u>Benefit (B)</u>
Summary Data Base	\$301.5K	4.03
CSS Info Flow	371.5K	3.75
Division Ammo DSS	152K	3.63
Total	<hr/> \$825K	<hr/> 11.41
Cash Surplus	\$175K	

Figure 6-19

DYNAMIC PROGRAM FOR VARYING BUDGETS

Objective Function: Maximize  $\sum_{i=1}^5 a_i x_i$

Subject to:  $\sum_{i=1}^5 c_i x_i \geq b$

and  $x_i = 0, 1$

where:  $c_i = \text{cost}$

$a_i = \text{benefit}$

$x_i = 1 \Rightarrow \text{do project, or}$

$0 \Rightarrow \text{don't do project}$

$b = \text{budget}$

Figure 6-20

## 7.0 FIVE-YEAR PLAN

### 7.1 General

The life-cycle of an AED is divided into four stages ending with the termination of the demonstration. These stages are:

- o Concept, where the idea generation activity similar to that conducted during Phase Two is performed;
- o Design, where the details to accomplish the demonstration are expressed and test criteria established;
- o Development and test, where the design will be activated into the actual demonstration and tested, and
- o Demonstration and enhancement, where the AED sponsors and other interested parties use and learn. This stage will entail minor modifications to meet user requests.

The termination of the AED will complete AIRMICS involvement with the project. Termination takes one of two modes; either transfer of the equipment and capability to an active unit or abandon the demonstration after potential lessons have been learned.

AIRMICS does not work in a vacuum in developing the AEDs. An essential element support to achieve the AED goal and a sponsor whose need is being met. The relationship of these parties is discussed below.

Life-cycle strategy is the philosophy of the "use-learn-develop" concept in action. Important to this strategy is the early identification exchange of information during all stages of the AED until termination.

## 7.2 Sources of Support

Support required to design, develop, and conduct a demonstration is in the form of contractors to perform the design or development functions; contractual assistance from government personnel; engineering review of performance of the contractor's effort; active Army unit or individual participation; and user representation, and developer review of the demonstration and their comments.

7.2.1 Contractor Support. The relatively small size of AIRMICS in terms of number of personnel requires the acquisition of outside assistance to perform the detailed research involved in any AED. Because of the nature of the acquisition system used by the military, and the lack of sufficient Army resources, this support normally comes from non-DOD sources. Under the "use-learn-develop" concept, AEDs are generally smaller projects (less than \$500,000) with a design and develop life of less than three years. Because of the relatively small number of contractors interested in working AEDs, it is in the best interest of AIRMICS to identify institutions or firms who desire

to work on the AED. Identification of these groups can be accomplished by advertising in the Commerce Business Daily, trade journals or similar publications, and by directly approaching, via letter or visit institutions or firms which have worked on similar projects in the past or purport to do so in the future.

7.2.2 Contractual Assistance. AIRMICS does not have its own contractual support activity; therefore, they are dependent on the services of their parent organization, U.S. Army Computer Systems Command. There are many types of contracts available to support the AED concept. Figure 7-1 indicates the type of contracts available. As a general rule, the type of contract used to achieve or obtain the service or materiel should reflect the stage of development of the product. The more developed the product, the more definitive the contract becomes and the contractor assumes full cost responsibility. At the other end of the development is a cost-plus-a-fixed fee type contract where profit, rather than price, is fixed and the contractor's cost responsibility is therefore minimal. The policy for selecting a particular contract simply calls for using a type, or combinations of types, which will promote the best interests of the government. The nature of research, development and test procurement requires that contracts normally are negotiated rather than formally advertised. This approach is necessary because in research and development, there are usually limited descriptions, drawings or specifications adequate to definitely describe the item being procured and no technical data or production package is suitable for advertising.

## CONTRACT TYPES

- o Fixed Price - Contractor guarantees the product or services at a specified price
  - o Firm Fixed Price - Contractor accepts all risks
  - o Fixed Price with Economy Price Adjustment - Provides for revision of contract price as stated within the contract.
  - o Fixed Price Incentive - Encourages contractor to reduce the item cost or improve equipment or delivery schedule, thereby gaining a higher profit under predetermined terms.
  - o Fixed Price with Price Redetermination - Used for quantity production type contracts after negotiations establish that from fixed price contract does not meet requirements.
  
- o Cost Reimbursable - Requires the contractor to try to achieve goals of the contract within the negotiated schedule and estimate cost.
  - o Cost (no fee) - Reimburse the contractor for all allowable costs but does not provide for a fee or profit.
  - o Cost Sharing - Contractor is reimbursed only for an agreed portion of allowable costs.
  - o Cost Plus Incentive Fee - Contract with provisions for a fee which is adjusted by formula in accordance with the relationship which total allowable cost bear to target costs.
  - o Cost Plus Award Fee - Contract has special fee provisions in that it provides a means of applying incentives in contracts which are not susceptible to final measurements of performance necessary for structuring incentive contracts.
  - o Cost Plus Fixed Fee - Contract which provides payment to the contractor for allowable costs plus a predetermined fee.

Figure 7-1

The general methods of establishing contracts are: competitive and sole-source. The competitive method is the more lengthy and costly process; however, it does allow for many firms to propose and, in theory, derives lower bids for the government. Sole-source is a method which allows the government to select the contractor best suited to the job and, using this approach, the time from need establishment to contract award is shorter than the competitive approach. This method, however, does not give the government a series of options concerning solution of the problem nor provide for cost comparison between proposals.

The AIS program with a series of small projects and demonstrations in the R&D environment are more suitable for cost (no fee) or possibly cost sharing types of contracts. The logical method of acquisition is sole-source, where AIRMICS personnel can choose the appropriate institution or firm which best can accomplish the desired tasks. While this is the recommended approach, it is recognized that government organizations often desire to broaden the number of potential contractors working on their tasks and reduce the appearance of collusion with any one organization. An alternate approach would be the competitive solicitation of a series of Basic Ordering Agreements with institutions and firms interested in working on AEDs. The awarding of any AED would then go to the particular organization (among the set of institutions and firms) which can best perform the demonstration.

It is important for AIRMICS to establish a dynamic, cost-plus arrangement for funding AED design, development, and demonstration stages. Projects which are producing results but require additional funding should be accepted as a normal condition of research. These efforts should receive additional monies

to meet underestimated or newly determined requirements. On the contrary, those projects which appeared rewarding early in their life-cycle, but later become non-productive or non-valuable should be terminated. A method of review and action of projects under development is mandatory to support the funding mechanism. The important characteristic of AED funding is the ability of AIRMICS to add or delete monies from projects based on their merit and not merely on the amount originated at AED conception. In other words, a true "cost-plus" environment and not an "original estimate ceiling" attitude is essential for the construction and implementation of successful AEDs.

7.2.3 Engineering Review. Technical review of projects in the design, develop, and performance stages of an AED can be performed by the AIRMICS staff. Any additional services can be acquired on a case-by-case basis from the resources of USACSC or through special contract support.

7.2.4 Active Army. All AEDs have been defined as a function being performed in a combat milieu. Therefore, the potential exists for at least part of the conduct of the AED to require active army individual or unit support. The extent to which this support is required cannot be stated at this time. Potential sources are the 4th Infantry Division at Fort Carson, Colorado (because the present commander is MG Hudachek, who recently left a similar post at USACSC and is familiar with the AIS project), the 9th Infantry Division at Fort Lewis, Washington (where a test-bed is being planned) or the units at Fort Hood, Texas where the Training and Doctrine Command has a test facility.

7.2.5 Users and Developers. An important part of the AIS concept is for AIRMICS to identify a sponsor early in the AED cycle. This step was initiated in the beginning of Phase Two with the establishment of contact with CACDA representatives who agreed to play this role. As a sponsor, they will provide review and comments at milestones of the conceptual, design, develop, conduct stages of an AED. Other interested parties are the development community and actual users of the potential system. Contact with these groups was initiated during Phase Two. This type of early contact during the AED concept stage is essential. Once contact is established, it must be continued during the life-cycle of the AED.

### 7.3 Life-Cycle Strategy

The essence of the life-cycle described in paragraph 7.1 is the establishment of a demonstration which allows users and developers to advance on the "use-learn-develop" path to an evolutionary developed system. Equipment or demonstratable parts of systems are used in AEDs for the purpose of learning more about the objective system. Information gained through this technique is recycled into the user and developer communities to affect refinement to a stated need or technical solution.

7.3.1 Broadcasts Letters. The technique suggested to accomplish the dissimulation of information is a broadcast letter. This technique is an informal missive with a universal format covering reports, findings, results, and other information generated during any of the stages of an AED. The emphasis is on the informality of the letter, which is signed and distributed by the project director. It is not intended to reflect command opinion or

position (a lead paragraph stating this may be appropriate) nor is it staffed within AIRMICS or USACSC. Letters should be dispatched bimonthly or when significant results are generated. A broadcast letter is a technical document indicating the results of research. As such, it has a wide distribution of anyone with the least bit of potential interest in the research project.

7.3.2. Performance Measurement. Consideration of the measurement of performance must be given to the particular stage of the AED. During the concept stage, performance being measured will be that of the research directors or project leaders in AIRMICS as they define the AED. This is objective and subjective, uses the benefit rating scheme outlined in paragraph 2.4, and is supported by the comments of the sponsors for whom the AED is conducted. During this stage, the AED is defined in detail in terms of function to be accomplished, lessons learned, etc. This definition will be used as criteria for the conduct of the demonstration stage. As AEDs are combat oriented, measures which should be considered are survivability, responsiveness, and reliability.

In the design stage, the performance measurements are established by the AIRMICS project officer and placed in the statement of work. Criteria are the ability to develop the number of desired alternative solutions, ability to meet time constraints, ability to accomplish desired function, work that can be accomplished within dollar constraints, and viability and visibility of the test plan developed. Milestones are established to track the progress of the contractor, who will present in-progress reviews (IPR) and interim papers as required by the project officer.

Performance measurement in the development stage is based on the test plan established with the design. Again, milestones are established and IPR conducted. Performance measurement is more objective in this stage as the test is normally binary: "does it work or not." The contractor should be required to divide his project into work packages. The test plan would link these packages together in a build-up fashion. The AIRMICS project officer does not have the time to review each test as it occurs in this cycle. However, certifications of completions of individual work package test are required from the contractor. The AIRMICS project officer and interested parties will observe the test of major groupings of work packages. Final acceptance testing will be accomplished by AIRMICS personnel. This test is orientated on the accomplishment of the functional requirements established in the concept stage.

Performance measurement in the last stage is based on the reaction of the personnel conducting the demonstration. The measurement is not contractually oriented as in the design and development stages. Rather, it focuses on the "use-learn" portion of the AIS thrust and is expressed in terms of quantity and quality of information learned. Judgment concerning the performance of this particular AED during the conduct stage will be used to influence subsequent AEDs.

