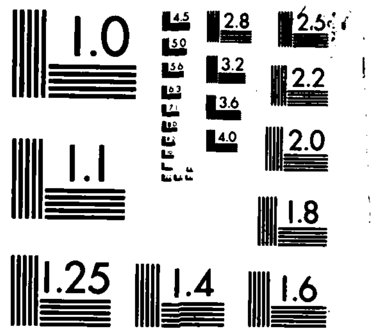
AD-A141 397 LONEX (LABORATORY OFFICE NETWORK EXPERIMENT) COST/BENEFITS STUDY VOLUME 2(U) BOOZ ALLEN AND HAMILTON INC BEDFORD MA APR 84 RADC-TR-84-62-VOL-2 1/1

UNCLASSIFIED F19628-78-C-0163 F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

RADC-TR-84-62, Vol II (of two)
Final Technical Report
April 1984

LONEX Cost/Benefits Study

Booz Allen & Hamilton, Inc.

ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, NY 13441

This report has been reviewed by the RADC Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be releasable to the general public, including foreign nations.

RADC-TR-84-62, Volume II (of two) has been reviewed and is approved for publication.

APPROVED:

JOHN L. McNAMARA
Project Engineer

APPROVED:

ALEX S. SISTI
Comptroller

FOR THE COMMANDER:

JOHN A. RITZ
Acting Chief, Plans Office

If your address has changed or if you wish to be removed from the RADC mailing list, or if the addressee is no longer employed by your organization, please notify RADC (ACML) Griffiss AFB NY 13441. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS: N/A
2a. SECURITY CLASSIFICATION AUTHORITY: N/A	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): N/A	5. MONITORING ORGANIZATION REPORT NUMBER(S): RADC-TR-84-62, Volume II (of two)
6a. NAME OF PERFORMING ORGANIZATION: Booz, Allen & Hamilton, Inc.* — 6b. OFFICE SYMBOL (If applicable):	7a. NAME OF MONITORING ORGANIZATION: Rome Air Development Center (ACML)
6c. ADDRESS (City, State and ZIP Code): Suite 27, Civil Air Terminal, Bedford MA 01730	7b. ADDRESS (City, State and ZIP Code): Griffiss AFB NY 13441
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Rome Air Development Center — 8b. OFFICE SYMBOL (If applicable): ACML	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: F19628-78-C-0163
8c. ADDRESS (City, State and ZIP Code): Griffiss AFB NY 13441	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO.: — PROJECT NO.: 9993MCNA — TASK NO.: — WORK UNIT NO.:
11. TITLE (Include Security Classification): LONEX Cost Benefits Study	
12. PERSONAL AUTHOR(S):	
13a. TYPE OF REPORT: Final — 13b. TIME COVERED: FROM ____ TO ____	14. DATE OF REPORT (Yr., Mo., Day): April 1984 — 15. PAGE COUNT: 98
16. SUPPLEMENTARY NOTATION: *Subcontractor: American Institute for Research, 41 North Road, Bedford MA 01731	

17. COSATI CODES

FIELD	GROUP	SUB. GR.
05	01	
05	02 (Continued)	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Data Processing, Office Automation, Prototype Productivity, Productivity Evaluation, Evaluation Methodology

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

This report documents the results of an analysis of costs and benefits which are expected to accrue to the Rome Air Development Center (RADC) through the acquisition and implementation of an organizational office automation system. The report has two major parts: (1) Volume I - the LONEX Cost/Benefits Study which describes the major findings and (2) Volume II - Appendix III, Cost Benefits Analysis - A comparative cost analysis is presented in accordance with AFSC regulations and guidelines. The ground rules and assumptions underlying the analysis are detailed and comparisons are made using constant, inflated and discounted dollars for three cases: (1) present (no automation), (2) lease and (3) purchase.

Appendices I & II were not published as they contain RADC unique information and have doubtful value to other organizations.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION: UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL: John L. McNamara	22b. TELEPHONE NUMBER (Include Area Code): (315) 330-7275 — 22c. OFFICE SYMBOL: RADC (ACML)

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

Block 17 (Continued)

COSATI CODES

Field	Group
09	02
14	01

PREFACE

APPENDIX III

The purpose of this Appendix is to document the detailed forecast costs and benefits which will accrue to the Rome Air Development Center through implementation of a Center-wide office automation system. These results have been summarized and incorporated into the LONEX Cost Benefits Study (May 1983).

This Appendix utilizes a format based on guidance contained in Air Force Systems Command Manual 173-1, Cost Estimating Procedures, and in Air Force Regulation 178-1, Economic Analysis and Program Evaluation.

TABLE OF CONTENTS

Page Number

INDEX OF FIGURES

INDEX OF TABLES

INDEX OF ATTACHMENTS

I. INTRODUCTION

1. PURPOSE OF THE APPENDIX

The purpose of this technical appendix to the Laboratory Office Network Experiment (LONEX) Cost Benefits Study is to detail the expected costs and net savings which could be gained by the implementation of an office automation system on a broad scale at the Rome Air Development Center (RADC). The planned automation system would support the managerial, professional and administrative processes of an Air Force Systems Command (AFSC) research and development laboratory environment.

The cost-benefits analysis was performed as one of a related series of assessment activities undertaken to determine the impact of the LONEX system on RADC activities and to forecast probable effects of a full scale system at RADC. The results of the analysis are based on information gathered during the implementation of the LONEX system at RADC. The data supporting the analysis and its results were obtained from the following sources:

- A study of the RADC organizational work activities

- Comparative case studies of RADC products produced using the LONEX automated office system

- Benchmark tests of selected LONEX electronic tools

- Analysis of LONEX demonstration system hardware costs and discussions of cost factors with office automation system vendors

- Other office automation cost experience established during Project IMPACT (IMProved Administrative Capability Test), an AFSC product division office automation prototype system.

- System planning data developed by program office (RADC/ACM) personnel.

The data were gathered during the time period August 1982-January 1983.

2. SUMMARY OF RESULTS

The system costs and benefits of the LONEX demonstration system were systematically documented and analyzed to project the potential impact of an operational office automation system at RADC. The major findings from the analysis are outlined below and detailed in the remainder of this document.

Organizational Analysis

- RADC business activity was categorized in two ways: input (managerial, professional, and administrative support work) and output (product and non-product work).

- The total annual value for the RADC internal workforce was calculated to be $49.5M per year.

- Product work was estimated to comprise fifty-five percent of RADC work.

System Impact

- The quantitative potential of automation on RADC was evaluated by its effect on product work, potential labor time savings, and the value of time saved. Emphasis was placed upon the amount of time saved through automation and the value of the time savings.

- Savings estimates were based upon observations of the use of the LONEX system. Six representative products to which automation was being applied were studied and labor savings factors established to quantify the value of savings for managers, professionals, and administrative support staff.

- Based upon the study average, time savings for managers was 2 percent, professionals 27 percent and administrative support staff 55 percent.

- Extrapolating the sample results to the entire RADC organization (assuming the sample was representative and the necessary conditions for the effective utilization of automation would exist across the entire RADC organization), the value of benefits was estimated to be $6.6M annually, or $26.4M over a five year period assuming a two year phase-in and a five year system life cycle.

- Intangible or qualitative benefits were also assessed. Qualitative benefits comprised of (1) enhancements to the quality of work output and (2) improvements in the quality of work life are believed to have a potentially significant impact on the organization.

Cost Benefit Analysis

- The cost of full scale implementation of an operational system at RADC, (including investment and operations and support costs) was estimated at $23.3M over a five year life cycle. This figure is based upon the use of the LONEX system hardware configuration and the documented LONEX hardware cost history and is judged to be conservative.

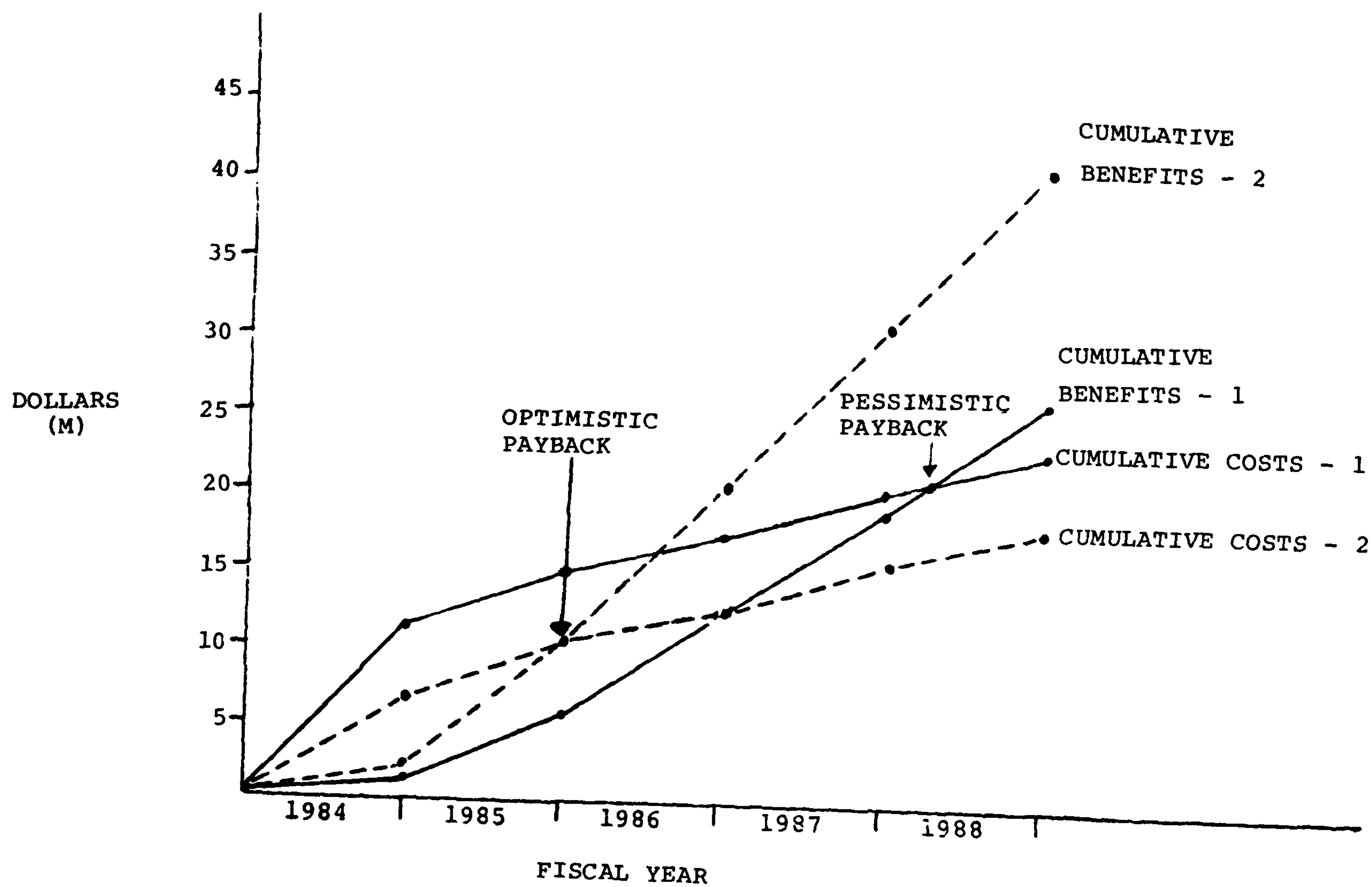
- A comparison of system cost and benefit estimates, based upon study assumptions and ground rules, indicated that the payback period would occur in slightly over four years.

- Ranges for costs and benefits were established by relaxing cost and benefit assumptions. A cost range was based upon the use of alternative system configurations; benefit range was established by considering results expected from similar systems in other Air Force organizations.

