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Final Technical Report
May 1980

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AIR FORCE MILITARY PERSONNEL CENTER, MICROFORM SYSTEM

Planning Research Corporation

J.T. Cathcart
T.A. Chaney
D.R. Perry

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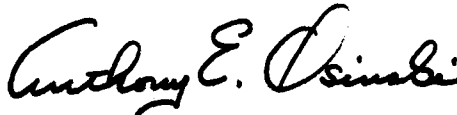
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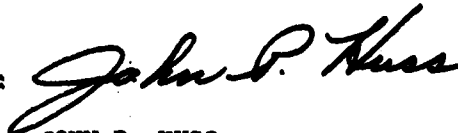
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22. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides a brief history of the Microform System in the IOC design and development phases (1969 through 1975). This final report provides a complete documentation for the actions performed under the current contract, F30602-74-C-0325. The discussion within the document identifies each major design recommendation, reviews the objective of each design effort, specifies whether or not the recommendation has been implemented and assesses the impact. Generally, it has been shown that		

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the Microform System provides significant improvement in the accessibility and utilization of the Master Personnel Record, thereby providing more effective force management of active duty personnel.

Item 19 (Cont'd):

Man/Machine System Design
Data Processing
Data Management Systems

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PREFACE

This document is the final report on the AFMPC Microform System design, development, and implementation performed, by the PRC Information Sciences, Data Systems, and Image Data Systems Companies, under contract number F30602-74-C-0325.

The authors of this report are Mr. J.T. Cathcart, Mr. T.A. Chaney, and Mr. D.R. Perry. Acknowledgements are made to Mr. A.E. Osinski, RADC, and Mr. J.E. Richstatter, AFMPC, for their review and comments.

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EVALUATION

This report provides a brief history of the Microform System in the IOC design and development phases (1969 through 1975). This final report provides a complete documentation for the actions performed under the current Contract F30602-74-C-0325. The discussion within the document identifies each major design recommendation, reviews the objective of each design effort, specifies whether or not the recommendation has been implemented and assesses the impact. Generally, it has been shown that the Microform System provides significant improvement in the accessibility and utilization of the Master Personnel Record, thereby providing more effective force management of active duty personnel.


ANTHONY E. OPINSKI
Project Engineer

I. INTRODUCTION

A. Purpose

This final report is designed to provide a record of the various Microform System design, development, and implementation tasks performed, by the Planning Research Corporation, under Contract Number F30602-74-C-0325. The major contractual obligations documented in this final report include:

- o File Conversion and File Maintenance
- o Hardware Engineering
- o Engineering Plans and Development
- o Training of Government Personnel
- o System changes to include: Implementation of the DATANET-355; Microform and APDS Interface; On-line Indexing; Image Production and Processing; MIDS Expansion; Management Information System
- o Fiche Coding change including: Software, Procedures, Implementation
- o System Enhancements which include the specific tasks of Equipment Integration, Test Software Development, Test and Evaluation, and Microform Analysis and Support Studies

B. Scope

This final report provides both a brief Microform System design, development, implementation, and test and evaluation history and complete documentation for the actions performed under contract number F30602-74-C-0325. This current contract documentation includes an end-of-contract System Configuration and Capabilities Summary and the identification of specific differences between the system implemented and the established design criteria.

C. Organization

This Final Report includes the following Sections in addition to Section I, Introduction:

- o Section II summarizes the design, development, implementation, and testing actions performed under the two previous Microform System major contracts (Nos: F30602-69-C-0354 and F30602-71-C-0157)
- o Section III details the actions performed within the purview of the current contract (No: F30602-74-C-0325)
- o Section IV compares these final Microform System capabilities to the established design requirements and identifies specific areas of disagreement when appropriate

D. References

Detailed information relative to the initial Microform System, which was designed, developed, implemented, subjected to a concentrated test and evaluation, and in operation at the start of the current contract, is included in either the Technical or Final Report identified in the following paragraphs.

1. Technical Report

The Air Force Military Personnel Center, Microform IOC System, Technical Report, dated March 1972, constitutes the final report on contract number F30602-69-C-0354. This Technical Report includes:

- o Volume I, System Design Plan
- o Volume II, Hardware Acquisition Plan
- o Volume III, System Implementation and File Conversion Plan

2. Final Report

The Air Force Military Personnel Center, Microform System, Final Report, dated May 1975, documents the actions performed under contract number F30602-71-C-0157. This Final Report includes:

- o Volume I, Executive Summary
- o Volume II, System Description and Test and Evaluation Results

II. PROJECT HISTORY

A. Introduction

The Federal Government has many extremely large document centers that store vast quantities of paper, or hardcopy, information for management and/or archival purposes. In some instances, these documents must be stored, maintained, and retrieved at the document, single-page, or sub-page level at an extremely high update and retrieval rate. The basic storage problem is further complicated by the requirement to keep either the hardcopy or a silver halide film for archival purposes.

The handling and storing of paperwork still remains a major cost factor that can be made more productive for business and government applications. Much has been done to modernize this process. Still Government agencies and business firms store the bulk of their hardcopy records on paper.