7.3.3 AED Termination. There are two methods of termination of an AED: absorption into the mainstream of army functions and the dropping of the entire effort as far as AIRMICS is concerned. In the former, the reaction of those engaged in the demonstration is such that they accept responsibility for the remainder of the life-cycle of the equipment. This will be the exception

rather than the rule as frequently the computer hardware will not be suitable for the battlefield environment and a logistical support system for parts and maintenance is not available. On the other hand, the AED could be handed to the development agencies for conversion to field-deployment use.

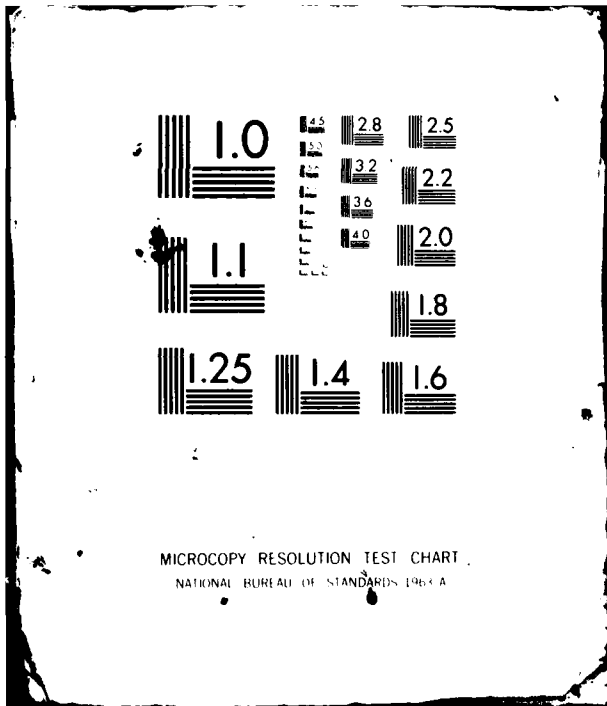
The criteria for the termination of an AED which has met its research goals must be considered at conception of the demonstration. The criteria are the meeting of the lessons learned portion of the AED definition. From a manager's point of view, termination criteria is dependent upon the proper decisionmakers and technicians having received broadcast letters and having viewed the demonstrations. Establishing a list of recipients of broadcast letters and of demonstrations is a responsibility of the AIRMICS project officer at the end of the concept stage before the statement of work is assigned to the contractor. This list should be modified as required during the life-cycle of the AED. Once all responsible parties have received the information generated by the demonstration, the AED should be terminated.

#### 7.4 Plan Statement

In developing the five-year plan for AIS, the following considerations were made:

- o Most important AEDs in terms of benefit and system impact would begin early in the five-year program;
- o All AEDs would start and end in the five-year period; and
- o An attempt was made to level expenditures over the five-year period.





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

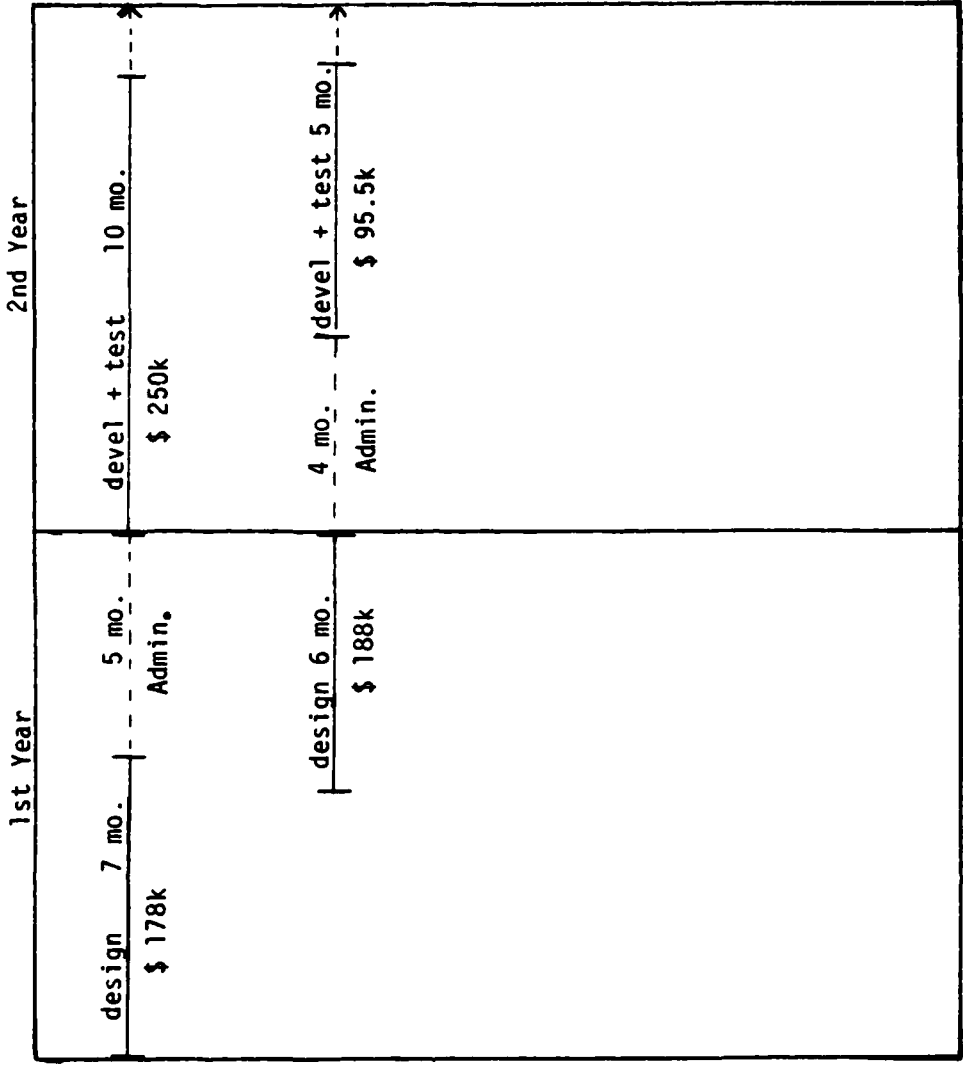
Cost estimates for AEDs were expressed in dollars and time. The cost data does not include either monies or time for administrative activities, such as specification writing, government review of design; documentation and briefings to senior headquarters. In developing the five-year plan, a factor of 0.5 was used for estimating administrative time. Using this formula, a project with a technical design, develop and demonstrate time of 16 months was hindered with administrative delays totaling eight months. Ideally, these delays would happen at the beginning of the AED before design began. However, history indicates that typically they occur between the completion of one stage (i.e., design) and before the commencement of the next (i.e. development and test.) Therefore, administrative delays were prorated over the AED life-cycle.

Using a five-year budget of \$2000K (\$400K per year), the model for the selected AEDs is presented in figure 7-2. (It should be noted that an annual budget of \$400K exceeds the requirements to develop the AEDs. See Section 6.)

AEDs are in order of importance and logical technical order considerations. Each is subdivided into the stages of design (d), development and testing (d&t), and demonstration and enhancement (d&e). The two AEDs (SDD-1, Army and CSS Info Flow) were started early based on the belief that lessons learned during these demonstrations would affect considerations for the two AEDs which address the data bases. The Division Ammo DSS AED, which is basically independent of the other AEDs, was used to balance the expenditures over the five-year time period.

Five - Year Program

AED



SDD -1, Army

CSS Info Flow

Division Ammo DSS

Summary Data Base

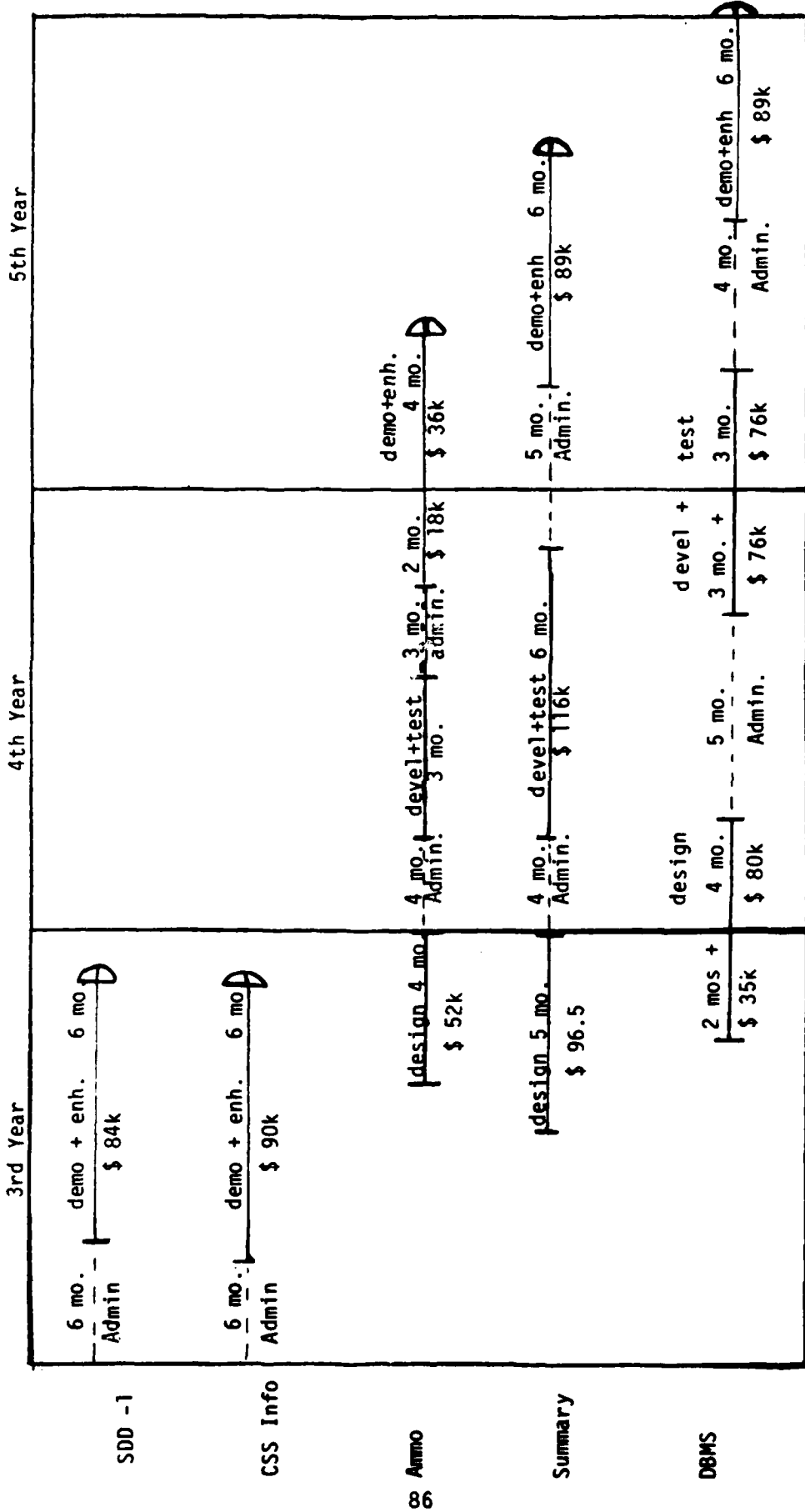
DBMS for Corps

COST: \$ 364k

COST: \$ 345.5k

FIGURE 7-2

Five - Year Program (Cont'd)



COST: \$ 357k

COST: \$ 336k

COST: \$ 290k

FIGURE 7-2 (Cont'd)

## 8.0 SUMMARY AND CONCLUSIONS

During Phase Two, thirteen AEDs were generated, defined, and evaluated to possibly enhance the Army's knowledge on research issues identified during the previous phase of the AIS Research Project. These AEDs were reviewed by a group of users and developers to determine those most beneficial to the Army. A benefit to cost relationship was established to rank and select the optimum AEDs.