- Comparison of cost benefit ranges resulted in the formation of the cost/benefit envelope. An office automation system at RADC is expected to cost between $18.5M and $23.3M and is expected to yield between $26.4M and $41.6M benefits over a five year period. Under the least cost/maximum benefit conditions, system payback could occur in two and a half years; the payback period for the maximum cost/minimum benefits condition is estimated to have a four and one quarter year payback period. These results are presented in the cost benefit envelope shown in Figure I-1.

The remainder of this report explains how these results were derived.

FIGURE I-1
Cost Benefit Envelope



3. STRUCTURE OF THE REPORT

This document is organized according to procedures suggested in AFSC Manual 173-1, Cost Estimating Procedures, and in AF Regulation 178-1, Economic Analysis and Program Evaluation. The report is presented in the following sections:

- Background and Scope - LONEX background information is provided and the scope of the analysis is defined.

- System Description - The system equipment configuration used for the cost benefits analysis and the rationale for the selection of this system are presented.

- System Cost Estimates - Pertinent ground rules and assumptions bearing on the analysis are outlined. Basic cost data, data sources, and data uses are summarized.

- System Benefit Data - A summary of estimated benefits is presented.

- System Cost and Benefit Estimates - Predicted costs and benefits are projected and summarized.

- Risk and Sensitivity - This section discusses the areas of estimating risk and sensitivity of costs and benefits to particular aspects of the system.

II. BACKGROUND AND SCOPE

The Laboratory Office Network Experiment (LONEX) is an Air Force Systems Command Directorate of Laboratories (AFSC/DL) study to determine the impact of office automation technologies on organizational activities in an Air Force Research and Development (R&D) environment. Although the experiment was conducted at RADC, the results of the LONEX demonstration will serve to guide the future application of office automation technology by other organizations within the Command.

This section provides an overview of the LONEX project and the scope of cost-benefits analysis.

1. LONEX PROGRAM OBJECTIVES

The broad charter of the LONEX program is to explore the impact of a range of emerging office automation technologies on individual and organizational productivity in an Air Force Systems Command (AFSC) research and development organization. The LONEX system design and the implementation and assessment strategies are designed to:

- Test the limits of off-the-shelf automated office technologies in the laboratory environment.

- Gain experience in the use of office automation tools to develop specialized applications tailored to meet unique organizational requirements.

- Provide hands-on automation experience for professional and support personnel at all levels of the organization.

- Assess the impact of the system on organizational work processes.

- Provide a basis for estimating costs and benefits which could accrue in a fully automated office environment.

- Provide an experimental environment in which the sociological aspects of emerging office technologies introduced into an AFSC environment could be studied.

It is anticipated that the lessons learned from LONEX will be disseminated to other Government organizations and that the results of the experiment will be incorporated into planning for office automation throughout the AFSC laboratory community.

2. LONEX PROGRAM ASSESSMENT PLAN

The overall LONEX program was managed by RADC personnel. The system installation; maintenance of the system hardware, software, and communications capabilities; implementation of required training; and the development of operations and procedures were performed by an integrating contractor, Bunker Ramo. Booz, Allen and Hamilton, Inc., and the American Institutes for Research comprised an independent assessment team to estimate costs and benefits on the basis of the LONEX demonstration system experience.*

The focus of the assessment team's efforts was upon the the conduct of a cost-benefits analysis to determine the extent to which improvements and efficiencies were able to be realized through the use of automated office system capabilities.

*The objectives and scope of this work are set down in the Statement of Work of Contract No. F19628-78-C-00163.

Although this effort is designed to address cost benefits for RADC, it is expected that the findings can be generalized to other AFSC Laboratories with similar work activity and staffing profiles.

3. SCOPE OF THE ANALYSIS

This analysis provides estimates of the relevant costs and benefits which could be obtained through the full scale implementation of a system of automated office system technologies at RADC. This subsection describes the approach taken during the assessment and the limitations of the study.

Assessment Approach. The assessment was conducted during June 1982-February 1983 and consisted of the following tasks:

- Definition of demonstration system objectives
- Data gathering on use of automated tools
- Analysis of results on the use of these tools
- Projections of benefits
- Estimates of costs
- Preparation of a cost-benefit analysis

The results are intended to provide support for management planning and budget estimating activities for the development of an RADC operational automated office system.

The assessment approach made use of the Product Methodology developed by Booz, Allen and Hamilton for IMPACT and used in assignments at other government agencies embarking on broad scale office automation efforts. This methodology focusses upon analysis of selected tangible paper "products" prepared by an organization. Specific products are selected which are (1) labor intensive, (2) important for the accomplishment of the organization's mission, and (3) lend themselves to automation. Baseline and comparison data are collected on both manual and automated product production processes at various levels of the organization. Time and workflow measures are used to quantify the difference in the level of effort required for manual and automated operations. In addition, qualitative comparisons of manual and automated processes are made based upon user ratings and team observations.

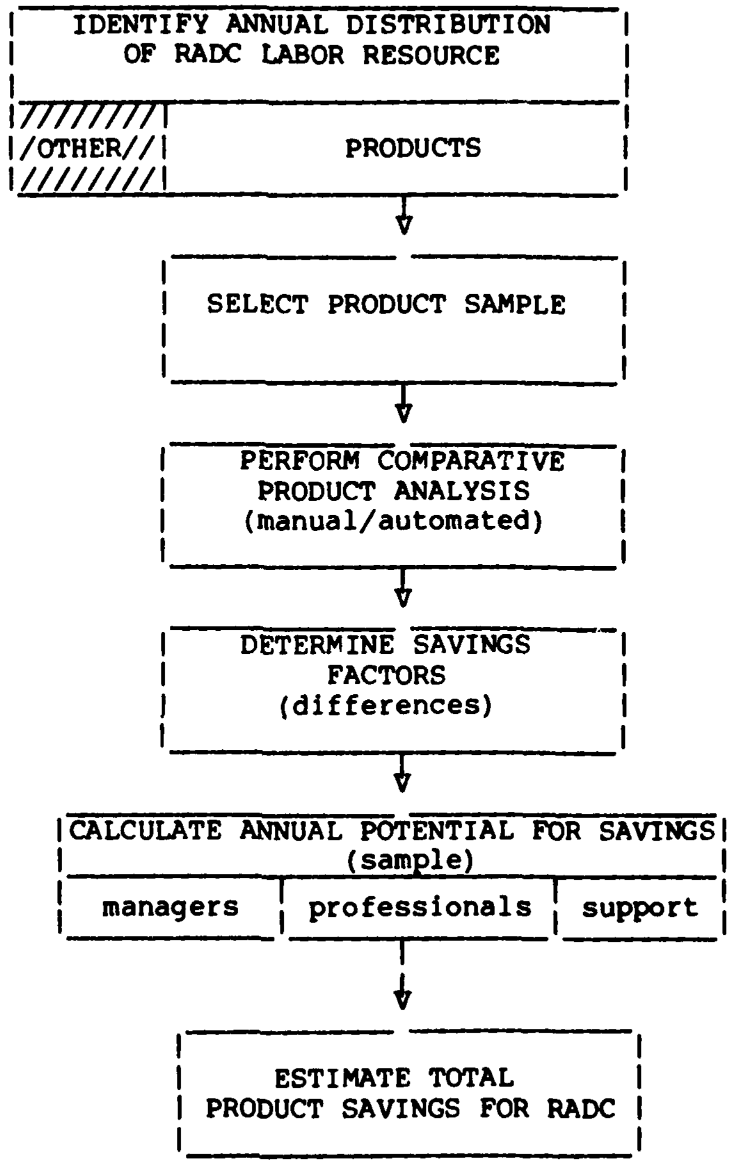
This approach was tailored for use at RADC, and implemented and revised as necessary to accommodate changes in the LONEX program schedule which affected assessment conditions. Initially the emphasis was upon the pre-contract award processing of RADC acquisitions, a 17-step process which requires several months to complete. Due to an unanticipated delay in the automation of this process, the focus of the study was shifted to other RADC products. Six representative RADC products which were being produced using the automated system during the scheduled formal test period were selected. The products were Correspondence, Briefings, Proposal Evaluation, Technical Reports, Program Status Reports (RADC Form 74) and Weekly Activity Reports.

The size of study population also changed during the demonstration. By direction from the program office, the formal assessment was scaled down from the entire RADC organization to a single RADC mission division that was designated by the program office to serve as the formal test group. Provisions were made to corroborate findings across the remainder of RADC offices as required.

Although the sample size was constrained by the size of the test group, the diversity and scheduling of study efforts permitted most division personnel to participate more than once in assessment activities. Product data for the economic analysis were provided by 6 managers, 18 engineers and 16 secretarial staff members. These individuals estimated and logged the time, steps and problems involved in the manual and automated processing of the six targeted products. Descriptive case studies of the product production process were developed from this information and data on workflow and level of effort requirements were analyzed.

Product data provided the detailed basis for the computation of benefits for the economic analysis; however, the full assessment approach involved several interrelated steps shown in Figure II-1. First, organizational products were identified and the level of effort expended annually on these products was calculated. From this segment of work, a sample of representative products was selected and data were gathered on manual baseline and automated production processes. Next, the quantitative and qualitative differences between the manual and automated processes were determined and the changes in the level of effort required to produce the sample products computed for managers, professionals and sec.etarial support staff.

FIGURE II-1
Cost Benefit Assessment Approach



To project annual time savings across all Products, the average change factor (based on differences between manual and automated work) for each of the three categories of personnel was applied against the RADC organizational work profile appropriate for automated support. Only the labor resources expended on the creation of products was considered. The total value of savings was then calculated using burdened wage rates for each category of personnel to estimate the benefit potential for a fully implemented operational system.

Study Limitations. The demonstration system results were used as a basis for estimating the likely impact of a fully operational system; however, it is important to note that the results of this analysis are affected by certain fundamental differences between the observed use of the demonstration system and the postulated use of an operational system. The most significant of these differences is user access to the system which is directly dependent upon the number of persons required to share terminals.

During LONEX, an average of 4.6 people shared each terminal. It is anticipated that the operational system will have a higher terminal density with an average of 1.6 people per terminal. This presents little problem for costing purposes as terminal and related equipment costs are reasonably well known and can be accounted for in the larger operational system. Projecting benefits is, however, a problem. Although it is believed that the more dense system will yield greater benefits, no experimental data exists on the use of a system with the planned increase in the level of user access.

Because of these study limitations, cost benefits estimates were developed in the following manner.

- A single point system cost estimate was calculated based upon an extrapolation of a LONEX-like system configuration to all of RADC.

- A single point benefits estimate was calculated based on the LONEX sample results.

- These two estimates were used as the "best estimate" of cost and benefits.

- A cost estimate range was established by comparing estimated costs of alternate configurations to the "best estimate" of cost.

- A benefits estimate range was established by comparing judgments about the RADC operational system benefits potential to the automation potential in other Air Force organizations.

- The cost and benefits ranges were used to describe a cost benefits envelope.