Benefit of each AED was measured according to five dimensions: (1) direct usefulness to the Army; (2) technical opportunity; (3) generality of the demonstration, (4) relevance of the project to AIRMICS; and (5) life-cycle favorability. Data used in employing these dimensions were primarily derived from user and developer responses to a questionnaire. Other data was obtained by visits to Army installations and interviews with Army decisionmakers and planners. Cost data were obtained by an interactive process of estimating time and monies needed to complete the AED, review of these estimates with peers and project managers of similar projects, and development of further estimations.

A five-level screening process was established to reduce the original 13 AEDs to a manageable set. Criteria used in this process were:

- o AIRMICS relevance;
- o Level of interest of users and developers;
- o Benefit as expressed by the user and developer community;

- o Redundancy; and
- o Low cost to benefit

The employment of this process resulted in the selection of five AEDs for development. These AEDs are:

- o SDD-1 Applied to Army CSS;
- o CSS Information System Availability;
- o Summary Data Base for Corps Commander's Required Information Needs;
- o DBMS for Corps Commander's Required Information Needs; and
- o Division Ammo Requirements DSS.

The level of funding anticipated to complete the AEDs was unknown to the project team. However, three levels ranging from \$1000K to \$2000K over a five-year period were estimated to determine which AEDs should be undertaken. Finally, a model of a five-year plan was postulated for the five selected AEDs based on a \$2000K level of funding.

The effort also keynoted two essential elements of the AIS Research Project: appropriate budgeting and procedures for periodically announcing the results of AEDs. Budgeting is more than obtaining approval to obligate the amount of monies needed to undertake the AEDs. Control of the budget is essential if the AIS Research Project is to meet its goals. AEDs will incur difficulties during the three stages leading to their completion. AIRMICS must be willing and able to terminate those AEDs doomed to failure and add monies to those having problems, but potentially successful.

The purpose of AEDs is to accomplish research on an appropriate subject which has impact on the Army user and developer communities. Procedures must be established to continue the relationships developed with these groups during both phases of the AIS Research Project and to enlarge upon these contacts. Frequent broadcast letters, briefings, visits and other such methods should be used to accomplish this aim.

## 9.0 RECOMMENDATIONS

Based on the study conclusions, AIRMICS should:

- o Obtain funding required to undertake the selected AEDs.
- o Work to establish suitably flexible budget control in order to act, based on sound managerial procedures, to research situations which arise during the implementation of the AEDs.
- o Award contracts, competitively or by sole-source selection, to appropriate universities, contractors and other agencies to assure the development of the AEDs.
- o Continue to develop the contacts established during both phases of the AIS Research Project. In particular, close relations with the Director, Army Research (Dr. Lasser); Director, Army Center for System Engineering and Integration (Mr. Diedrichsen); Combined Arms Center Development Activity (Mr. Mahoney); and personnel at the Defense Applied Research Projects Agency and Army Logistics Center are essential to the success of the AIS Research Project.
- o Establish procedures by which information obtained during all stages of the AEDs can be announced to the user and developer communities.

APPENDIX A

Advanced Experimental Demonstrations

## CSS INFORMATION SYSTEM AVAILABILITY

The research effort will be the construction of a system to demonstrate the capability to continue to provide information system (IS) service in conditions of degradation or complete failure of a key information node. Postulated will be: a five node, three level distributed information system (see Figure 1) in support of the command structure of CSS; traffic load between actual and simulated nodes; a tactical communication system; application programs at each node; and files at each node. The demonstration will be conducted in three phases: (1) complete failure of D1 causing a request from F1 to be obtained from C1 via D2. (Investigated will be a minimum of two approaches: transfer by human action and by software.) (2) degraded services at F1 causing the system to obtain backup at either the same or higher level; (3) degradation of a link between F1 and D1 causing portions of the traffic sent from F1 to C1 to be handled by another. Results of the demonstration will be development of information concerning manual and automatic switching techniques between nodes in a network; communication link capacity requirements; redundancy requirements for hardware and software; and estimates of memory storage requirements to support secondary files and programs necessary for the system to survive.

1. Purpose. (1) To determine trade-offs between switching techniques required with the degradation or failure of nodes and links; (2) to determine redundancy requirements for hardware, software and communications.

2. Lessons to be Learned. (1) Data which could be used to estimate the potential cost of providing continuity of operations; (2) human acceptability of switching technique; (3) refinement of communication requirements.

3. Environment. A combat milieu with a hierarchical network linking information systems in support of the COSCOM, DISCOM, and FASCO.

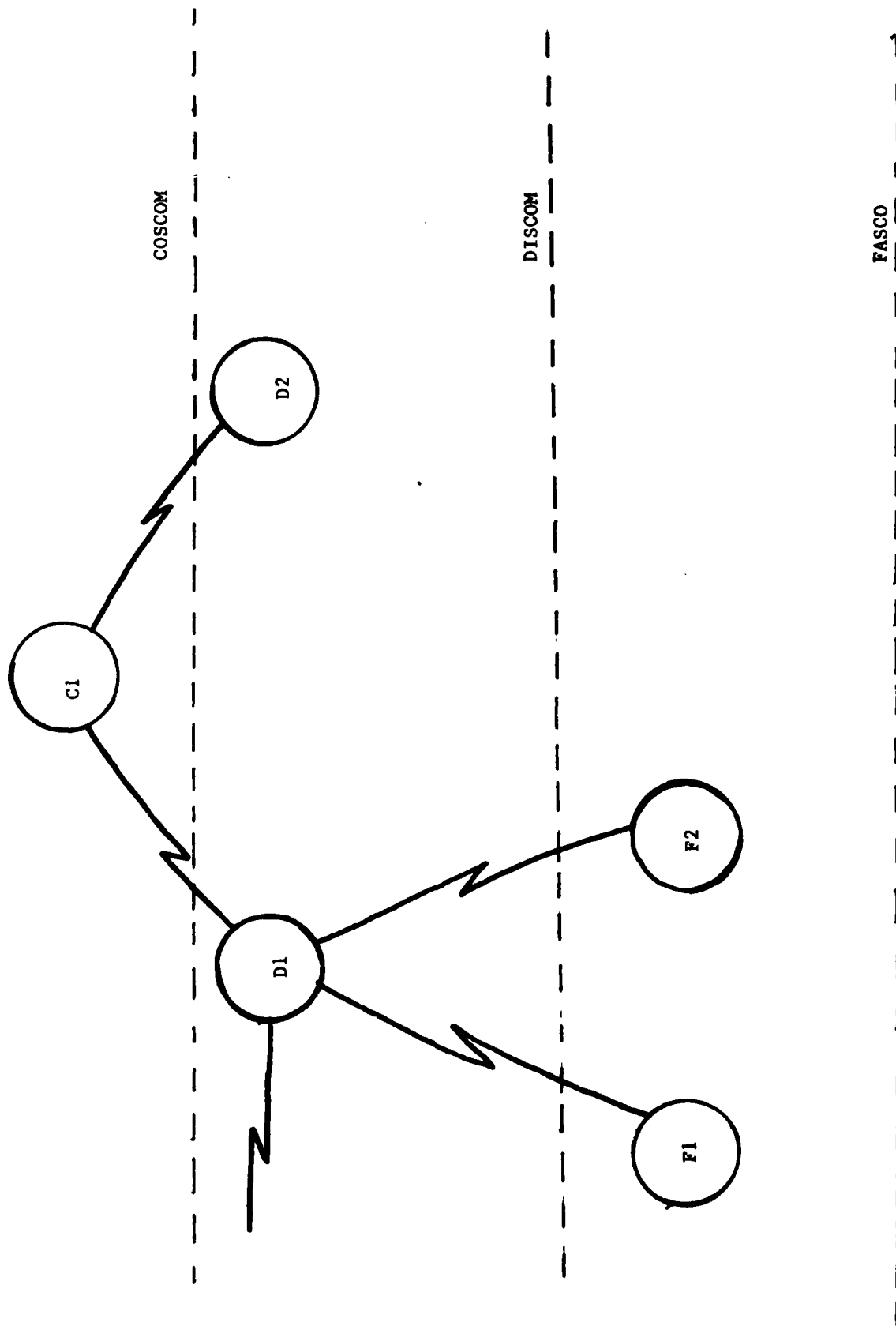
4. User. An enlisted man who is the operator of the computer used at each node.

5. Equipment. Each node would consist of a computer (possibly a TCS) and would be connected to other nodes.

6. Assumptions. None.

7. Special Requirements. Government must provide traffic and computation loads.

8. Research Issue. Continuity of operations, network architecture.



A2

Figure 1

## DISTRIBUTED CSS COMMODITY MANAGEMENT

The contractor shall design and demonstrate a procedure for distributed commodity management within a Corps, whereby COSCOM subordinate officers for such commodities as POL, ammo, and transportation assets would locally make decision recommendations as to allocation of their own resources to units within the Corps, and the Corps G4 would coordinate the overall decision process - as opposed to the current method by which the Corps G4 makes the decisions based only on information from subordinate officers rather than recommendations. The procedure shall imitate, in a functional way, the procedure by which a large linear program is solved by a decomposition method, that is, the decision will be decomposed into a set of single-commodity decisions, with coordination provided by a set of master constraints (such as POL and transportation requirements to move ammo). The system is expected eventually to offer several benefits, the two most important being (1) the amount of routine traffic of commodity information between Corps and subordinate elements would be greatly reduced, and (2) subordinate officers could participate in the decision making and gain some autonomy and local authority (although the Corps would retain full authority for the final allocation decisions).

1. Purpose. The purpose of this AED is to demonstrate a distributed procedure for CSS commodity management, and to provide a demonstration system that will allow estimation of its prospective benefits and costs.
2. Lessons to be Learned. How to distribute CSS commodity decision making and reduce commodity-management data transmittal within the Corps area. What benefits can be derived from the participate management approach toward decision making.
3. Environment. Combat environment at COSCOM.
4. Equipment. The contractor shall furnish any needed equipment.
5. User. Field grade officers at Corps G4 and COSCOM.
6. Assumptions. The contractor shall generate suitable assumptions.
7. Special Requirements. None
8. Research Issue. Information System Network Architecture, Decision Support Systems.

## SDD-1 APPLIED TO ARMY CSS

A distributed CSS information system will result in each functional area of CSS having a local data base with an inherent capability for the local user to input, store, manipulate, and query information peculiar to his needs. However, if this local user needs access to information from a peer's data base, a software-based network control system is needed so that a query or (possibly data input) made at this local user's location will search out the data base in which the correct data is (is to be located), route it back to the query location, combine it with the local information and present it to the user.

Such a software capability has been developed by the DARPA and applied to Navy command and control problems. This software in the SDD-1 system could be "captured" by the Army, modified as necessary, adapted to CSS and Army battlefield ADPE and used to experiment with distributed data bases for commodity and executive decision level information purposes.

The basic software algorithms and documentation will be obtained from DARPA and the Navy and the contractor will modify, adapt and illustrate the use of the Distributed Network Control System (DNCS) in conjunction with either real or simulated CSS Class IX data bases.

This AED contains two phases. Phase one will be demonstrated on peer level data bases at the Division Echelon. Phase two will extend the capability to either higher or lower echelons to illustrate and learn about how to control multiple echelon reporting.

1. Purpose. Evaluate the utility of being able to access data both locally and remotely with a single query.
2. Lessons Learned. How to control and maintain a distributed data base; Implications for organization.
3. Environment. Class IX logistical support at several Division HQs. At least four similar but distributed data bases will be exercised; one maintained by the contractor for test hardware and software evaluation and maintenance.
4. User. G4 at Division HQ in Phase I, G4 at Corps and Division HQ in Phase II.
5. Equipment. DAS3 with intelligent terminals and circuit (wire) and communications.
6. Special Requirements. Interactive data base query capability with realistic or simulated Class IX data base.
7. Assumptions. (1) DAS3 hardware can be obtained from commercial sources and from the CSC; (2) Interactive DBMS and intelligent terminals can be obtained from commercial sources; (3) The distributed network control system (SDD-1) can be obtained from DARPA; (4) The Class IX data bases will be derived from LogGen data; (5) Successful exercise at the Division level is to be subsequently extended to include Corps level query.
8. Research Issues. Distributed Network Architecture, Multiple Echelon Reporting.

## AUTOMATING THE LINK BETWEEN BATTLEFIELD, AND DEPOT OR BASOPS

The current link between the user in the field and the supplier in the rear area is a series of paper messages transmitted by a system of couriers and teletype machines. With the proposed automated battlefield, the means will exist to change the methods of reporting between echelons. The results of this AED will be a demonstration of the ability to pass, in near real time, status messages and requests from the battlefield to the rear area, stateside, and/or BASOPS information systems. This AED calls for access to AUTODIN type circuits from a user terminal at Corps and a demonstration of the ability to send and receive messages to the intended recipient or data base. Included are cueing protocols for message transmission by priority and the ability to route messages to multiple users. The demonstration will be in two phases:

Phase I: Examines the ability to send and receive message traffic from the CORPS HQ to a BASOPS or Depot location without human intercession. Current Army communications equipment and Autodin II technology will be used to the maximum extent possible. (See Figure 1)

Phase II: Extends the complexity of multiple inputs, varying priorities of digital messages, and multiple addressees. The messages from II CORPS can be simulated. This phase will include a cost/benefit analysis of the AED system and the current communications center system. (See Figure 2).

1. Purpose. Phase I. (a) To engineer the circuits and interfaces required for user to user transactions; (b) To determine requisite modifications (if any) to existing communications or CSS battlefield ADP equipment.

Phase II. (a) To examine routing protocols and traffic priorities among multiple users; (b) To send digital messages to multiple addressees; (c) To analyze benefits from demonstrated system vs. current system.

2. Lessons Learned. An understanding of required interfaces and a quantifiable appreciation for the information requirements and communications loading from field to BASOPS or Depot.

3. Environment. Corps HQ to rear area BASOPS. Class IX information will be used for demonstration in Phase I. Phase II may expand the data base to types of information.

4. User. G4 at Corps HQ and operator at BASOPS (SAILS) location.

5. Equipment. Terminal with digital communications capability at CORPS (possibly a TCS or DLDED) and one terminal each at BASOPS and Headquarters.

6. Assumptions. The Autodin Access and Transmission equipment will be GFE.

7. Special Requirements. Army will provide messages to simulate wartime operations communications between II Corps on the battlefield and the BASOPS SAILS system and supporting HQ.

8. Research Issue. Multiple Echelon Reporting, Data Communications.

PHASE I

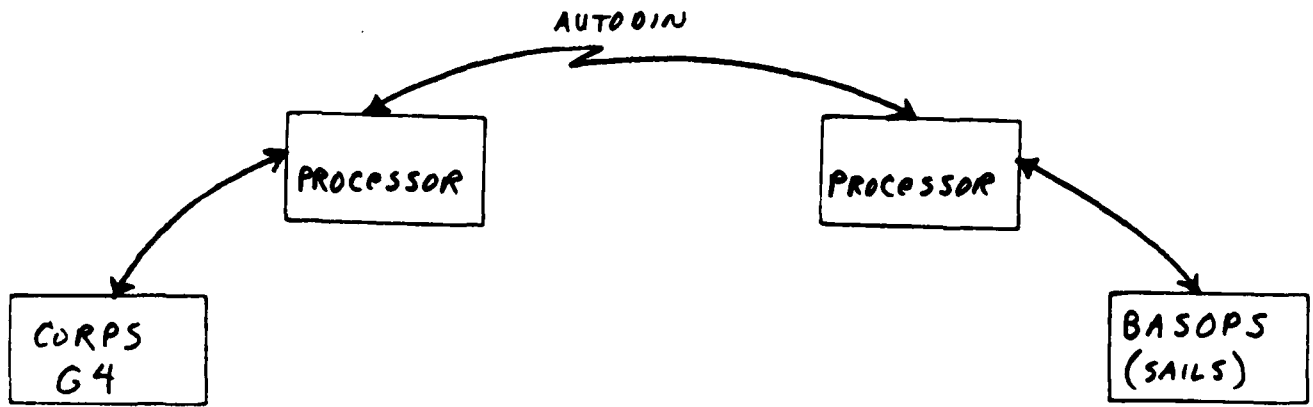


FIGURE 1

PHASE II

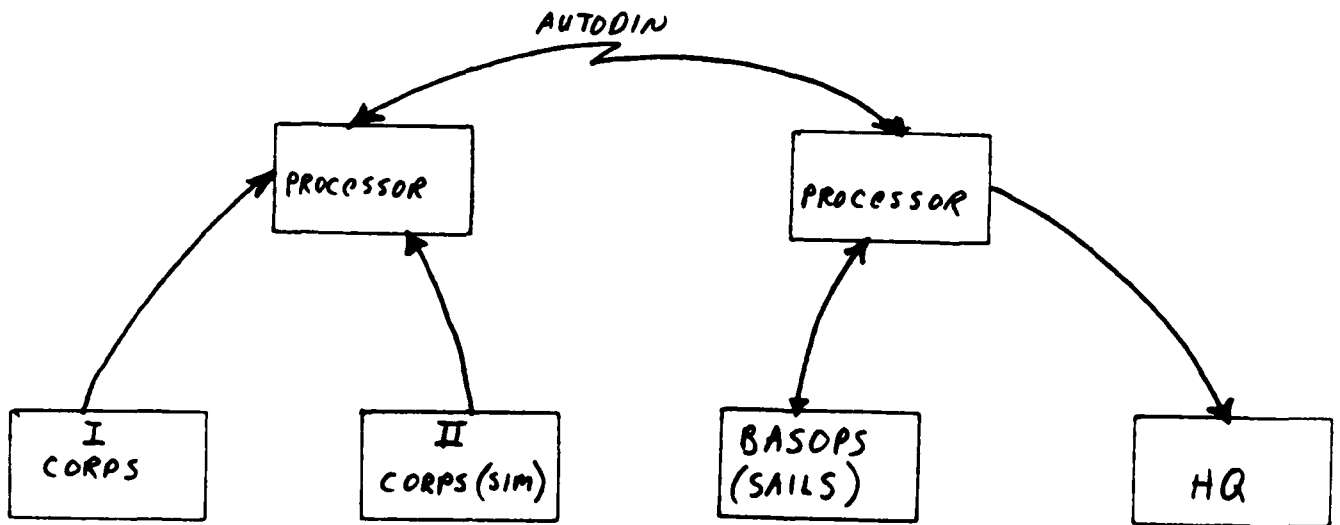


FIGURE II

## BATTLEFIELD READINESS STATUS

The Army has a peace time readiness reporting status system delineated in AR 220-1. This regulation describes a roll-up capability starting at the lowest level (separate detachment, company or battalion level organization) through division to the major command with Corps, while not in the chain of command, using the reporting system as a primary management tool. Major readiness components of a unit's rating are: personnel, logistics, and training. Knowing the status of an organization is more important in combat, particularly for the G3 and his staff, who uses the maneuver control system. The contractor shall design, develop and demonstrate a battlefield readiness status capability based on maintenance of status of separate detachments, companies and battalions. Readiness conditions will be expressed in two categories: ready (in three levels of C1, C2 and C3) and not ready (C4). Categories which will derive these conditions are:

### Personnel Readiness

- Personnel fill
- Positions filled by qualified personnel
- Personnel readiness rating

### Logistics Readiness

- Total reportable equipment line items
- Equipment line item density
- Pacing item density
- Equipment operationally ready rate
- Pacing item operationally ready rate
- Ammunition rating
- Fuel rating
- Equipment status rating

Users of the system are anticipated to be located at organizations from reporting unit through corps. These users will have the capability of determining the rating of reporting units, groups of reporting units by task organization, and aggregations at brigades, divisions and corps. In addition, the user shall have the capability of further interrogation of the system to determine the personnel and readiness categories and subcategories. Normal use of the system will cause queries to be generated by the G3 staff in the maneuver control domain with the information required to complete the report stored in the combat service support domain. The report should be generated in the CSS domain and transmitted to the G3 for display.

1. Purpose. (1) To develop software required to query, aggregate, summarize, and respond to request for unit, task force, division, and corps status. (2) To demonstrate the capability in a field environment.
2. Lessons Learned. (1) Determine the usefulness of a reporting system to the G3; (2) Enhance the interface between command and control in maneuver control and combat service support. (3) Develop a proper display of readiness information.
3. Environment. Combat environment simulated in field test. Data will be

transmitted by standard Army tactical communications, ie. TRITAC, SINGARS and PJH. Queries will be initiated by G3 staff at Division, using the maneuver control system; replies generated in CSS, display of information at G3.

4. User. Field grade officer who is on G3 staff.
5. Equipment. DAS3 at CSS; TCS at G3 (Maneuver Control System).
6. Special Requirement. Army will provide the equipment, personnel to conduct the test and record data, and a test data base.
7. Assumptions. None
8. Research Issues. Decision Support System, Interface between C2 at MC and CSS.