III. SYSTEM DESCRIPTION

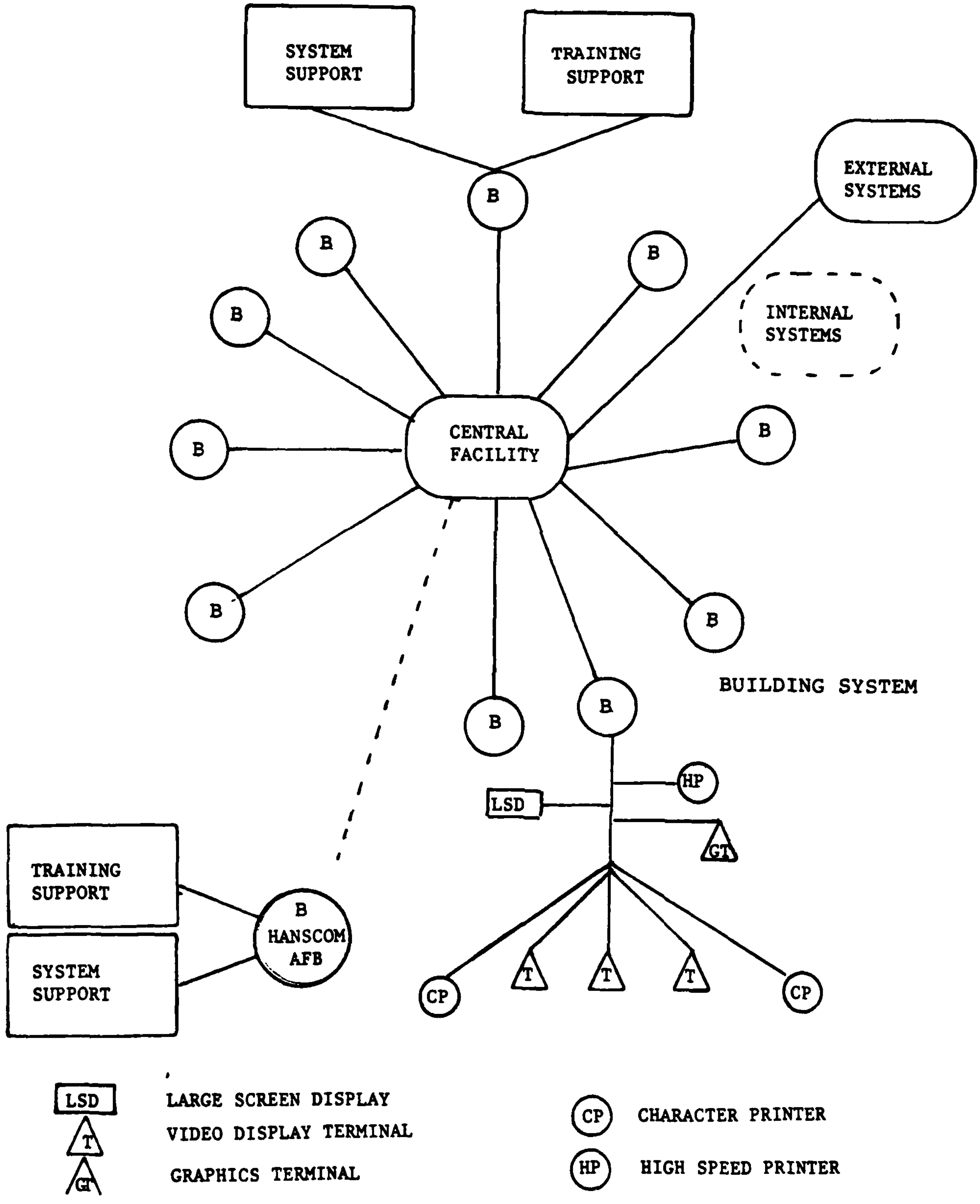
This section describes the configurations of the LONEX demonstration system and of the likely full scale operational system projected for RADC. The office automation system is designed to provide all levels of RADC professional and support personnel located at Griffiss and Hanscom Air Force Bases with access to basic communication, text, and data processing capabilities appropriate for the conventional management, engineering, financial, contractual, administrative, and clerical activities associated with RADC research and development efforts. The operational system will consist to the extent practical of commercially available equipment with proven capabilities. Because a detailed specification has not been finalized (to allow vendors to propose varying competitive configurations to meet stated requirements), certain assumptions were made about the operational system for this analysis. The assumed configuration, equipment, software, and personnel components of this system are detailed in the following subsections.

1. SYSTEM ARCHITECTURE

The operational system configuration presented in Figure III-1 is primarily an expansion of the LONEX demonstration system. The primary elements are the Building Systems (systems which will support occupants of various RADC buildings at Griffiss Air Force Base and Hanscom Air Force Bases) and a Central Facility. Each Building System contains video display terminals, graphics terminals, large screen displays and character printers. The Building Systems are linked by a communication bus with the Central Facility. Through the Central Facility, each Building System has access to other building systems and external scientific and research computer resources as well as internal RADC MIS data bases. To maintain the efficient operation and use of the system, specialized support and training resources are provided both at Griffiss and Hanscom Air Force Bases.

FIGURE III-1

OPERATIONAL SYSTEM CONFIGURATION



2. SYSTEM EQUIPMENT

The equipment requirements for the operational system are sized to support current RADC manpower and to meet RADC's unique geographic needs. The main difference between the demonstration and operational system is in the numbers of terminals. Overall, operational equipment allocations provide a 1.6:1 ratio of persons to terminals as compared to the 4.6:1 ratio of the LONEX demonstration system.

RADC managers (chiefs and assistant chiefs from the Commander down to the section chief level) and all secretarial support staff have dedicated system terminals. (In a few small staff offices, the manager and secretary could share a terminal.) Scientific and engineering staff have access to terminals on a 2:1 basis. All other professionals and support staff will have terminal access on a 4:1 ratio. Terminals are also provided to support training facilities at Griffiss and Hanscom Air Force Bases and to accommodate the activities of the system operations and support staff. Major equipment requirements for the demonstration operational system are shown in Table III-1. A more detailed description of the distribution of terminals is presented in Attachments B and Attachment C provides detailed information on the hardware configurations.

TABLE III-1
System Equipment Requirements

Type	Demonstration System	Operational System
Central Processing Units (CPU)		
Central	2	4
Building	9	28
Standalone	5	15
Printers		
High Speed	11	32
Character	100	352
Terminals		
Unintelligent	205	542
Graphics Enhanced	30	270
Large Screen Displays	4	14

3. SOFTWARE REQUIREMENTS

The operational office system will provide a basic set of off-the-shelf capabilities to including the following:

- Office System Application Package
  (comprehensive system of generic capabilities, e.g., text processing, electronic spread sheet, business graphics, electronic mail, document transfer, desk calculator and calendar management)

- Data Management System
  (limited file management and data handling capability sufficient for conventional business activities)

- BASIC Compiler

- COBOL Compiler

- FORTRAN Compiler

It is assumed some tailoring of off-the-shelf capabilities will be needed to fully meet specified requirements.

BASIC, COBOL and FORTRAN Compilers are provided to support the development of office system specialized application programs by system personnel and are not intended to service the scientific programming and analysis requirements presently handled by external computer systems.

4. SYSTEM PERSONNEL REQUIREMENTS

Implementation of a full-scale operational office automation system at RADC will require personnel to maintain the system and to provide the training necessary for its effective use. It is assumed that government personnel will provide most training and maintenance support. The estimate of total system support personnel is shown in Table III-3. Cost details are contained in Attachment D.

TABLE III-2
System Support Personnel Requirements

Position	Number
Manager	4
Data Base Administrator	2
System Analyst	4
Computer Programmer	5
Computer Operator	4
System Engineer	11
Electrical Engineer	1
Training Instructor	2
User Operations Support	3
Secretary	2
TOTAL	38

In summary, an operational automated office system has been postulated for RADC based upon a projected expansion of the LONEX demonstration system architecture. System costs estimated for acquisition and operation of the system are described in the next section.

IV. SYSTEM COST ESTIMATES

This section presents the estimated relevant costs for the acquisition and operation of a full scale automated office system for RADC. First, costing ground rules and assumptions are presented. Then the cost elements are described, including a discussion of the estimating methodologies and the cost estimates for each element. The final subsection summarizes and compares the system cost estimates for purchase and lease alternatives.

1. GROUND RULES AND ASSUMPTIONS

Ground rules are those constraints imposed on the analysis by higher authority. These include constraints from program direction, the statement of work, and the program office. The assumptions are additional estimating constraints established as part of the analysis.

The ground rules which affect this analysis may be grouped into two categories. The first deals with the nature of the organization to which automation will be applied. The second deals with constraints of the system that will be applied to the organization.

Organizational Ground Rule Constraints. The following general ground rules were used in the analysis.

- An RADC mission division (RADC/OC) was used as the formal study case.

- The organizational structure and geographic location of organizational elements will not undergo major change.

- No major change in the number and distribution of personnel is anticipated.

- The profile of research and development workloads is expected to remain constant in the near future.

- Three alternatives are to be addressed:

    (1) Present Case (continue without automation, i.e., the baseline)
    (2) Lease Case
    (3) Purchase Case

System Ground Rule Constraints. The system described in Section III was used as a basis for this analysis. It is essentially an expansion of the LONEX demonstration system which increases user access to the system through the use of more terminals and has the following characteristics.

- The operational system is comprised of commercially available equipment, proven hardware and off-the-shelf software with some tailoring.

- A detailed system architecture for the operational automated office system will not be specified by RADC. Detailed functional requirements will be delineated, and prospective bidders will be free to propose architectures able to meet specified requirements.

- The same guidelines developed for the allocation of equipment at RADC/Griffiss apply to RADC/Hanscom.

Assumptions. Most assumptions are presented in the appropriate sections of this analysis, however, some of the more significant financial assumptions are summarized below.

- A five year life cycle is assumed, beginning in Fiscal Year 1984. This assumption is based on the predicted technological life for today's typical automated office systems. The operational system could theoretically be utilized for a longer period.

- Equipment delivery and installation will be phased in through the fifteenth month of the five year period. The last nine months of this implementation period include system checkout and correction.

- Investment costs are incurred during the first two years (See Table IV-9).

- Annual operating and support costs are incurred in proportion to system cost benefits.

- The achievement of benefits lag the acquisition and training process (See Table V-3).

- Constant dollars are Fiscal Year 1983 dollars.

- Inflated dollars are based on OSD inflation rates contained in HQ AFSC/ACC letter of 16 April 1982.

- Terminal or salvage value of equipment or software at the end of the life cycle is ignored.

- The costs for office automation already incurred due to the LONEX demonstration are ignored in the Present Alternative. Thus, the baseline (Present Alternative) assumes that work is performed without LONEX or LONEX-like capabilities, and, therefore, costs are for the current level of RADC personnel only.

- A conservative costing approach for equipment provides sufficient reserve to cover estimating risk and management reserve.

System cost estimates in the next section are based on the above ground rules and assumptions.

2. COST ELEMENTS

System costs are divided into two categories. The first set includes all the costs required to provide the system to the user. These are the investment costs (sometimes referred to as acquisition costs). The second set includes the annually recurring costs related to system use. These are the operations and support (O&S) costs (sometimes referred to as ownership costs).

Investment Costs. The investment costs include the identifiable items of equipment and services required to acquire and install the system. These costs are categorized in a Work Breakdown Structure (WBS) for this system was developed using guidance contained in MIL-STD-881, Work Breakdown Structures for Defense Material Items, Appendix B, Electronic Systems. A WBS tailored for the acquisition of an automated office system is shown in Table IV-1.

TABLE IV-1
Work Breakdown Structure for an Automated Office System

WBS Level 1	WBS Level 2	WBS Level 3
RADC Automated Office System		
	Prime Mission Equipment	
		Equipment
		Software
		Communications
	Training	
		Services
		Facilities and Equipment
	System/Program Mangement	
		System Engineering
		Project Management
	Data	
	Operational Site Activation	
		Technical Support
		Assembly, Installation and Checkout
	Initial Spares and Supplies	

The investment cost elements for WBS Level 2 are defined as follows:

- Prime Mission Equipment (PME). This element includes all major hardware and computer programs required to accomplish the mission, i.e., all of the office automation equipment, software and communications elements.

- Training. This element addresses all training services and efforts required to train personnel to operate and maintain the PME and other system elements. This includes both in-house and purchased or vendor-supplied training.

- System/Program Management. This element contains the engineering, technical control and business management support for the program and its projects.

- Data. This element refers to all deliverable data required by the contract data requirement list.

- Operational Site Activation. This element includes contractor technical support, special construction required at the facilities, and services and materials involved in preparing the PME for use at the sites.

- Initial Spares and Repairs. This element refers to replacement items which will generally be consumed during system use in the first year.

Operations and Support (O&S) Costs. Operations and Support costs are comprised of those expenses which are incurred because of system use. They are incremental to system acquisition costs.

The cost elements which are expected to comprise the system O&S costs are defined below. Unless otherwise specified, they are annually recurring costs.

- System Support Personnel. This element includes the costs incurred by having personnel to operate and maintain the system.

- Training. This element refers to the costs associated with upgrading skills of personnel who have received initial training, indoctrination of new personnel during the system life cycle, and training system users in new applications.

- Maintenance. This element contains the annual costs for both periodic (scheduled and unscheduled) maintenance of automated equipment. Generally, these costs are paid to equipment vendors.

- Supply. This element contains the incidental supplies that are consumed by the operation of the sytem.

- Energy. This element addresses the additional costs for energy that will be incurred through system operation.

A summary of system cost elements is presented in Table IV-2.

TABLE IV-2
Summary of System Cost Elements

INVESTMENT COSTS
Prime Mission Equipment
Training
System/Program Management
Data
Operational Site Activiation
Initial Spares and Repairs
OPERATIONS AND SUPPORT COSTS
System Support
Personnel
Training
Maintenance
Supply
Energy

Estimates of the costs for each of the investment and operations and support elements are discussed in the next two sections.

3. INVESTMENT COST ESTIMATES

Estimates of system investment costs are discussed below by individual cost element.

Prime Mission Equipment (PME). The PME cost estimate is comprised of three parts: equipment, software, and communications.

- Equipment: Equipment cost factors are based upon hardware costs for the demonstration system. They are based upon documented, commercially available, off-the-shelf equipment, delivered and installed.

The major equipment components of the operational system are presented in Table IV-3 and reflect equipment allocations described in Section III. Unit costs reflect large-buy discount thresholds where appropriate.

TABLE IV-3
Equipment Costs

Equipment	Units	Cost Per Unit ($K)	Total Cost ($K)
System			
Central Subsystem	4	403.2*	1,612.8
Building Subsystem	28	152.6*	4,272.8
High Speed Printers	32	9.7	310.4
Standalone Subsystem	15	7.3	109.5
Subtotal			6,305.5
Peripheral			
Terminals (with glare screen)	812	1.1**	893.2
. Graphics Enhancement	270	1.1	297.0
Character Printers (with tractor feed)	352	1.7**	598.4
. Keyboard Enhancement	140	.4	56.0
Large Screen Displays	14	12.2	170.8
Subtotal			2,015.4
Total Cost			8,320.9

* Detailed computation of unit cost shown in Attachment C.

** Cost reflects large-buy discount.

- Software: Software costs are based upon commercial costs for the purchase of off-the-shelf software capabilities ($35K) plus the cost of purchased programming support to refine software to meet RADC requirements ($300K). Off-the-shelf software costs are shown in Table IV-4:

TABLE IV-4
Software Costs
($K)

Capability	Total Cost ($K)
Office Automation Package	335K*
Data Management System	5
BASIC Compiler	2
COBOL Compiler	2
FORTRAN Compiler	2
Total Cost	346

* One time license fee for comprehensive set of Basic Capabilities including word processing, electronic spread sheet, business graphics, electronic mail, document transfer, desk calculator, and calendar management. Programming support for tailoring of capabilities is $300K, i.e., three contractor programmers for one year at an average cost of $100K per person.

It is assumed that off-the-shelf software with some tailoring will provide the basic set of automated office capabilities specified by RADC. The cost of specialized software required to support specific RADC applications, e.g., the RADC seventeen step acquisition process, is not included in software costs.

- Communications: It was assumed that organizational elements at Griffiss AFB and Hanscom AFB will be tied together locally through the use of a broad band, coaxial cable bus network and that communication between Griffiss and Hanscom AFBs will be accomplished using the MILNET. A twisted pair network is presently in place at RADC Hanscom and a coaxial cable bus network is scheduled for installation at RADC Griffiss beginning in January 1983. The Griffiss network is to be used by a variety of RADC users and it is assumed that channels can be dedicated for office system use at no additional cost. It is assumed the twisted pair network at Hanscom will be replaced in the future with a coaxial cable at no additional cost.

  Access to a local area coaxial network requires the use of Bus Interface Units (BIU). It is assumed that each terminal and printer will require a BIU, a total of 1164 units being required. The BIU cost range was found to be $500-600; a midpoint of $550 was used as the unit cost. Access to MILNET for communications between Hanscom and Griffiss will require the installation of a BBCN30 interface unit at Hanscom.

  The investment costs for communications are summarized in Table IV-5.

TABLE IV-5
Communications Equipment Costs

Equipment	Units	Cost Per Unit ($K)	Total Cost ($K)
BBNC 30 MILNET Interface	1	30.0	30.0
Bus Interface Unit	1164	.55	640.2
Total Cost			670.2

- PME Total. The sum of the cost elements for equipment, software, and communications yields a Prime Mission Equipment Cost of $9337K.

Equipment + Software + Communications = Prime Mission Equipment Costs
$8,321K + $346K + $670K = $9337K

Training. Training consists of courses to teach basic skills to use and to operate the system and of courses to upgrade existing skills. The first type of training is an investment cost and includes the related training services, facilities, and equipment. The second is continuing training which is addressed as an operations and support cost.

It is assumed that both types of training will be provided using RADC training personnel and facilities and that investment training costs will be limited to the cost of commercially training a cadre of RADC system support personnel and a small group of users. The personnel, equipment and material costs associated with the establishment of an internal RADC training resource are included in other investment cost elements.

The total estimated cost for training services, based on the number of personnel to be trained and the current price of commercial courses, is $63K. The courses and personnel to be trained are presented in Attachment E. Travel costs for attendance at training at the vendor's facility are estimated at $29K. Total investment costs for training are the sum of the services and travel costs:

Training Services + Travel = Investment Training Costs
$63K + 29K = $92K

<u>System Engineering/Project Management</u>. This cost is comprised of System Engineering Support and System Project Management. Based on the RADC experience with LONEX and with ESD experience with IMPACT, it is estimated that a total of three labor years of contractor system engineering support will be required during implementation. Using current rates for automated office system support (including direct labor, other direct costs, overhead, administrative costs, and fee) of approximately $100K per year, this total is $300K.

The RADC project management costs are based on eight program management staff members (shown in Attachment F) being involved one half time for the first operational year and full time for the second year. It is assumed program office personnel will spend half time during the first year on LONEX transition activities and that the operational system is operated and managed by RADC System Support personnel following acceptance from the contractor at the end of the second year.

Based on the one and one half year allocation, the total program management costs for personnel and travel are $483K.

The total system management costs are:

Engineering Support + Project Management = System/Management Costs
$300K + $483K = $783K

Data. Most of the data costs for off-the-shelf components are contained in their purchase or lease price. Additional relevant data costs are for system level manuals describing the integration of system components, a reproducible copies of appropriate training manuals and materials, and the cost of monthly management reports. Total system data costs, estimated at $61K, are presented in Attachment G.

Operational Site Activation. Two components of costs are included under this element: construction, and assembly, installation and checkout.

It is assumed that the installation of the terminals and printers will be accommodated within present office designs. The installation of CPUs may require minor facility modifications. The costs assume grouped sets of CPUs. If three CPUs and their associated peripherals are installed together, ten rooms would be required of which three are presently available. At an average cost of $35K per room for modernization, (walls, cabling, tile, etc.) construction costs total $245K.

Assembly, installation and checkout (AI & CO) costs are expected to be similar to those typically incurred for communications and control programs, approximately three percent of the PME costs:

$$.03 \times 9{,}337 = \$280K$$

Total investment costs for operational site activation are:

Construction + AI&CO = Operational Site Activation Costs
$245K + $280K = $525K

Initial Spares and Repairs. Based on IMPACT experience, one percent of the cost of the PME will be required for spares and repairs.

Spares Factor x PME = Initial Spares and Repairs Costs
.01 x 9,337 = $93K

Investment Cost Summary. Based on the cost factors and estimates described above, the total investment cost estimated for the RADC operational office automation system is $10,891K as shown in Table IV-6.

TABLE IV-6
Estimated Investment Cost Summary
(FY83$K)

Cost Element	Estimated Cost
Prime Mission Equipment	9,337
Training	92
System/Program Management	783
Data	61
Operational Site Activation	525
Initial Spares and Repairs	93
Total	10,891

4. OPERATIONS AND SUPPORT COST ESTIMATES

System Support Personnel Costs. The annual cost for system support personnel (excluding training personnel) is $1,237K, based on the burdened salaries of 35 professionals (See Attachment D).

Annual Training. A requirement exists for continual user training. Training will be needed for (1) changes caused by personnel attrition and transfer, (2) refresher courses, and (3) new applications software and procedures. On-the-job training is assumed for new system support personnel. Assuming a complete turnover of RADC user personnel during the five year economic life of the system (20 percent per year), a permanent training staff would be required to present the basic system operations course, refresher courses and training in new application software and procedures.

The cost of the training manager and two trainers identified in Attachment D is $96.K.

Annual Maintenance. The maintenance cost for the system is based on the cost of the equipment to be maintained and a maintenance factor. The ESD experience with IMPACT showed that the average annual automated equipment maintenance costs were 15 percent of the initial hardware cost. Applying this factor to the purchase cost of the equipment contained in PME results in an estimated annual maintenance cost of:

$$.15 \times \$8,321K = \$1,248K$$

Annual Supplies. The program office estimates the cost of system supplies (paper, ribbons, print wheels, etc.) for the 1982 demonstration period to be $15K. As automation becomes more integrated into work activities and its applications expand, an increase in consumables is likely. Therefore, an annual supply cost of $60K is estimated for the operational system.

Annual Energy Costs. The equipment energy costs represent an additional cost to the Air Force. Energy cost is calculated based on estimated power consumption and a rate of $.075 per KW hour. It is estimated that the system would cost approximately $500 per day, based on an energy estimating model used by ESD/OCH for Project IMPACT. For a typical work year of 200 days this results in an annual equipment energy cost of $100K.

Days x Daily Costs = Annual Energy Cost
200 x $500 = $100K

Annual Communications. The use of MILNET to support system communications between RADC/Hanscom and RADC/Griffiss is not expected to represent an additional annual cost to the Air Force.

Operations and Support Cost Summary: Based on the cost factors and estimates described above, the operations and support costs estimated for the RADC operational office automation system is $2,741K per year as summarized in Table IV-8.

TABLE IV-8
Estimated Annual Operations and Support Cost Summary
(FY83 $K)

Cost Element	Estimated Cost
System Support Personnel	1,237
Training	96
Maintenance	1,248
Supplies	60
Energy	100
Total	2,741

5. COST SUMMARY OF PURCHASE AND LEASE COMPARISONS

The RADC automated office system is expected to be phased in over a two year period with equipment installation occurring through the fifteenth month. As shown in Table IV-9, all equipment is installed and all personnel trained by the end of the first quarter in Fiscal Year 1985.

TABLE IV-9
Two Year System Phase-In Schedule

	FY 84				FY 85			
Fiscal Year Quarter	1	2	3	4	1	2	3	4
Equipment Installed			50%	75%	100%			
Personnel Trained			50%	75%	100%			
Program Management	Half Time				Full Time			

Purchase Alternative: For the purchase case, it is assumed that $10,730K of Fiscal Year 1984 money would be obligated for investment and that an additional $322K would be obligated during Fiscal Year 1985. Operation and Support (O&S) costs are assumed to accrue at one-half the full annual rate for the first year of operation and at full cost for each of the remaining years. A total purchase cost summary is shown in Table IV-10.