## DIVISION WATER POINT LOCATION DSS

A preliminary DSS for locating water supply points in accordance with FM 5-17, with emphasis on minimizing total resupply effort (gallon-miles) by supported units who must pick up 400-gal water loads at the designated water points, has been developed and is ready for user testing. The data structures and user interfaces, in particular, are not well designed in the preliminary DSS, although it functions accurately and has satisfactory response times. The contractor shall (1) perform surrogate-user familiarization tests to identify needed improvements (test subjects supplied by contractor), (2) propose a specific set of enhancements and modifications, and obtain preliminary AIRMICS approval of them, (3) write specifications for enhancements and modifications, and obtain AIRMICS approval of the specifications, (4) write, verify, document, and demonstrate the enhanced and modified version, (5) design, implement, and analyze formal user experiments to measure solution accuracy, solution time, and user learning rates on a population of contractor-generated test problems, using Government-furnished users, and (6) recommend further development of the DSS.

1. Purpose. The purpose of this AED is to demonstrate and evaluate the capability to provide computer support of the Division Engineer in locating favorable water supply points. Favorable demonstration should imply the feasibility of providing similar DSS for other location decisions such as ammo depots, POL points, motor pools, etc., within the CSS purview.

2. Lessons to be Learned. Workability of small self-contained micro-processor-based DSS for CSS planning and operating decision support.

3. Environment. The demonstrations will be performed under "office" conditions simulating a CSS operation on the battlefield.

4. Equipment. The demonstrations and experiments must be performed on a stand-alone Chromatics CG-1999 color graphics system with 50K of user memory, light pen, digitizer pad, and dual floppy disk drives. The Government will supply this equipment for demonstration and testing; in addition, the contractor may obtain scheduled access of up to 10 hours weekly at either Atlanta, GA or Ft. Lee, VA. The Government will furnish two duplicate floppy disks containing documented code and a test problem, in BASIC language, and two copies of the master's thesis which documents the entire DSS.

5. User. The user will be the Division Engineer or a subordinate staff member.

6. Assumptions. The situation map forming the background for locating combat units and proposed water point locations is assumed to be available in hardcopy form at a suitable scale. The user is assumed not only to desire to locate water points, but also sometimes to desire to identify favorable water points so as to reduce the number of needed reconnaissance missions to prospective water points.

7. Special Requirements. None

8. Research Issues. Decision Support Systems.

## SUMMARY DATA BASE FOR CORPS COMMANDERS REQUIRED INFORMATION NEEDS

To demonstrate a capability to create a data base of summarized information to satisfy the Corps Commanders Required Information Needs. To test this concept we have chosen Class IX supplies where the required information need as defined in the TIC (E Systems Study G 7139.01.27, July 79) is for critical items. This AED will give the Corps Commander or his G-4 the means to query the data base and display summary data on critical parts for management and planning purposes.

The current data base on Class IX parts consists of raw data from all units in the Corps. Out of this data base will be created another data base containing that information needed for management and planning purposes including information of critical parts and summary information on the system for meaningful statistical analysis. The desired display and the information content deemed meaningful will be determined in concert with the user. In addition, the user will have the capability of adjusting the criticality levels of individual parts. Information in the new data base will be updated both periodically and by transaction to ensure currency of information.

1. Purpose. (1) Test ability to aggregate and summarize information for decision making by CORPS Commander; (2) Test information flows from CSS Data Base to CORPS Commander; (3) Evaluate workability of data summarizing and aggregation; (4) Evaluate ability to interact with the system to adjust criticality levels.
2. Lessons Learned. (1) How to use the computer to facilitate the planning and decision process; (2) Frequency of summary data base update required.
3. Environment. Corps HQ in combat environment requesting information from a summary data base especially prepared from CSS Data Base.
4. User. G4 or CORPS Commander at CORPS HQ.
5. Equipment. DAS3 hardware, DS4 software at CSS with link to terminal with query capability at CORPS HQ (e.g., TCS).
6. Special Requirements. (1) All data from CSS resides in a single data base provided by the Army; (2) CSS summary data base will be updated both by event and periodically; (3) the user will have the capability to change the level of criticality of Class IX parts.
7. Assumptions. (1) Aggregation and summary will take place in CSS domain prior to crossing the interface to MC domain; (2) Communications interface exists between CSS and MC.
8. Research Issue. Interface between CSS and C<sup>2</sup> at MC.

## DBMS FOR CORPS COMMANDERS REQUIRED INFORMATION NEEDS

To demonstrate a capability to query and display information from the CSS data base to satisfy the Corps Commanders Required Information Needs. Class IX parts will be the specific vehicle for the demonstration where the Corps Commanders Required Information Needs (as defined by the CIF) consist of critical parts. The concept tested is how responsive a DBMS will be to query by the Corps Commander or his G4. The proof of the test will be ability to plan and manage from the Corps level using information obtained directly from the CSS data base and converted to a summary form for display at the Corps.

The Army will provide a data base containing Class IX information and will assist the contractor in determining the nature of information required to provide a meaningful display.

1. Purpose. Evaluate ability of DBMS to provide meaningful display and query capability.
2. Lessons Learned. Can a DBMS make a summary data base unnecessary?
3. Environment. Corps HQ in combat environment requesting information from the CSS Data Base.
4. User. G4 or Corps Commander at Corps HQ.
5. Equipment. DBMS configured computer in CSS with link to terminal with query capability at Corps HQ.
6. Special Requirements. Data base at CSS on Class IX to be provided by the Army.
7. Assumptions. (1) DBMS capability can be obtained from commercial sources, off the shelf for purposes of the test; (2) Communications interface exists between CSS and MC.
8. Research Issue. Interface between C<sup>2</sup> at MC and CSS.

## CSS INFORMATION INPUT USING PJH

The Army has indicated that the PLRS/JTIDS Hybrid (PJH) will be available on the battlefield in the 1986 time period. The PLRS contains a small, hand-held device which has a limited capability to input data to an information system. The contractor shall develop and demonstrate a scheme to enter CSS data as described in the TIC and transmit this information using the PJH to a data base. The contractor shall also develop and demonstrate the capability for the device to receive an acknowledgement/non-acknowledgement (ACK/NACK) of a valid message.

1. Purpose. (1) To examine and document the amount and types of information which may be input into an IS using the PJH device; (2) Design, develop and demonstrate the capability to receive an ACK/NACK.
2. Lessons Learned. Feasibility of employing the PJH device as an input device; establish requirements for simple device to transmit information required but not possible using the PJH device.
3. Environment. Simulation of a combat milieu with PJH devices on the same network. Data will be transmitted over the PJH from combat, combat support, and combat service support elements of a mechanized infantry division. A Honeywell level 6 will represent the data base and host computer to transmit the ACK/NACK.
4. User. Enlisted operator of the device at each unit.
5. Equipment. The PJH device and a Honeywell level 6.
6. Special Requirement. List of information needs will be provided by the Army. The PJH will be GFE.
7. Assumption. None.
8. Research Issue. Input/Output.

## DIVISION AMMO REQUIREMENTS DSS

The contractor shall conceive, design, build, demonstrate, and evaluate an initial demonstration version of a DSS to aid a Division G4 in forecasting or estimating Division ammunition requirements given operations orders and applicable data assumed to be available in a special data base prepared from the CSS data base and available on a floppy disk or other small off-line data device.

(Preparation of the data base is not part of this project.) The contractor must support the design with a specific study of how the estimates are actually made in the field currently, including study of relevant Army documents and at least 200 hours of field observation. The aim of the DSS will be demonstrate feasibility of supporting CSS commodity requirements decisions, with ammo as a specific example, using very small stand-alone computer systems.

1. Purpose. The purpose of this AED is to demonstrate the applicability of very small stand-alone computer systems in providing decision support for CSS commodity requirements decisions, and also to gain experience in the process of performing field research to observe decision structures, in support of DSS design.
2. Lessons to be Learned. How to provide small-scale decision support for commodity-requirements decisions. How to perform observation experiments of decision-making procedures. How to create special-purpose small data bases as special reports from large MIS.
3. Environment. The demonstrations will be conducted under "office" conditions simulating a combat environment at division.
4. Equipment. The contractor shall choose and supply all equipment. The equipment must be of the smallest physical size and lowest cost consistent with satisfactory performance. Hard-copy output is not required; a desktop computer system is anticipated to be representative of a suitable choice.
5. User. The user will be the Division G4, making decisions in a combat situation after the battle has begun.
6. Assumptions. A suitable off-line data base specifically prepared for this DSS is assumed to be obtainable from the CSS MIS.
7. Special Requirements. The contractor must show capability in psychology or human factors industrial engineering to support the decision-observation experiments.
8. Research Issues. Decision Support Systems.

## INTERLINK BETWEEN DAS3, TCT/TCS, AND DLDED

Current Army thinking envisions IS support on the battlefield being provided by a variety of ADPE. Specifically, the equipment which will support elements below corps are: DAS3 (Honeywell level 6), TCS (militarized ROLM 1666), TCT (a Singer built terminal compatible with the TCS), and DLDED (IBM series 1). In the near term, the DAS3 will be the workhorse of the CSS domain; batch processing is the mode of operation. During this same time frame, the DLDED will be used in the CSS domain to reduce data to magnetic media entry. Both the DAS3 and DLDED have capabilities beyond their near term employment. The linking of these two devices in an interactive mode demonstrates the greater potential of equipment under current procurement.

Recent decisions indicate that IS support for the command and control within the CSS domain will use TCS/TCT equipment. The contractor shall demonstrate in three phases the capability to interlink the four devices in the CSS domain (Figure 1 thru 3):

Phase I: A DAS3 will hold a portion of the Class IX data base. A DLDED, TCS, and TCT supporting nodes at the Corps Maintenance Management Office, COSCOM HQ, and DISCOM HQ respectively will query the DAS3 data base and display the Class IX information received.

Phase II: Informal message traffic stating the status of personnel will be transmitted between DLDED, TCS, and TCT support the same organizations as in Phase I.

Phase III: Interlink four nodes of DLDED, TCS, TCT and DAS3 into a single net to receive information from the data base located at DAS3 and pass it to the other two nodes and to establish queries at DAS3 which are sent to the DLDED, TCS, and TCT.

1. Purpose. (1) To examine the interface between the systems; (2) To design software protocols for accessing and exchanging information; (3) Design, develop and demonstrate hardware/software modifications necessary to provide the interlink; (4) Design, develop and demonstrate a capability to interchange equipment, i.e. replace TCT with DLDED.
2. Lessons Learned. Can the systems be linked to exchange CSS information? Can the devices be interchanged?
3. Environment. DAS3 at COSCOM holding Class IX data base; TCS at COSCOM HQ; TCT at DISCOM HQ; DLDED at COSCOM Maintenance Management Office; all operating in a combat environment.
4. User. Enlisted operators of all devices/computers.
5. Equipment. DAS3, DLDED, TCS, and TCT.
6. Special Requirements. Army will provide the demonstration data base and DS4 software and design information on the equipment.
7. Assumptions. Communications will be cable for the demonstration with the contractor developing information for using radio.
8. Research Issue. CONOPS, Network Architecture.