TABLE IV-10
System Cost Summary - Purchase Alternative
(FY83 $K)

Cost Element	Cost Per Fiscal Year					
	1984	1985	1986	1987	1988	Total
Investment Cost	10,730	322	-	-	-	11,052
O&S Cost	1,371	2,741	2,741	2,741	2,741	12,335
Total	12,101	3,063	2,741	2,741	2,741	23,387

Lease Alternative: Unlike the purchase costs which must be borne at the front end of the program, the lease costs for equipment is expected to be incurred in proportion to the PME buildup (75% in 1984) and then evenly throughout the life cycle. Current commercial annual leasing rates for automated equipment average 48% of the purchase price, or 4% per month. Other investment costs and annual operating and support costs are the same as for the purchase case. The phase-in of equipment results in a first year's equipment lease cost of $3361K. Thus, a life cycle lease cost estimate of $35,178K is spread annually as shown in Table IV-11.

TABLE IV-11
System Cost Summary - Lease Alternative
(FY83 $K)

Cost Element	Cost Per Fiscal Year					
	1984	1985	1986	1987	1988	Total
Investment Cost (PME)	3,361	4,482	4,482	4,482	4,482	21,289
Investment Cost (Non-PME)	1,232	322				1,554
O&S	1,371	2,741	2,741	2,741	2,741	12,335
Total	5,964	7,545	7,223	7,223	7,223	35,178

Total five year cost estimates for purchase and lease cases are therefore as follows:

- $23,387K Purchase Case
- $35,178K Lease Case

V. SYSTEM BENEFIT DATA

The benefits of automation are comprised of quantifiable benefits expressed in terms of labor hours saved and of non-quantifiable improvements. The LONEX assessment provided information on both types of benefits. Over half of RADC's total labor resource is devoted to the creation of tangible paper products, e.g., correspondence and statements of work. Automated office capabilities are directly applicable to supporting these types of paper-oriented work processes; therefore, the focus of quantifiable and non-quantifiable benefits in this analysis is upon product-related work activities.

Case study data were gathered on the activities and level of effort involved in the development of representative RADC products under manual (without LONEX) and automated (with LONEX) conditions. Labor hours saved by managers, professionals and support personnel and related non-quantifiable improvements were determined and projected across all RADC product work efforts to determine the theoretically achievable benefits for a fully implemented operational system.

1. QUANTIFIABLE BENEFITS

Projecting the pattern of benefits from the LONEX demonstration system to an operational system at RADC indicates that 130 professional and 85 secretarial labor years would be made available each year for other work. This subsection describes how this estimate was derived.

The RADC labor pool contains about 1309 labor years of effort. Fifty-five percent of this resource is expended in the creation of products; the remaining productive time is devoted to work activities having less tangible outputs, e.g., conducting laboratory tests, attending meetings, travel, etc. (In addition, seventeen percent of the labor resource is commited to non-work requirements, e.g. training, sick leave and vacation.) Baseline data on the organization indicate the labor resource is distributed as shown in Table V-1.

TABLE V-1
Distribution of RADC Labor Resource

Category	Labor Years			
	Product Work	Other Work Activities	Other Non-Work	Total
Managers	94	53	30	177
Professionals	472	282	154	908
Support Staff	154	32	38	224
Total	720	362	222	1309
Percentages	55%	28%	17%	100%

To determine the portion of product labor years able to be saved through automation, savings factors due to automation were established for managers, professionals and support staff. These factors were based upon average demonstration system time savings on six RADC products which account for over 25 percent of the RADC level of effort expended on product-related work activities in a year. Savings factors were applied to RADC labor years expended in the creation of products to project the quantifiable benefits for the operational system assuming the following operational conditions:

- Adequate access to equipment is provided. Terminals and printers are positioned to provide unrestricted access to the system and system reliability is high.

- Appropriate procedures and guidelines are established. Procedures are documented and implemented to maximize the efficiency and effectiveness of users in applying system capabilities to their work activities.

- Adequate access to training is provided. A comprehensive training concept and training resources are available to provide users with basic and advanced skills and with knowledge about effective system application procedures.

- All RADC personnel are system users. RADC personnel have gained the sophistication needed to accept and to integrate system capabilities into daily work routines as a result of their demonstration system experience.

- Keyboarding skills are comparable to those documented during demonstration system assessment period.

- Transition period is effectively utilized. A significant period of time is provided prior to the implementation of the operational system to effect organizational changes to meet the requirements underlying projected benefits.

Product time savings for managers, professionals, and support staff were estimated to be 2 percent, 27 percent, and 55 percent respectively. These factors were then applied to the product work time for each category of personnel. This resulted in a calculation of the annual value of benefits shown in Table V-2.

TABLE V-2

Annual Value of Benefits With Full Implementation

Category	Labor Years Saved	Cost Per Annum * ($K)	Value of Benefits ($K)
Management	1.9	58.6	111.3
Professional	127.4	38.1	4,853.9
Support Staff	84.7	19.8	1,677.1
TOTAL	214.0	N/A	6,642.3

* A combined annual average salary is computed for each personnel category as follows:

Management: The average grade of civilian manager is assumed to be a GM-14, Step 5. A burden factor of 30.8% is applied. It is assumed that field grade officer positions have an average grade of O-5 and that 38 of the 42 authorized positions are management positions.

Professional: An average salary is computed for the company grade officers and an average grade of GS-11, Step 5, is used for the professional civilians.

Support Staff: A computed average salary is based upon an average grade of GS-4, Step 5, for secretarial staff and documented salary levels for other types of support personnel.

The accrual of benefits will lag the acquisition and training process. As shown in Table V-3, it is estimated that 25 percent of the annual potential can be realized during the first year, 75 percent during the second, and 100 percent in the subsequent years, yielding a total five year benefits value of $26,569K.

TABLE V-3
Achievement of System Benefits

Fiscal Year	Percentage of Benefits Achieved	Quantifiable Benefits ($K)
1984	25	1,661
1985	75	4,982
1986	100	6,642
1987	100	6,642
1988	100	6,642
Total		26,569

2. NON-QUANTIFIABLE BENEFITS

The automation of the RADC work activities resulted in several qualitative benefits. Although these benefits are not expressed in quantified terms of labor year dollars, they are an important aspect of automation and can sometimes be of more value to the organization than the quantitative benefits. Under conditions where cost and benefits are estimated as being essentially equal, non-quantifiable benefits can rise to become the determining factor in decisions about system implementation and use. Some of the more important qualitative benefits are summarized below.

- Improved Quality of Products. The quality of work products can be impacted by automation in two ways: appearance and content. Although it is easy to observe that automation can improve the appearance of a document, it is more difficult to judge if the content is improved. LONEX users provided insight into these two areas.

  Seventy percent of the LONEX users surveyed indicated that the use of the system had led to improvements in the appearance of the documents they produce and 53 percent reported that the quality of the contents had also improved.

  Professionals and secretaries reported that the ease of making changes using automation permitted them to be more particular about document format and the correction of minor typographical and grammatical errors. Some professionals found they were less inhibited and could communicate more clearly when they realized that the formal documents they prepared for review at higher levels of the organizations could be easily changed. They tended to focus less upon anticipating higher-level management wording preferences and to be more concerned about the message they were communicating. These professionals stated that the final documents prepared were superior to those prepared without automation. Not only were the documents usually more complete because materials could be easily added, but they were more meaningful because the statements they contained frequently were more direct.

- Improved Worker Satisfaction Levels. The majority of LONEX users were affected in positive ways by the use of automation to support their work activities. Over half reported that the demonstration system was suitable for their work activities. Seventy percent indicated that their working group was more efficient as a result of automation and that they were interested in using an enhanced operational system.

Professionals found that automation provided a level of control and freedom which improved the general nature of their jobs. The ability to easily create and change materials and the option to elect how the system would be used to support their work activities, freed professionals from the burdens imposed by the sharing and priority arrangements typically established within offices to meter out scarce secretarial resources. The option to personally keyboard drafts rather than create them in longhand for "final" typing fostered a sense of spontaneity among some professionals and permitted the creation of legible drafts able to be readily shared and discussed without undue concern about the implication of proposed changes on the secretarial typing workload or turnaround time requirements. For example, engineers and scientists interested in the development of technical reports and papers indicated that access to automated office capabilities had buoyed their hopes that they could become more prolific now that they were no longer held captive by the typing queue. Other professionals found they were more relaxed and confident about being able to meet their deadlines given the increased flexibility that automation provided to them in the scheduling and the distribution of their workloads. Professionals reported they were able to organize and perform their work in new ways. Memos and messages could be sent quickly without secretarial support; the scheduling and accomplishment of work no longer had to be tied tightly to secretarial lead time requirements; and overall, less energy was spent on checking on the status of typing in the queue to insure work would be accomplished on schedule.

Secretaries found that automation increased their satisfaction with the quality of the products they were able to produce and that it relieved some of the pressures of their job. Last minute changes or repeated changes to documents were less problematic. Repetitious work having a standard format; record keeping; and required office documentation, such as file plans, were made easier and less burdensome. Some secretaries reported they would no longer be satisfied with a job in an office which did not have at least a good standalone text processing system.

- Reduced Turnaround Time. The ability to reduce the amount of elapsed time required to handle a document can provide several types of intangible benefits. Even if automation does not reduce the amount of work effort a product requires, reducing turn-around time can help in several ways. It can limit the problems resulting from slow exchange of information and can maintain the momentum of thought processes by reducing periods of inactivity. Reduced turnaround time also can enhance other's perception of an organization's or individual's competency and can increase the general level of activity and organizational output.

The liklihood of achieving the benefits of reduced turn-around time is a function of the nature of the product and the level of effort required. The turnaround time for some products, such as internal correspondence and memos, automatically becomes shorter as a function of reducing the amount of effort required to create and to mail the product. Other products, such as the technical review of proposals, are controlled largely by external schedules and by activities which are not effected by automation. Under these conditions, the amount of elapsed time is not likely to be reduced, e.g., the formal time period allocated for proposal evaluation and the reading and thinking time of evaluators.

- Increased Availability of Information. The ability to rapidly retrieve information on a more timely, accurate, and flexible basis can permit improved product quality and enhance decision-making. Access to external scientific data bases and internal RADC management information permits professionals to expand the information base from which they work and thereby improve the quality of their output. For example, engineers can conduct more extensive document searches of archived research materials and managers can more frequently check on the status of project funds or schedules with less effort and support by others.

- Reduced File Storage Capacity. Electronic file storage can greatly decrease the need for conventional document storage facilities. The storage of office working files and the archiving of infrequently used documents decreases office space requirements, provides quick access by remote users and can reduce the liklihood of lost documents resulting from a borrower's failure to return the only hardcopy.

In summary, qualitative benefits can significantly enhance the work of mission organizations and improve the service that the staff organizations can provide. LONEX users reported the following improvements:

- Improved Document Appearance
- Improved Quality of Document Contents
- Easier Changes to Documents
- Reduced Turnaround Time
- Increased Availability of Information
- Reduced File Storage

Perhaps most importantly, LONEX users reported higher levels of work satisfaction and increased efficiency of their immediate working group.

VI. SYSTEM COST AND BENEFIT ESTIMATES

This section compares the forecast costs and benefits for the life cycle of an office automation system at RADC. The data are presented in the following formats to support the planning, budgeting and decision making process:

- Cumulative costs and benefits expected during the system life cycle.
- Comparisons of the lease and purchase alternatives using both constant and inflated dollars.
- Present (discounted) values of cost and benefits.

A fourth subsection summarizes the above results and compares the outcomes to the present cost of doing business at RADC.

1. CUMULATIVE COSTS AND BENEFITS

The estimated system costs and benefits for the five year system life for purchase and lease cases are presented in Table VI-1.

TABLE VI-1
Lease Versus Purchase Alternative
(Constant FY83$K)

Case		1984	1985	1986	1987	1988	Total
Lease	Benefits	1,661	4,982	6,642	6,642	6,642	26,569
	Cost	5,964	7,545	7,223	7,223	7,223	35,178
	Benefits -Cost	(4,303)	(2,563)	(581)	(581)	(581)	(8,609)
Purchase	Benefits	1,661	4,982	6,642	6,642	6,642	26,569
	Cost	12,101	3,063	2,741	2,741	2,741	23,387
	Benefits -Cost	(10,440)	1,919	3,901	3,901	3,901	3,182

Assuming purchase of the system, a two year implementation period, and a benefits achievement rate which lags the rate of cost accrual, payback is expected to occur shortly after four years from the start of the program. A comparison of lease and purchase alternatives, using constant Fiscal Year 1983 values, reveals that the lease alternative is not cost beneficial during the five year system life.

2. INFLATED COSTS AND BENEFITS

To account for the effect of inflation, inflation indices contained in Table VI-1 were applied to the costs and benefits for both alternatives.

TABLE VI-2
Inflation Indices*

Fiscal Year	Index
1983	100.00
1984	103.98
1985	107.67
1986	111.21
1987	114.68
1988	118.19

*Source: AFSC/ACC, Revised OSD(C) Inflation Rates as of 15 April 1982.

The application of these inflation indices to Table VI-1 yields the following results.

TABLE VI-3
Lease Versus Purchase Alternative
(Inflated $K)

Case		1984	1985	1986	1987	1988	Total
Lease	Benefits	1,727	5,364	7,387	7,617	7,850	29,945
	Cost	6,201	8,124	8,033	8,283	8,537	39,178
	Benefits Cost	(4,474)	(2,760)	(646)	(666)	(687)	(9,233)
Purchase	Benefits	1,727	5,364	7,387	7,617	7,850	29,945
	Cost	12,583	3,298	3,048	3,143	3,240	25,312
	Benefits -Cost	(10,856)	2,066	4,339	4,474	4,610	4,633

While the amounts increase over those in Table VI-1, the outcome remains the same. The Lease Alternative is not cost beneficial over the life of the system and the Purchase Alternative reaches payback during the fourth year of operation. Table VI-4 summarizes the results of the two alternatives in both constant and inflated dollars.

Table VI-4
Summary of Benefits and Costs of
Automation Alternatives
($K)

Alternative	Benefits	Costs	Benefits-Cost
Constant FY 83 Dollars			
Lease	26,569	35,178	(8,609)
Purchase	26,569	23,387	3,182
Inflated Dollars			
Lease	29,945	39,178	(39,178)
Purchase	29,945	25,312	4,633

3. DISCOUNTED COSTS AND BENEFITS

Discounting recognizes the time value of money. Simply stated, the Government could invest $.909 today at a 10 percent rate and have $1.00 a year later. Conversely, next year's $1.00 has a present value of $.909. Future alternative costs and benefits are equated to their present value, in this case to Fiscal Year 1983 values, using the techniques and discount factors (end of year factors) recommended in AFR 178-1, Economic Analysis and Program Evaluation for Resource Management.

Benefits. The benefits from automation are expected to be the same for both Lease or Purchase cases. When discounted to the present values, they sum to the amounts shown in Table VI-5.

TABLE VI-5
Discounted Benefits for Either Lease or Purchase Alternative
(Constant FY83 $K)

Fiscal Year	Total Benefits	Discount Factors	Discounted Total Benefits
1984	1,661	.909	1,510
1985	4,982	.826	4,115
1986	6,642	.751	4,988
1987	6,642	.683	4,536
1988	6,642	.621	4,125
Totals	26,569		19,274

Table VI-5 indicates that, ignoring inflation, today's value of the future benefits is $19,274.

Costs. The present values of lease and purchase costs summarized in the following two tables are based on discount factors applied to the totals contained in Table VI-1.

TABLE VI-6
Discounted Costs for Lease Alternatives
(Constant FY83 $K)

Fiscal Year	Total Lease Costs	Discount Factors	Discounted Total Lease Costs
1984	5,964	.909	5,421
1985	7,545	.826	6,232
1986	7,223	.751	5,424
1987	7,223	.683	4,933
1988	7,223	.621	4,485
Totals	35,178		26,495

TABLE VI-7
Discounted Costs for Purchase Alternatives
(Constant FY83 $K)

Fiscal Year	Total Purchase Costs	Discount Factors	Discounted Total Purchse Cost
1984	12,101	.909	11,000
1985	3,063	.826	2,530
1986	2,741	.751	2,058
1987	2,741	.683	1,872
1988	2,741	.621	1,702
Totals	23,387		19,162

The two tables above indicate that the present values of the costs for the lease and purchase alternatives are $26,495 and $19,162 respectively.

Inflated Alternatives. The next three tables repeat the discounting exercise, this time using inflated values from Table VI-3.

TABLE VI-8
Discounted Benefits for Either Lease or Purchase Alternative
(Inflated $K)

Fiscal Year	Total Benefits	Discount Factors	Discounted Total Benefits
1984	1,727	.909	1,570
1985	5,364	.826	4,431
1986	7,387	.751	5,548
1987	7,617	.683	5,202
1988	7,850	.621	4,875
Total	29,945		21,626

TABLE VI-9
Discounted Costs of Lease Alternative
(Inflated $K)

Fiscal Year	Total Lease Costs	Discount Factors	Discounted Total Lease Costs
1984	6,202	.909	5,637
1985	8,123	.826	6,710
1986	8,032	.751	6,032
1987	8,283	.683	5,657
1988	8,537	.621	5,301
Totals	39,177		29,337

TABLE VI-10
Discounted Costs for Purchase Alternatives
(Inflated $K)

Fiscal Year	Total Purchase Costs	Discount Factors	Discounted Total Purchase Cost
1984	12,583	.909	11,438
1985	3,298	.826	2,724
1986	3,048	.751	2,289
1987	3,143	.683	2,147
1988	3,240	.621	2,012
Totals	25,312		20,610

TABLE VI-11
Summary of Discounted Benefits and
Costs of Automation Alternatives
($K)

Alternative	Benefits	Costs	Benefits-Cost
Constant FY 83 Dollars			
Lease	19,274	26,495	(7,221)
Purchase	19,274	19,162	112
Inflated Dollars			
Lease	21,626	29,337	(7,711)
Purchase	21,626	20,610	1,016

Table VI-11 indicates that the application of discounting shows again that the only cost beneficial alternative is the Purchase Alternative.

4. COST AND BENEFIT SUMMARY

This section summarizes the results of the previous subsections and compares the automated alternative (purchase and lease) to the present system (no automation). Table VI-12 presents the outcomes for the three alternatives in constant dollars; Table VI-13 in inflated values.

The current annual personnel cost for RADC was calculated to be $49.5M, a total of $247.5M over five years. Under the conditions of this analysis, the net value of a leased automation system would add to the total cost. A purchased automation system, however, would yield a net savings in both constant and inflated values.

TABLE VI-12
Cost and Benefit Summary
(Constant FY83 $M)

Alternative	Fiscal Years					Total
	1984	1985	1986	1987	1988	
Present System:						
RADC Labor Cost	49.5	49.5	49.5	49.5	49.5	247.5
System Costs	--	--	--	--	--	--
- Benefits	--	--	--	--	--	--
Net Cost	49.5	49.5	49.5	49.5	49.5	247.5
Leased System:						
RADC Labor Cost	49.5	49.5	49.5	49.5	49.5	247.5
System Costs	6.0	7.5	7.2	7.2	7.2	35.1
- Benefits	1.7	-4.9	-6.6	-6.6	-6.6	-26.4
Net Cost	53.8	52.1	50.1	50.1	50.1	256.2
Purchased System:						
RADC Labor Cost	49.5	49.5	49.5	49.5	49.5	247.5
System Costs	12.1	3.1	2.7	2.7	2.7	23.3
- Benefits	-1.7	-4.9	-6.6	-6.6	-6.6	-26.4
Net Cost	59.9	47.7	45.6	45.6	45.6	244.4

TABLE VI-13
Cost and Benefit Summary
(Inflated $M)

Alternative	Fiscal Years 1984	1985	1986	1987	1988	Total
Present System:						
RADC Labor Cost	51.5	53.3	55.0	56.8	58.5	275.1
System Costs	--	--	--	--	--	--
- Benefits	--	--	--	--	--	--
Net Cost	51.5	53.3	55.0	56.8	58.5	275.1
Leased System:						
RADC Labor Cost	51.5	53.3	55.0	56.8	58.5	275.1
System Costs	6.2	8.1	8.0	8.3	8.5	39.1
- Benefits	-1.7	-5.4	-7.4	-7.6	-7.9	-30.0
Net Cost	56.0	56.0	55.6	57.5	59.1	284.2
Purchased System:						
RADC Labor Cost	51.5	53.3	55.0	56.8	58.5	275.1
System Costs	12.6	3.3	3.1	3.1	3.2	25.3
- Benefits	1.7	-5.4	-7.4	-7.6	-7.9	-30.0
Net Cost	62.4	51.2	50.7	52.3	53.8	270.4

The results of the above two tables were summarized in terms of net cost avoidance (differences between net cost of the present system and the alternatives) in Table VI-14.

TABLE VI-14
Projected Five Year Comparison of System Net Cost Avoidances
($M)

Alternative	FY83 $M	Inflated $M
Present System	0.0	0.0
Leased System	(8.5)	(9.1)
Purchased System	3.1	4.7

Based strictly on quantitative values and given the choice between not automating (Present System) or leasing an automated system for a 5 year life, Table VI-14 indicates that RADC should retain the Present System. While benefits would accrue from automation, there is no cost avoidance from leasing the system. On the other hand, the Purchase System shows a net cost avoidance over five years in terms of both constant FY83 dollars and inflated dollars.

VII. RISK AND SENSITIVITY

The objective of this section is to present information regarding areas of estimating risk and sensitivity. Under risk, the possible effects of estimating errors on costs and benefits are described. This type of post-analysis documentation points to aspects which deserve further management attention and shows what could happen to the results under varying conditions. Finally, the system cost/benefits estimates are compared to an "envelope" of possible cost/benefit results.

1. RISK

In this analysis, risk is separated into two categories: cost risk and benefits risk. The cost risk that is unfavorable is the case in which costs have been under-estimated, i.e., the system would cost more than has been estimated. Unfavorable benefits risk deals with an over-estimate of potential benefits, i.e., the system does not yield at least the level of benefits postulated.

Cost Risk. The greatest area of risk in the investment estimate is in Prime Mission Equipment (PME). PME comprises over 80 percent of the investment costs and, through its use with factors, affects other cost elements. Within PME, hardware is the largest cost component.

Hardware unit costs were based upon documented costs of LONEX system components. These costs are believed to be conservative for at least three reasons. First, the demonstration system was obtained and fielded through an integrating contractor and therefore contains equipment handling charges. An original equipment manufacturer could usually offer hardware at a lesser cost (although other services might change). Second, during the LONEX demonstration period, many hardware costs have actually decreased relative to their capabilities. Third, the acquisition of a large operational system, possibly even combined with system acquisitions for other organizations, will lend itself better to quantity discounts.

In addition to hardware, the PME estimate contains software and communications costs. Most of the basic office system software capabilities postulated for RADC have been available in the marketplace for several years and their costs are well documented. For the remaining capabilities, the estimate provides for the cost of support to tailor these basic capabilities to RADC. The software element, therefore, would not seem to be a financially risk area; however, software in general is inherently risky and should always be recognized to have moderate risk.