PHASE I

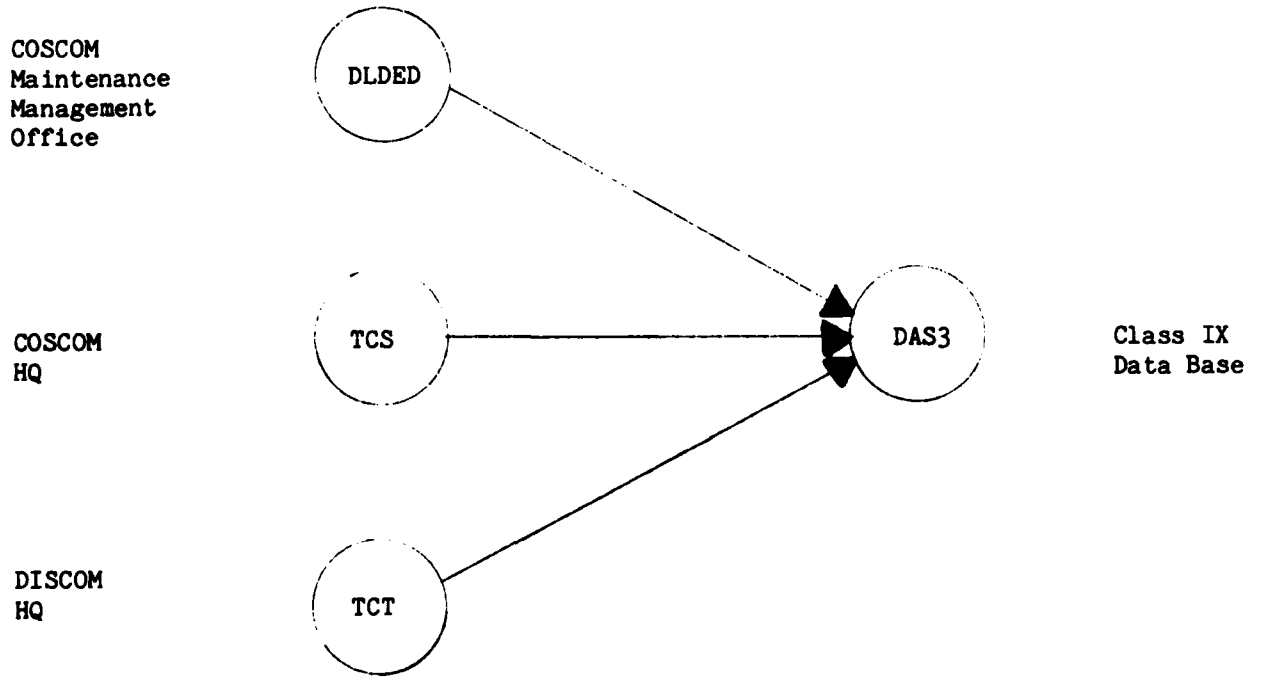
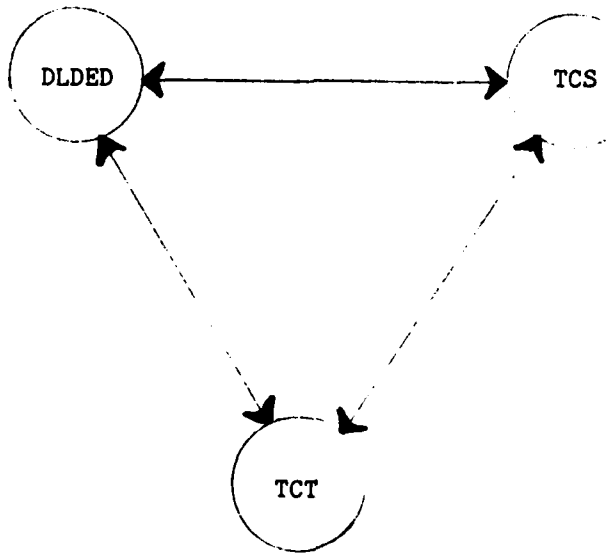


Figure 1

PHASE II

COSCOM  
Maintenance  
Management  
Office



COSCOM  
HQ

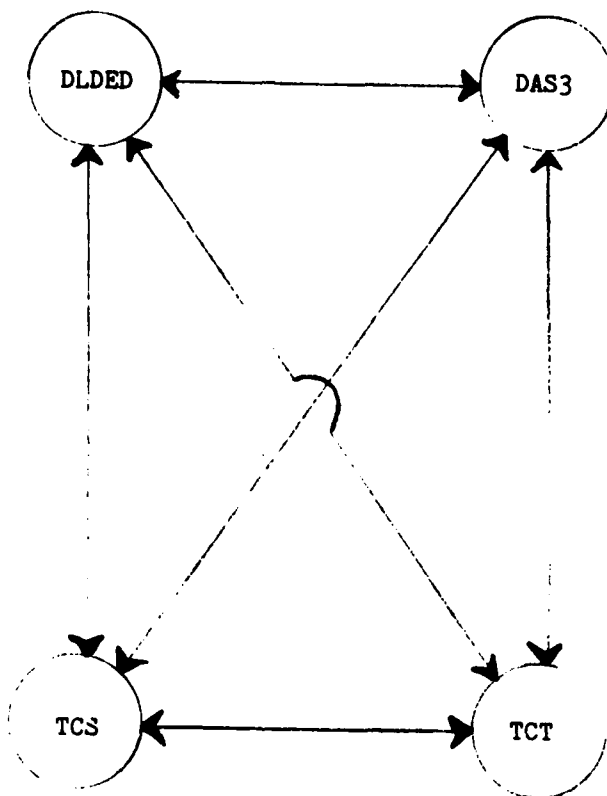
DISCOM  
HQ

Figure 2

PHASE III

COSCOM  
Maintenance  
Management  
Office

Data  
Base



COSCOM  
HQ

DISCOM  
HQ

Figure 3

## SITUATION DIAGRAM GRAPHICS GENERATOR

The contractor shall write, document, and demonstrate a turnkey software package having the capability of allowing convenient interactive creation, editing, and manipulation of static (non-moving) eight-color pictorial and alphanumeric elements (standard military map symbols, graphics symbols, user-created pictures, user-specified ASCII text strings) to provide an efficient means of creating and editing division-level battlefield situation diagrams displaying military units and Combat Service Support (CSS) assets on a color-graphics CRT screen. The package shall also be capable of efficiently supporting the creation and editing of briefing slides and network diagrams. Limited contractor access to a Government-furnished color graphics system can be provided for both development and demonstration work at either Atlanta, GA or Ft. Lee, VA. As part of the work, the contractor shall optimize the software design according to Government-furnished criteria, and shall present evidence that the approach chosen (detailed capabilities, response times, data structures, details of user interface, etc.) is cost-effective for supporting further research and development.

1. Purpose. The purpose of this advanced experimental demonstration (AED) is to demonstrate the capability, at reasonable cost and at an overall cost savings compared to present methods, to manipulate graphics symbology efficiently, so as to be able to produce such things as battlefield situation diagrams, training aids, network diagrams, briefing slides, etc., with special emphasis on being able to make detailed revisions more easily than with current methods; to provide a tool that can be user-tested by the Army in order to support the writing of suitable specifications for a prototype Graphics Generator; and to provide a tool that can be demonstrated to Army elements with special graphics-generation needs (for example, ACSAC and TASA) to enable them to contribute to specifications for further development.

2. Lessons to be Learned. How to use color graphics efficiently to support and/or replace current Army graphics-preparation methods. Workability of the concept of substituting color-graphics CRT displays for hard-copy wall charts and overlays in creating and updating static battlefield situation diagrams. Feasibility of implementing limited dynamic capabilities for movement of units in battlefield situation diagrams (for example, letting units move at specified rates and distances, continuously displaying fire-capability areas, visibility sectors, etc.).

3. Environment. The demonstration will be performed under indoor conditions with nominal 115V power supply 60-Hz alternating current.

4. Equipment. If the contractor desires to use Government-furnished equipment, it is a Chromatics CG-1999 color graphics system with 50K of user memory, light pen, digitizer pad, and dual floppy disk drives. Up to 10 hours weekly of scheduled access to this equipment can be provided at either Atlanta, GA or Ft. Lee, VA. The contractor may choose to use color graphics equipment of similar capabilities, furnished by the contractor, upon approval.

5. User. The user of the graphics generator is assumed to be DISCOM Commander Representative whose primary purpose is to display and move CSS assets on a battlefield situation diagram. Where possible, design decisions should be made to make the system also useful to anyone in the Army we must prepare a diagram or display consisting of pictorial and alphanumeric elements whose sizes, colors, and locations need to be interactively changed in order to make the diagram or display optimally effective.

6. Assumptions. Pictorial elements already exist in hard-copy form suitable for digitizing on a 10" x 10" digitizer pad. Rotation of elements is not desired. Three-dimensional graphics are not desired.

7. Special Requirements.

8. Research Issue. Decision Support Systems.

## DIGITAL TRAFFIC PROFILE GENERATOR

This research effort demonstrates the capability to create and maintain a message traffic profile of digital, radio communication which will support the units' cover and deception plan by presenting the enemy with traffic analysis information representing the arbitrary signature. The communications message traffic profile of the DISCOM will be analyzed and a scenario developed to support the number and type of message transmitted over a 24-hour period divided into 12 minute increments. A network will be established representing the computer at DISCOM HQ and a host computer emulating other DISCOM CSS elements. Algorithm will be developed to generate dummy message traffic which is added to normal traffic to create the desired profile for the DISCOM headquarters in the modes of preparation for the offensive and defensive operations.

1. Purpose. To test a method of providing security to digital traffic and overall security of operational intent.
2. Lessons to be Learned. (1) Feasibility of providing information security by a scheme to develop a message profile; (2) Method of providing message protocols to distinguish dummy and invalid messages; (3) Documentation of information flow patterns between DISCOM HQ and other DISCOM elements.
3. Environment. A combat environment of DISCOM HQ and its CSS elements simulated in the laboratory by a minicomputer and a host computer.
4. User. An enlisted operator.
5. Equipment. Keyboard, CRT, minicomputer to represent the test node; DEC VAX to represent the DISCOM elements.
6. Assumptions. None
7. Special Equipment. Government will provide access to documents, headquarters or scenarios which provide information to develop the desired profiles.
8. Research Issue. Network security.

APPENDIX B

Survey

AED #

MILITARY AND/OR SCIENTIFIC REVIEW OF A  
PROPOSED ADVANCED EXPERIMENTAL DEMONSTRATION

Please answer those questions on which you can form an opinion or give advice. When a "how much" question is asked or you wish to give a quantitative answer, please use a scale of 1 to 5 from "very little" to "very much."