The communications area contains more cost risk than the other PME elements. A local area network is essential to the operation of the system. The cost estimates assume that the operational system will depend largely on a communications network comprised of components which either exist at RADC or will be installed for other purposes. Any other communications configuration will add to the cost. Additional costs could be incurred if the automated office system stretches the capabilities of these components or these components are not made available.

The non-PME investment and annual operations and support costs are based upon reasonably known requirements and upon the level of support the program office intends to provide to the system. These costs are believed to contain little risk. A summary of the assessment of cost risk is presented in Table VII-1.

TABLE VII-1
Cost Risk Assessments

Cost Element	Assessment of Cost Risk		
	Low	Moderate	High
Equipment	X		
Software		X	
Communications		X	
Training	X		
System Management	X		
Data	X		
Site Activation	X		
Initial Spares and Supplies	X		
Operations and Support	X		

In summary, best judgment indicates that the probability of an over-estimate of cost is low to moderate. It should be noted, however, that there has been no specific amount set aside for management reserve in this analysis and any "cushion" inherent in this conservative estimate could be accounted for by unanticipated factors.

Benefits Risk. Benefits risk involves the probability that the projected benefits will be achieved. The major source of estimating error deals with errors made about the sample and the subsequent extrapolation to the entire organization.

The quantified benefits predicted in this analysis are based upon a small sample of work accomplished at RADC. Efforts were made to control for any potential bias by selecting representative RADC products; however, data collection was limited to those products available during scheduled assessment period. The achievement of the projected benefits in an operational system is predicated upon the following conditions:

- Adequate access to equipment
- Established procedures and system use guidelines
- Adequate training
- User knowledge of automated capabilities prior to and during implementation of the operational system
- Use of full system applicabilities

Overall, if these conditions are met, there is a high degree of confidence that benefit expectations will be met. It was assumed that the patterns observed are reflected throughout the remainder of RADC administrative and professional, and management population.

The pattern of secretarial support savings in this analysis is similar to the results observed of other studies. To the extent that secretarial work tends to have common functions in both industry and government, there is a high degree of confidence in the results observed at RADC.

The benefits obtained through savings of managerial and professional time depend heavily upon organizational characteristics, are more sensitive to the establishment of new work processes which effectively integrate manual and automated activities, and require adequate access to equipment. The quantified savings to which should accrue to managerial users of the system are relatively small and should be easily achieved; professional savings, however, are more sensitive.

It should also be noted that the quantified benefits were projected on the basis of potential savings in RADC product time only. Product time at RADC was estimated to be 55 percent of total time. Deducting the estimated 17 percent of total time for vacation, training and leave, 28 percent remains which could be favorably impacted by automation. This portion of time is work-related, but not necessarily directly associated with products. No calculations were made on the impact of automation on this time at RADC, but certainly there will be some savings in this area too.

2. SENSITIVITY

The two key estimates developed in this analysis are the single point estimates derived for the system five year life cycle costs (purchase case) and the system life cycle benefits. These estimates, expressed in 1983 constant dollars, are:

\$26.4M,	Expected System Benefits
\$23.3M,	Expected System Cost
\$3.1M	Net Cost Avoidance

Subsequent calculations (lease case, inflation, and discounts) were based upon these two estimates and use of standard factors.

Should the key conditions used in this analysis change, the resulting best estimates would change as well. The cost estimate is most sensitive to configuration. The benefits estimate is most sensitive to requirements and intended use. An analysis of these sensitivities follows.

Cost Sensitivity. The system configuration used in this analysis was based upon use of four central processors and 28 building processors; however, this configuration may not reflect the architecture which will be selected from industry responses as the RADC operating system. As part of the sensitivity analysis, preliminary discussions were held with two vendors who suggested that a cost alternative might be based upon use of larger and more powerful (and therefore fewer) central processing units. While there is no assurance that these alternative systems could fully support operating system requirements, this vendor feedback suggests that configurations which are less expensive than those used in this analysis will be proposed.

Two hypothetical configurations which appear to superficially meet known requirements were drawn up based on the use of one central processor and ten building processors. A cost estimate for each system alternative was calculated. The average cost of these two systems was $18.5M, considerably less than the $23.3M point estimate of the analysis. It is likely that there are a number of other possible configurations, but it is believed that most, if not all, would fall somewhere within the $18.5M and $23.3M cost range.

Benefits Sensitivity. The benefits estimated for the operational system were based on data gathered on use of the demonstration system. There are two indications that the estimates of potential benefits understate full potential benefits. First, by the time the operating system is installed, lessons learned from demonstration system use will be incorporated and the user-experience level will be higher. Therefore, use of the RADC operational system should be more effective than the demonstration system. Second, additional uses beyond specified office automation requirements are likely to increase the potential for quantified benefits at RADC.

Greater productivity in an operational environment can be achieved through better use of system capabilities. Improvements are expected to result from the establishment and use of more formal system procedures, the increased training of system users, the refinement of system requirements and selection criteria, and the general improvements in automation technology which have occurred since LONEX began. Perhaps most important, both RADC management and system users have become more knowledgeable about use (and misuse) of office automation as a result of their experience with LONEX.

While the impact of applications above those designated as LONEX requirements have not been factored into the estimates of benefits, the operational system will provide equipment and procedures which will be used for information management activities beyond office automation. For example, although LONEX was designed for office automation, the capabilities and procedures can also be used for other management information and decision support activities, including entering, extracting and manipulating data from existing or planned data bases. Although the exact magnitude of this "gratuitous" effect is difficult to assess, there are no apparent reasons precluding RADC from achieving productivity increases approximating those expected for the other types of AFSC organizations comtemplating automated information management on a large scale.

In the absence of hard RADC data on these two aspects, comparisons were made with study results of the Electronic Systems Division (ESD) and the Air Force Office of Scientific Research (AFOSR). The annual value of benefits forecast for these two organizations under full operating conditions, expressed as a percentage of annual personnel costs, was 24 percent and 18 percent respectively, compared to approximately 14 percent for RADC. Obviously, there are several organizational differences which limit generalizing from one organizational system to the other. ESD is larger than RADC; AFOSR is smaller. ESD and RADC offices are spread out; AFOSR is contained in one building. ESD is an AFSC product organization; AFOSR is a management office; RADC is a laboratory. There are also many similarities. Organizational issues aside, however, the main difference appears to be the intent to use office automation capabilities to support specialized information management applications applications software contemplated at both ESD and AFOSR. These extend the potential significantly.

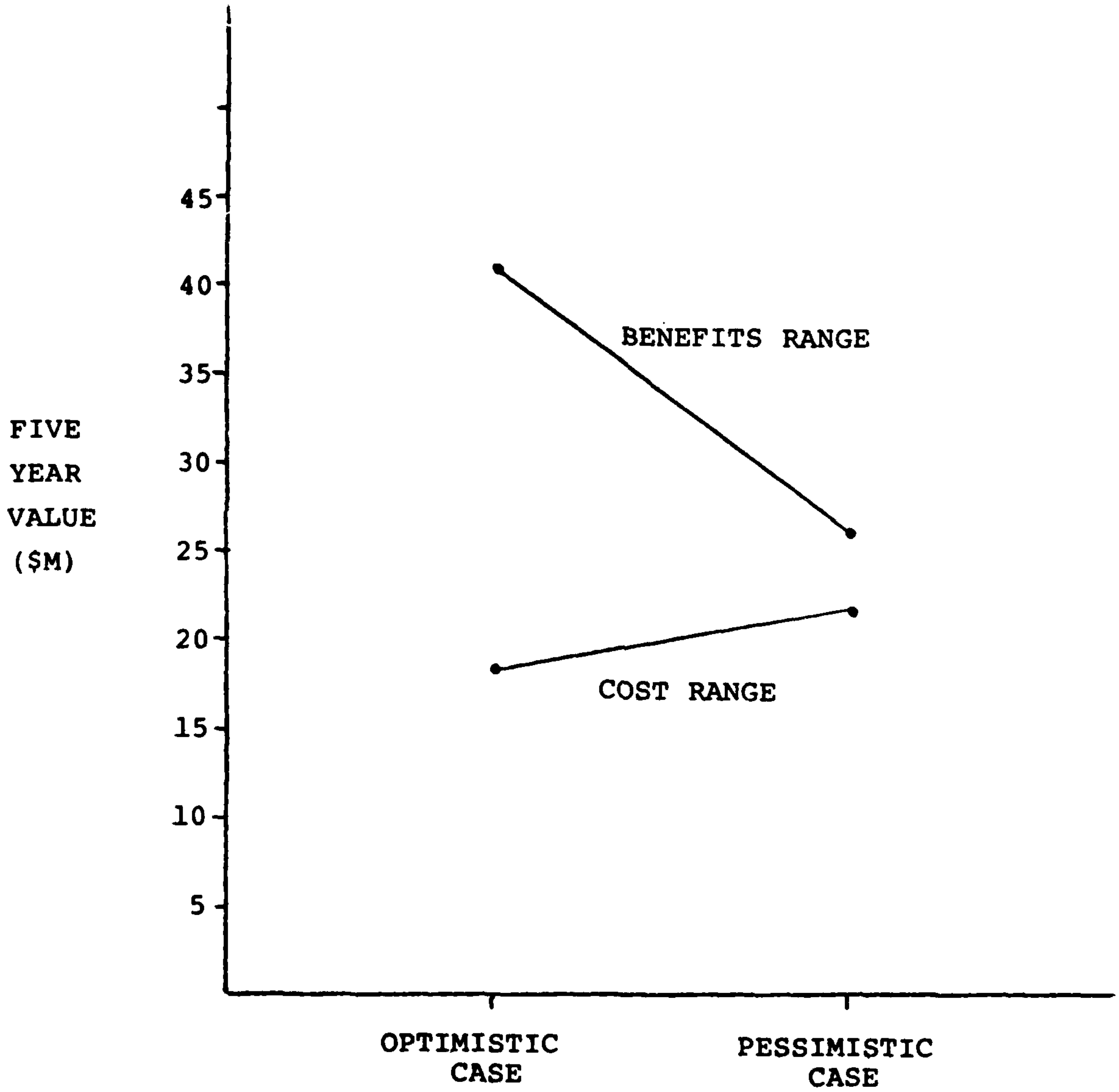
An optimistic estimate of benefits for RADC is therefore established between the ESD and AFOSR estimates. The easiest single number to use is the average of the annual personnel cost under full operating conditions, 21 percent. Implementing at 25 percent and 75 percent of the potential annual benefit of $10.4M for the first two years expecting the total five year optimistic accrual of these benefits according to the planned implementation schedule for RADC would yield a total five year benefit estimate of $41.6M.

This optimistic estimate of $41.5M, combined with the point estimate of $21.4M, is believed to be the best judgment of a benefits range based on knowledge to date.

3. COST-BENEFIT ENVELOPE

Figure VII-1 compares the cost and benefits ranges established in the previous section. In all cases the benefits are expected to outweigh the costs.