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?
  
2. What would be the most important benefit to the Army if the capability indicated by this AED were to be successfully demonstrated?
  
3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?
  
4. How well does the general thrust of this AED match with your own vision of those portions of future battlefield information systems that will support Combat Service Support functions?
  
5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.



10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.

11. How valuable, for further development of information systems in general, is the potential scientific information that may be gained by implementing this AED research?

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

14. If only a few AEDs could be undertaken, would you advise AIRMICS to undertake this AED based solely on its own merits? What are your main reasons why or why not?

15. What approximate contractor cost and performance time do you deem appropriate for this initial AED effort?

16. On a 1-to-5 scale from bad to good, please evaluate this AED along the following dimensions (omit unclear or unfamiliar questions):

circle

- (a) 1 2 3 4 5 Clarity of stated purpose
- (b) 1 2 3 4 5 Direct relevance to future CSS information systems
- (c) 1 2 3 4 5 Prognosis for success of AED
- (d) 1 2 3 4 5 Scientific value of potential results
- (e) 1 2 3 4 5 Military value of potential results
- (f) 1 2 3 4 5 Wide interest in Army
- (g) 1 2 3 4 5 Wide applicability beyond specific demonstration
- (h) 1 2 3 4 5 Long-term potential in distributed information networks
- (i) 1 2 3 4 5 Cost effectiveness of initial AED effort
- (j) 1 2 3 4 5 Appropriateness within Army information system research
- (k) 1 2 3 4 5 Relevance to near-term battlefield information needs

- (l) 1 2 3 4 5 Potential for opening new R&D areas
- (m) 1 2 3 4 5 Match with current CSS procedures and functions
- (n) 1 2 3 4 5 Ability of potential contractors to implement AED
- (o) 1 2 3 4 5 Furtherance of AIRMICS research goals
- (p) 1 2 3 4 5 Generality of results, assuming success
- (q) 1 2 3 4 5 Potential contribution to battlefield information security
- (r) 1 2 3 4 5 Potential contribution to decision relevance of battlefield information
- (s) 1 2 3 4 5 Potential contribution to accuracy and reliability of battlefield information
- (t) 1 2 3 4 5 Potential contribution to reducing human effort
- (u) 1 2 3 4 5 Potential contribution to timeliness of battlefield information

### General Questions for Reviewers

After having performed the individual reviews of candidate AEDs, please provide the following information:

1. If you wish to elaborate on any answers, please put the AED number(s) and question number(s) on a sheet of paper and respond at any length. These comments and elaborations will be very useful to AIRMICS in evaluating AEDs.
2. If possible, please submit a scientific review, of any length, of any AED that looks particularly promising.
3. If possible, please submit a detailed suggestion for an additional AED candidate.
4. If possible, identify any important research issues, pertaining particularly to (Combat Service Support) CSS portions of future battlefield information systems, that are underrepresented or left untouched by this group of AEDs.

APPENDIX C

Benefit Rating

Respondent # 1

AED	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	5	4	4	5
Commodity Mgmt	2	NR	NR	NR	NR
SDD-1, Army	3	5	4	4	5
Depot/BASOPS Link	4	NR	NR	NR	NR
Readiness Status	5	NR	NR	NR	NR
Water Point DSS	6	NR	NR	NR	NR
Summary Data Base	7	4	5	4	4
DBMS for Corps	8	4	5	4	4
PJH for CSS	9	NR	NR	NR	NR
DIV Ammo DSS	10	NR	NR	NR	NR
Interlink ADPE's	11	NR	NR	NR	NR
Situation Diagram	12	NR	NR	NR	NR
Traffic Profile	13	NR	NR	NR	NR

Respondent # 2

AED	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	5	NR	4	5
Commodity Mgmt	2	NR	NR	NR	NR
SDD-1, Army	3	5	NR	4	5
Depot/BASOPS Link	4	NR	NR	NR	NR
Readiness Status	5	NR	NR	NR	NR
Water Point DSS	6	NR	NR	NR	NR
Summary Data Base	7	4	NR	4	4
DBMS for Corps	8	4	NR	4	4
PJH for CSS	9	NR	NR	NR	NR
DIV Ammo DSS	10	NR	NR	NR	NR
Interlink ADPE's	11	NR	NR	NR	NR
Situation Diagram	12	NR	NR	NR	NR
Traffic Profile	13	NR	NR	NR	NR

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C - I RANKING BY RESPONDENT

\* Combine 7 and 8

Respondent # 3

AED		Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	NR	NR	NR	NR	NR
Commodity Mgmt	2	4	4.5	4	4.5	4.5
SDD-1, Army	3	NR	2	NR	NR	NR
Depot/BASOPS Link	4	NR	NR	NR	NR	NR
Readiness Status	5	NR	2	NR	NR	NR
Water Point DSS	6	NR	NR	NR	NR	NR
Summary Data Base	7	NR	NR	NR	NR	NR
DBMS for Corps	8	NR	NR	NR	NR	NR
PJM for CSS	9	2	2	1.5	1.5	1.5
DIV Ammo DSS	10	NR	NR	NR	NR	NR
Interlink ADPE's	11	NR	NR	NR	NR	NR
Situation Diagram	12	NR	NR	NR	NR	NR
Traffic Profile	13	NR	NR	NR	NR	NR

Respondent # 4

AED		Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	5	4	4	4	4
Commodity Mgmt	2	3	3	2	2	NR
SDD-1, Army	3	4	2	4	4	2
Depot/BASOPS Link	4	3	2	4	4	NR
Readiness Status	5	NR	4	NR	NR	NR
Water Point DSS	6	1	1	NR	2	2
Summary Data Base	7	5	5	5	5	5
DBMS for Corps	8	1	NR	NR	NR	NR
PJM for CSS	9	3	3	4	4	NR
DIV Ammo DSS	10	3	2	NR	NR	NR
Interlink ADPE's	11	4	3	NR	NR	NR
Situation Diagram	12	4	3	4	4	NR
Traffic Profile	13	2	2	NR	1	1

Respondent # 5

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	3	NR	NR	NR
Commodity Mgmt	2	NR	NR	NR	NR
SDD-1, Army	3	3	3	NR	NR
Depot/BASOPS Link	4	3	2	NR	NR
Readiness Status	5	NR	NR	NR	NR
Water Point DSS	6	NR	1	NR	NR
Summary Data Base	7	NR	NR	NR	NR
DBMS for Corps	8	NR	NR	NR	NR
PJH for CSS	9	NR	NR	NR	NR
DIV Ammo DSS	10	NR	NR	NR	NR
Interlink ADPE's	11	NR	NR	NR	NR
Situation Diagram	12	NR	NR	NR	NR
Traffic Profile	13	2	4	4	2

Respondent # 6

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	5	4	4	4
Commodity Mgmt	2	2.5	2	2	3
SDD-1, Army	3	5	4	4	4
Depot/BASOPS Link	4	5	3	4.5	4
Readiness Status	5	5	4	4	5
Water Point DSS	6	NR	NR	NR	NR
Summary Data Base	7	4	3	5	4
DBMS for Corps	8	4	4	5	4
PJH for CSS	9	2	1	1	2
DIV Ammo DSS	10	3	5	4	3
Interlink ADPE's	11	3.5	3	4	3.5
Situation Diagram	12	NR	NR	NR	NR
Traffic Profile	13	NR	NR	NR	NR

Respondent # 7

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	2	2	2	1
Commodity Mgmt	2	5	5	4	3
SDD-1, Army	3	3	1	2	4
Depot/BASOPS Link	4	2	2	3	2
Readiness Status	5	3	2	3	2
Water Point DSS	6	4	2	4	3
Summary Data Base	7	3	2	2	3
DBMS for Corps	8	2	2	2	3
PJH for CSS	9	2	2	4	5
DIV Ammo DSS	10	2	2	3	3.5
Interlink ADPE's	11	2	2	3	3
Situation Diagram	12	4	4	4	4
Traffic Profile	13	3	2	3	2.5

Respondent # 8

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	4	5	4	4
Commodity Mgmt	2	2	2	2	1.5
SDD-1, Army	3	5	4.5	5	5
Depot/BASOPS Link	4	3	4	5	4.5
Readiness Status	5	5	5	5	5
Water Point DSS	6	4	3	3	4
Summary Data Base	7	5	4.5	5	5
DBMS for Corps	8	NR	NR	NR	NR
PJH for CSS	9	2	NR	NR	5
DIV Ammo DSS	10	4	4	NR	4
Interlink ADPE's	11	4	5	NR	4
Situation Diagram	12	4	5	NR	3
Traffic Profile	13	3	NR	NR	NR

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\* Combine with # 7

Respondent # 10

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	NR	4	4	NR
Commodity Mgmt	2	NR	NR	NR	NR
SDD-1, Army	3	NR	NR	NR	NR
Depot/BASOPS Link	4	NR	NR	NR	NR
Readiness Status	5	2	2	5	NR
Water Point DSS	6	5	3	3	5
Summary Data Base	7	5	2	5	4.5
DBMS for Corps	8	5	2	5	4.5
PJM for CSS	9	4	2	4	5
DIV Ammo DSS	10	5	3	3	5
Interlink ADPE's	11	3	2	2	3.5
Situation Diagram	12	3	3	3	5
Traffic Profile	13	1	NR	NR	NR

Respondent # 9

AED		Dimension			
		Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
CSS Info System	1	3.5	2	4	2.5
Commodity Mgmt	2	2	1	2	3
SDD-1, Army	3	4	4	4	5
Depot/BASOPS Link	4	4	4	4	3.5
Readiness Status	5	4.5	3	4	4.5
Water Point DSS	6	4	3	4.5	4
Summary Data Base	7	4	3	4	4.5
DBMS for Corps	8	4	3	4	4.5
PJM for CSS	9	3	2	3	3.5
DIV Ammo DSS	10	4	3	5	5
Interlink ADPE's	11	3.5	2	3	3.5
Situation Diagram	12	4	2	3	4
Traffic Profile	13	3	2	3	3.5

CSS Info System

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		5	4	4	5
2		5	NR	4	5
3		NR	NR	NR	NR
4		5	4	4	4
5		3	NR	NR	NR
6		5	4	4	4
7		2	2	2	1
8		4	5	4	4
9		3.5	2	4	2.5
10		NR	4	4	NR
AVG		4.06	3.57	3.75	3.6
NR		2	3	2	3
					10

Commodity Mgmt

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		4	4.5	4	4.5
4		3	3	2	NR
5		NR	NR	NR	NR
6		2.5	2	2	3
7		5	5	4	3
8		2	2	2	1.5
9		2	1	2	3
10		NR	NR	NR	NR
AVG		3.08	2.92	2.66	3
NR		4	4	4	5
					17