FIGURE VII-1
Cost and Benefit Ranges



An envelope of costs and benefits can be established by using the end points of the ranges established for cost and benefits. The four combinations of net cost avoidances (benefits less cost) are:

- B1, C1 - Most pessimistic case, also the best estimate based on demonstration system results

  B1- C1= \$26.4 - \$23.3 = \$3.1 M

- B1, C2 - Pessimistic benefits, Optimistic cost:

  B1 - C2 = \$26.4 - \$18.5 = \$7.9M

- B2, C1 - Optimistic benefits, Pessimistic Cost:

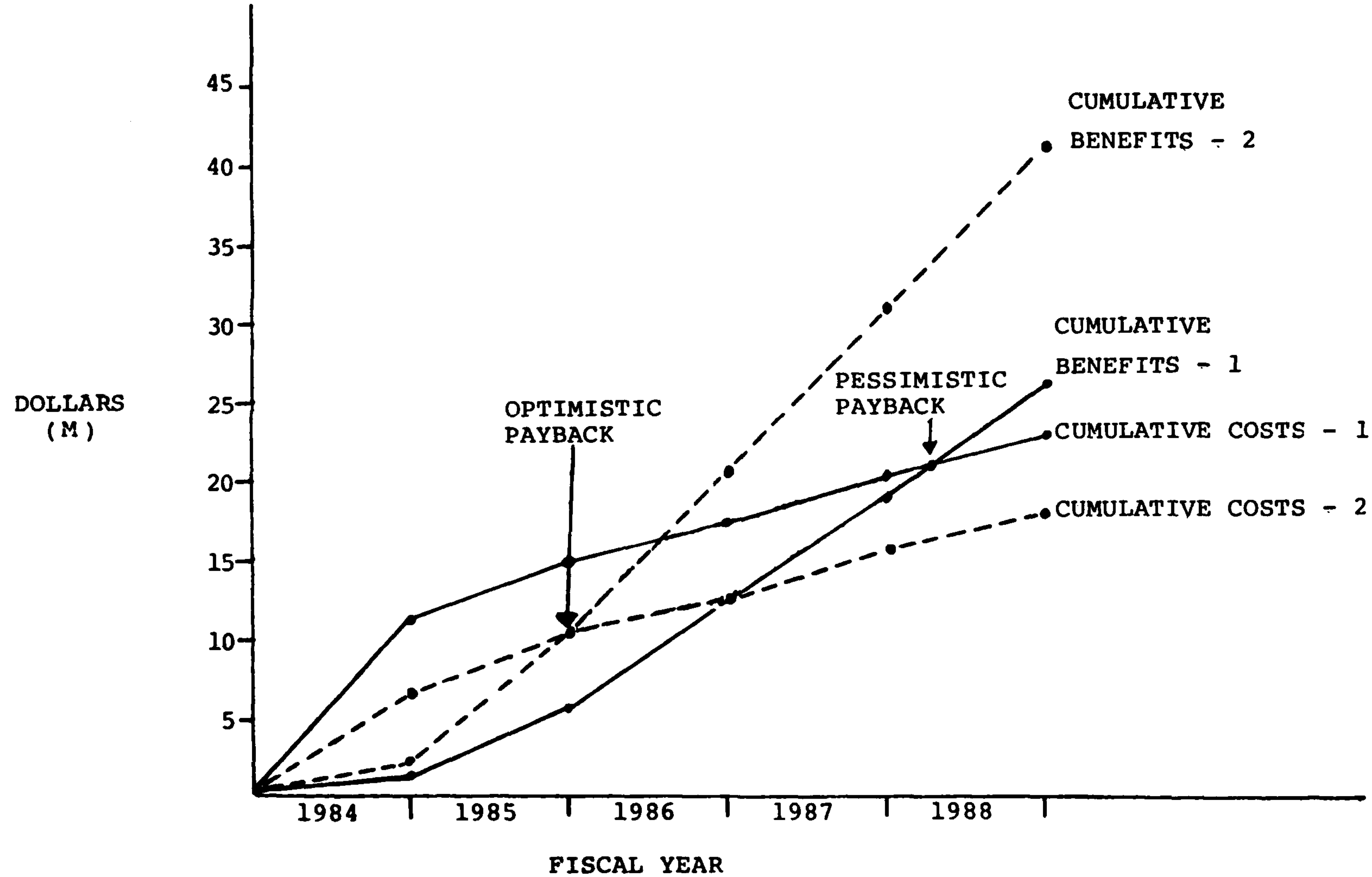
  B2 - C1 = \$41.6 - \$23.3 = \$18.3M

- B2, C2 - Optimistic benefits, Optimistic Cost:

  B2 - C2 = \$41.6 - \$18.5 = \$23.1M

Graphically, using constant Fiscal Year 1983 cumulative system costs, the curves in Figure VII-2 show the range of payback potential, and the most likely envelope of cost benefit results.

FIGURE VII-2
Cost-Benefit Envelope



As Figure VII-2 shows, the system estimate based on the conditions established for this study, (B1, C1), yields a cumulative five year savings of $3.1M, and a payback shortly after year four. The least likely estimate (B2, C2) is the optimistic estimate of $23.1M, with a payback potential of two and one half years. Other two estimate combinations (B1, C2 and B2, C1) would fall somewhere between the optimistic and pessimistic estimates. Based on this sensitized envelope of benefits and costs, the RADC operational system is expected to become cost beneficial between two and one half and four and one quarter years from the start of implementation.

ATTACHMENT A
RADC Authorized Positions

	Civilian	Officer	Airman	Total
Griffiss AFB				
Scientific and Engineering	474	104	---	578
Technical	112	---	13	125
Other	315	22	44	381
Sub Total	901	126	57	1084
Hanscom AFB				
Scientific and Engineering	138	17	---	155
Technical	27	---	10	37
Other	24	1	8	33
Sub Total	189	18	18	225
RADC Total				
Scientific and Engineering	612	121	---	733
Technical	139	---	23	162
Other	339	23	52	414
Grand Total	1090	144	75	1309

ATTACHMENT B
Terminal Distribution

Positions		Number of Personnel	Number of Terminals	Personnel to Terminal Ratio*
Griffiss AFB				
Managers:	S&E	95	95	1:1
	Other	55	52**	~1:1
Professionals:	S&E	483	242	2:1
	Techs	125	31	4:1
	Other	161	55	~3:1
Support:	Secretary/Clerks	126	126	1:1
	All Other	39	13	3:1
Sub Total		1084	614	
Hanscom AFB				
Managers:	S&E	25	25	1:1
	Other	2	2	1:1
Professionals:	S&E	130	65	2:1
	Techs	37	9	4:1
	Other	3	1	3:1
Support:	Secretary/Clerks	16	16	1:1
	All Other	12	3	4:1
Sub Total		225	121	
Training Facility			30	
Operations & Support Facility			47	
Sub Total			77	
RADC Total		1309	812	1.6:1

* The following positions were allocated dedicated terminals for the operational system: Commander, Vice Commander, Chief Scientist, Chief of Corporate Plans, Division Chiefs, Assistant Division Chiefs, Comptroller, Chief of Operations Office, Chiefs of all Staff Offices, Chiefs of Support Staff Offices (BC, LW, WE), Branch Chiefs, Assistant Branch Chiefs, Section Chiefs, Chiefs of Management Offices, Secretaries, Clerk Stenos, Clerk Typists, Procurement Clerks/Stenos/ Typists, Documentation Clerks/Typists, and Clerical.

ATTACHMENT C
Hardware Details

I. Operational System Configuration

	Operations	Training	System Support	Total
Griffiss				
Central CPU	4	-	-	4
Building CPU	25	-	-	25
High Speed Printer	25	-	1	26
Character Printer	287	2	3	292
Terminals	615	20	11 + 29*	675
Hanscom				
Central CPU	-	-	-	-
Building CPU	3	-	-	3
High Speed Printer	5	-	1	6
Character Printer	56	2	3	61
Terminals	121	10	3 + 3*	137
Total				
Central CPU	4	-	-	4
Building CPU	28	-	-	28
High Speed Printer	30	-	2	32
Character Printer	343	3	6	352
Terminals	736	30	14 + 32*	812

*Terminals dedicated to each CPU console.

II. System Unit Cost Computation

Equipment	Units	Total Cost ($K)
Demonstration System Hardware		3,186,543
Less Peripheral Costs		
Character Printers with tractor feed	100	307,600
. Keyboard Enhancement	46	19,090
Terminals with glare screen	235	414,775
. Graphics Enhancement	30	46,680
Large Screen Display	7	85,645
Standalone Subsystem	5	36,450
High Speed Printers	11	96,778
Subtotal		1,007,018
Remaining System Costs		
Central Subsystem	2	806,424
Building Subsystem	9	1,373,101
Subtotal		2,179,525*
System Unit Cost		
Central	1	403,212
Building	1	152,567

* Remaining System Costs are prorated between Central and Building Subsystems based on ratio of total CPU prices, i.e., 37 and 63 percent respectively. A subsystem includes additional equipment items associated with the central processor, e.g. disc drives, tape cassettes, transports and controllers.

ATTACHMENT D
System Support Positions

Position	Number of Personnel Griffiss	Number of Personnel Hanscom	Total	Grade	Annual Cost* ($K)
Senior System Manager	1		1	GM-14	61,189
Operations Manager	1	1	2	GM-13	103,556
Training Manager	1		1	GS-11	36,331
System Data Base Administrator	1		1	GS-12	43,543
Assistant Data Base Administrator	1		1	GS-11	36,331
System Analyst	3	1	4	GS-12	174,172
Computer Programmer	4	1	5	GS-11	181,655
Computer Operator	4		4**	GS-7	98,188
System Engineer	8	1	9***	GS-11	326,979
System Engineer	1	1	2	GS-9	60,052
Electrical Engineer	1		1	GS-13	51,778
Training Instructor	1	1	2	GS-9	60,052
User Operations Support	2	1	3	GS-5	59,460
Secretary	1	1	2	GS-5	39,640
TOTAL	30	8	38		1,332,926

* Based on 1 October 1982 general pay schedule (Step 5) and on 30.8 percent average benefits rate obtained from RADC FY82 operating data.

** Provides only Central Facility support, one operating shift and back-up personnel.

*** Assumes a Central Facility, grouped Building CPUs (three to a site) and one operating shift.

ATTACHMENT E
Investment Training Cost Details
($K)

Training Courses Required	Cost Per Attendee*	Estimated Cost
<u>Hardware Operating System Course</u> (5 days)		
(2 Operations Managers & 20 Operators)	.725	15.95
<u>Applications Programmers Course</u> (5 days)		
(4 System Programmers & 10 Division Programmers)	.625	8.75
<u>User System Operations Course</u> (5 days)		
(39 System Staff & 30 Users + 6 Program Staff)	.500	37.50
<u>Data Base Adrinistration</u> (5 days)		
(1 Data Base Administrator & 1 Data Manager)	.540	1.08
Total Cost		63.28

*Training costs are based on current tuition rates for commercial courses

ATTACHMENT F
Program Management Costs

Position	Number	Grade	Annual Cost* ($K)
Program Manager	1	0-5	51.8
Technical Director	1	GM-14	61.2
Technical Coordinator	2	GS-12	87.1
Applications Specialist	2	GS-11	72.6
Support Staff	2	GS-5	39.6
Sub-Total			312.3
Travel Expense			10.0
Total	8		322.3

* Based on Fiscal Year 1983 pay scale (Step 5 for civilians) including fringe and benefits.

ATTACHMENT G
System Data Costs

Data	Total Cost (FY83 $K)
5 System Level Manuals	$35
5 Training Manual(s) & 1 Reproducible Copy	1
5 Users Operating Manual & 1 Reproducible Copy	1
24 Monthly Progress Reports	12
24 Monthly Cost Reports	12
Total	$61K

MISSION
of
Rome Air Development Center

RADC plans and executes research, development, test and selected acquisition programs in support of Command, Control Communications and Intelligence (C^3I) activities. Technical and engineering support within areas of technical competence is provided to ESD Program Offices (POs) and other ESD elements. The principal technical mission areas are communications, electromagnetic guidance and control, surveillance of ground and aerospace objects, intelligence data collection and handling, information system technology, ionospheric propagation, solid state sciences, microwave physics and electronic reliability, maintainability and compatibility.

END

FILMED

DTIC