SDD-1, Army

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		5	4	4	5
2		5	NR	4	5
3		NR	2	NR	NR
4		4	2	4	2
5		3	3	NR	NR
6		5	4	4	4
7		3	1	2	4
8		5	4.5	5	5
9		4	4	4	5
10		NR	NR	NR	NR
AVG		4.25	3.06	3.86	4.29
NR		2	2	3	3
					10

Depot/BASOPS Link

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		3	2	4	NR
5		3	2	NR	NR
6		5	3	4.5	4
7		2	2	3	2
8		3	3	4.5	4.5
9		4	4	4	3.5
10		NR	NR	NR	NR
AVG		3.33	2.66	4.0	3.5
ENR		4	4	5	6
					19

Readiness Status

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		2	2	5	NR
2		NR	NR	NR	NR
3		NR	2	NR	NR
4		NR	4	NR	NR
5		NR	NR	NR	NR
6		5	4	4	5
7		3	2	3	2
8		5	5	5	5
9		4.5	3	4	4.5
10		2	2	5	NR
AVG		3.58	3	4.3	4.13
ENR		4	2	4	6
					16

Water Point DSS

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		1	1	NR	2
5		NR	1	NR	NR
6		NR	NR	NR	NR
7		4	2	4	3
8		4	3	3	4
9		4	3	4.5	4
10		5	3	3	5
AVG		3.6	2.17	4.13	3.6
ENR		5	4	6	5
					20

Summary Data Base

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		4	NR	4	4
2		NR	NR	NR	NR
3		5	5	5	5
4		NR	NR	NR	NR
5		NR	NR	NR	NR
6		4	3	5	4
7		3	2	2	3
8		5	4.5	5	5
9		4	3	4	4.5
10		5	2	5	4.5
AVG		4.29	3.25	4.29	4.29
#NR		3	3	3	3
					12

DBMS for Corps

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		4	NR	4	4
2		4	NR	4	4
3		NR	NR	NR	NR
4		1	NR	NR	NR
5		NR	NR	NR	NR
6		4	4	5	4
7		2	2	2	3
8		NR	NR	NR	NR
9		4	3	4	4.5
10		5	2	5	4.5
AVG		3.43	2.75	4	4
#NR		3	6	4	4
					17

PJH for CSS

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		3	3	4	NR
5		NR	NR	NR	NR
6		2	1	1	2
7		2	2	4	5
8		2	NR	NR	5
9		3	2	3	3.5
10		4	4	4	5
AVG		2.29	2.4	3.2	4.1
#NR		4	5	5	5
					19

Division Ammo DSS

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		3	2	NR	NR
5		NR	NR	NR	NR
6		3	5	4	3
7		2	2	3	3.5
8		4	4	NR	4
9		4	3	5	5
10		5	3	3	5
AVG		3.5	3.17	3.75	4.1
#NR		4	4	6	5
					19

Interlink ADPF's

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		4	3	NR	NR
5		NR	NR	NR	NR
6		3.5	3	4	3.5
7		2	2	3	3
8		4	5	NR	4
9		3.5	2	3	3.5
10		3	2	2	3.5
AVG		3.3	2.83	3	3.5
#NR		4	4	6	5
					19

Situation Diagram

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		4	3	4	NR
5		NR	NR	NR	NR
6		NR	NR	NR	NR
7		4	4	4	4
8		4	5	NR	3
9		4	2	3	4
10		3	3	3	5
AVG		3.4	3.4	3.5	4
#NR		5	5	6	6
					22

Traffic Profile

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1		NR	NR	NR	NR
2		NR	NR	NR	NR
3		NR	NR	NR	NR
4		2	2	NR	1
5		2	4	4	2
6		NR	NR	NR	NR
7		3	2	3	2.5
8		3	NR	NR	NR
9		3	2	3	3.5
10		1	NR	NR	NR
AVG		2.3	2.5	3.3	2.25
#NR		4	6	7	6
					23

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
AVG					
#NR					

Respondent	Dimension	Direct Benefit	Technical Opportunity	Generality	Life-Cycle Favorability
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
AVG					
#NR					

APPENDIX D  
Developmental Comments

SUMMARY DATA BASE FOR CORPS COMMANDERS  
REQUIRED INFORMATION NEEDS

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?

One researcher's comments, "Clear, but apparently redundant to ongoing CACDA activities related to TOS, TCS and other development." The CSS bias may result in "proliferation of software" and procedures. All other comments were favorable in response to this question.

3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

1985.

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.

- Maintenance of consistency between what is reported and what is really going on.

- Make demo a "super convenient system with friendly interface."

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by, this AED).

ATCL-CA, LOGCEN  
TSM SIGMA, Ft Leavenworth  
PM OPTADS, Ft Monmouth  
TOS2-ARTADS

7. How good is the prognosis for success of this AED in terms of the contractor's being able to provide a valid, successful demonstration?

"Hard to do without more operations involvement."

"High," "good," "90%," "5"

9. What organizations within the Army or DoD would be most interested in the results of this AED?

TRADOC  
CACDA, LOGCEN  
CENTACS  
CSC, ACSAC, ARTADS

10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.

No replies.

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

"No," "I think so."

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

- Change lessons to "can aggregated data be used to control logistics in a field environment."

SDD-1 APPLIED TO ARMY CSS

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?

Reply synopsis: adequate to very good.

Suggested improvements and comments: One response from the Army research community felt the research goals were unclear.

3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

Times listed were 1984 by one researcher and 1985, 1886, and 1990 by three users. Most respondents chose not to answer this question.

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.

- Most respondents said "none" or did not answer the question.
- One researcher felt the problems would be political and that we "must design (the work statement) so that local users have control over information which they do not want released."
- Another representative from the research community felt that the experiment would be unnecessarily expensive as described and that interfaces for a "MULTIBASE" approach would be better (see question 6).

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by this AED).

MULTIBASE-joint effort; NAVELEX-John Machado, AV 222-6090; DARPA/IPTO, Jack Dietzler, AV 224-5051.

7. How good is the prognosis for success of this AED in terms of the contractor's being able to provide a valid, successful demonstration?

- "Good," "high," "90%," "contractor dependent"
- No negative comments.

9. What organizations within the Army or DoD would be most interested in the results of this AED?

- ACSAC, LOGCON, ADMINCON, and CACDA were specifically mentioned by at least one respondent.
- One reply said "all."

10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.

Computer Corporation of America (CCA), Cambridge, MA.

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

- Mostly "yes" or blanks.
- One researcher who was concerned with the political implications (see question 5), felt that the scope needed "more work."

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

- One researcher offered the following changes:
  - Change references to "network control" to "data base management" since DBMS refers to manipulating the data and network should refer to a "transparent utility."
  - In paragraph one, don't limit access to only "peer's" data.
  - Use a "MULTIBASE" approach (SDD-1 follow-on effort).

CSS INFORMATION SYSTEM AVAILABILITY

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?

"Good," "adquate," "3," "fairly clear," "2"

3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

1990, 1988, 1984-85

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.

"Define goals specifically," "define techniques to be tested."

"If network is dependent on wire...the future will negate this concept....If not....this is a logical task.", "Communication system....(not) part of the narrative."

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by, this AED).

- One researcher recommended holding off on test design until "a complete current bibliography was produced."
- Packet Radio and PJH - TSM ADDS, DARPA.

7. How good is the prognosis for success of this AED in terms of the contractor's being able to provide a valid, successful demonstration?

"5", "95%", "depends on Comm system."

9. What organizations within the Army or DoD would be most interested in the results of this AED?

ACSAC  
CSC, CENTACS  
DARPA  
Logcen

10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.

Collins Radio (Packet), Hughes (PJH)  
SRI International

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

Yes

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

- "Address the communications system".
- "Scope of application/database should be spelled out before AED is approved."
- One user suggested dropping because "long range value" was low.
- "Consider potential for supporting interactive graphics plus data exchange plus interactive user to user messages."
- "See more emphasis on connectivity/data sharing, at same level of command."

DIVISION AMMO REQUIREMENTS DSS

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?

- The user community thought the goals were "clear" or "good."
- The research community, on the other hand, generally thought the goals were unclear and gave specifics on the problems as envisioned.

3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

1985, 1986, 1983-1985

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.

"Militarized hardware is starting to look more pertinent."

"Developing a mechanism for accurately translating non-standard operation orders into a form to be automatically manipulated and interacted with the LOG data base, will pose a most challenging problem."

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by, this AED).

Dr. Ruth Phelps, ARI, 202-274-8905, ARI Report; "A Prototype Aid for Evaluating Alternative Courses of Action for Tactical Engagement" D&D Inc., McLean, VA.

7. How good is the prognosis for success of this AED in terms of the contractor's being able to provide a valid, successful demonstration?

80%, high

9. What organizations within the Army or DoD would be most interested in the results of this AED?

CSC/PM TACMIS

10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) who AIRMICS should consider in procuring this AED research.

Decisions and Designs, Inc., Suite 600, P.O. Box 907,  
8400 Westpark Dr., McLean, VA 22101, (703) 821-2828

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

"Yes," "probably"

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

Two researchers took issue with the description of the AED on the grounds that the AED predefines the solution. The following changes were recommended:

- Change references to "very small," "stand-alone," "small-scale" and "special-purpose" to terms that describe the desired result.
- Change the Environment of the test to more "real world" as opposed to "office" conditions.

DBMS FOR CORPS COMMANDERS  
REQUIRED INFORMATION NEEDS

1. From the description of this AED, how clearly stated are the purposes and research goals of the experimental demonstration?

"Very clear except difference between DBMS and Summary Data Base."

"Make it another phase of Summary Data Base."

"Terrible! Purpose and lessons learned are inconsistent and dumb."

3. What would be the appropriate, reasonable time (approximate year) that you would envision actual fielding or incorporation of the eventual results of the research and development started by this AED?

1984

5. Please indicate potential difficulties or special considerations that should be reflected in the work statement or research administration of this AED.

Three of the respondents gave reference in this AED to their comments in the AED on Summary Data Base.

6. Please indicate (with project titles, managers' names, etc., where possible) any other research or development work of which you are aware that may be closely related to this AED (anything that may overlap, conflict with, provide background for, preempt, affect, or be affected by this AED).

None given.

7. How good is the prognosis for success of this AED in terms of the contractor's being able to provide a valid, successful demonstration?

"Good," "85%."

9. What organizations within the Army or DoD would be most interested in the results of this AED?

CACDA, USA Logcen.

10. Please name any specific contractors or types of contractors (universities, equipment manufacturers, system houses) whom AIRMICS should consider in procuring this AED research.

None mentioned.

12. Is this AED the smallest effort that would adequately demonstrate the desired capability?

"Yes," only one comment given.

13. Please provide suggestions for specific changes (as to scope, lessons to be learned, environment, users, assumptions, special requirements, or research issues) that would improve this AED.

- "Needs more definition."
- Three reviewers felt this AED was too similar to the AED on Summary Data Base to be separated.
- "DBMS does not provide for a meaningful display and query capability." One change was recommended by the user who thought the purpose and lessons learned were inconsistent (see Question 1).

**APPENDIX E**

**Bibliography**

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