1. Parameters For A Large Interactive Hardcopy System

Specific hardcopy format storage and retrieval system constraints and design parameters are identified and discussed in the following summary.

a. Paper files lack input control in that records managers are frequently unable to answer the questions:

- o Are the file contents complete?
- o If the file is incomplete, what document(s) are missing?

b. File Integrity

Paper records lack file integrity since the records manager is unable, as a rule, to verify the accuracy, timeliness, and validity of the record content.

c. Multiple Access

Paper records are usually stored in single copies and, as a consequence, cannot be used by two people at the same time for widely diverse purposes. Additional constraints posed by this single copy characteristic include the records availability for users who are geographically separated from the file location and the time the record is in transit between the file and user.

d. File Security

Paper files lack security since both confidential and general use documents are frequently stored in the same folder; consequently, the records manager is unable to:

- o insure that the record content is neither accidentally nor deliberately perused by an unauthorized user
- o protect the records from theft, carelessness, fire, or water

e. Direct Inquiries

Generally, in a paper records system, an inquiry elicits a time consuming handling process. The user prepares a written request which flows through the mail channels and is read and handled at each distribution point and a file clerk searches through rows of file cabinets, retrieves the records, and forwards the record to the user. In the same manner as the request, the record is subject to several handlings before it reaches the user.

f. Management Information

The paper records system does not provide a convenient means for collecting management information relative to:

- o file utilization volume
- o file utilization effectiveness

2. The Air Force Master Personnel Records System

In 1969, the Air Force Systems Command Rome Air Development Center (RADC), undertook a research project to determine the best available method of automating or semi-automating the hardcopy military personnel records of AFMPC. At that time, and as subsequently updated in 1970 and 1971, RADC determined that there were three technical approaches to solving the AFMPC records management problem. These technical approaches, summarized in Figure II-1, consist of fully digital storage, digitized image storage or microfilm storage.

In 1969, the memory capacity of 10^{12} bit was for all practical solutions beyond the state-of-the-art and surely beyond the government's ability to finance. In addition, the time required to keypunch 250 million records bordered on the astronomical. It has been estimated that it would have taken 1,000 keypunch operators 25 years to have keypunched the personnel records of the Military Personnel Center. The image storage approach had an even greater storage requirement although it did not have a problem with media transformation. Therefore, the microfilm technical approach was selected. This decision was aided by the legal requirements that all personnel records at AFMPC must be maintained in either hardcopy form or on silver halide film.

An Engineering Development Plan based on the Microform System was prepared by Rome Air Development Center (RADC). Subsequent to the issuance of the Engineering Development Plan, a contract accomplish Microform System Phase 1 initial analyses. Upon completion of the study phase, PRC was awarded a contract (F30602-71-C-0157) to accomplish the system design and implementation phase.

Generally, the Microform Project was established to design and develop a system to improve the methods of storage and retrieval of documents authorized for retention in the Master Personnel Records (MPerR) of active, retired, reserve, and former members of the United States Air Force. These records existing as paper source documents filed in records jackets, comprised a file bank in excess of 130,000,000 documents, and continued to accumulate at the

APPROACH	STORAGE MEDIA	RISK
FULL DIGITAL	DIGITAL	COST EFFECTIVE RANDOM ACCESS BULK STORAGE (10^{12} BITS) COST EFFECTIVE CONVERSION TECHNIQUES
IMAGE	DIGITAL	COST EFFECTIVE RANDOM ACCESS BULK STORAGE (10^{14} BITS)
MICROFORM	FILM	RELIABLE AUTOMATIC IS&R SYSTEM COST EFFECTIVE MICROFICHE PRODUCTION

FIGURE II-1. TECHNICAL APPROACHES AVAILABLE

rate of more than 2,800,000 documents per year. They occupied more and more physical space for storage and presented an ever increasing problem in records management in terms of increased requirements for personnel and facilities.

In effect, the Microform System as designed and implemented provides a significant improvement in records accessibility and is forecast to provide, when fully operational, the capability for:

- o More effective force management
- o More detailed and responsive management of the individual member
- o Improved assignment of resources to meet current requirements and improved ability to predict future requirements
- o Significantly improved Air Force awareness of its own personnel resources
- o Increased capability to perform strength accounting
- o Vastly improved capability to perform historical and statistical research within the entire body of personnel records in order to evaluate the effectiveness of personnel policies and directives
- o Consolidation of personnel records, and maintenance and usage procedures
- o Increased file integrity
- o A significant reduction in the average unit of cost of personnel management transactions

B. System Operational Description

The pilot system of the Microform IOC Project consists of three operating subsystems: the Automatic Data Processing (ADP) subsystem; the File Conversion and File Maintenance subsystem and the Image Storage and Retrieval (IS&R) system.

1. Automatic Data Processing Subsystem

The primary functions of the ADP subsystem are that of bookkeeping and control. This subsystem is so organized and implemented that it actually both controls the mounting of the film on the microforms and maintains the bookkeeping on the production line throughput, both original conversion and maintenance. The ADP subsystem also controls the storage, retrieval and output of the IS&R subsystem.

a. ADP Equipment Configuration

The ADP subsystem is shown in block diagram form in Figure II-2. The ADP subsystem consisted of a Honeywell 6033 Central Processing unit with 96K of main core memory, four magnetic tape units and associated controller, three disk drives, a Datanet 30 for external communication, plus other peripherals. A Varian Data Machine 62 F with 16K of main core was used as the input/output unit for standard and non-standard peripherals used in the IS&R and File Conversion subsystem.

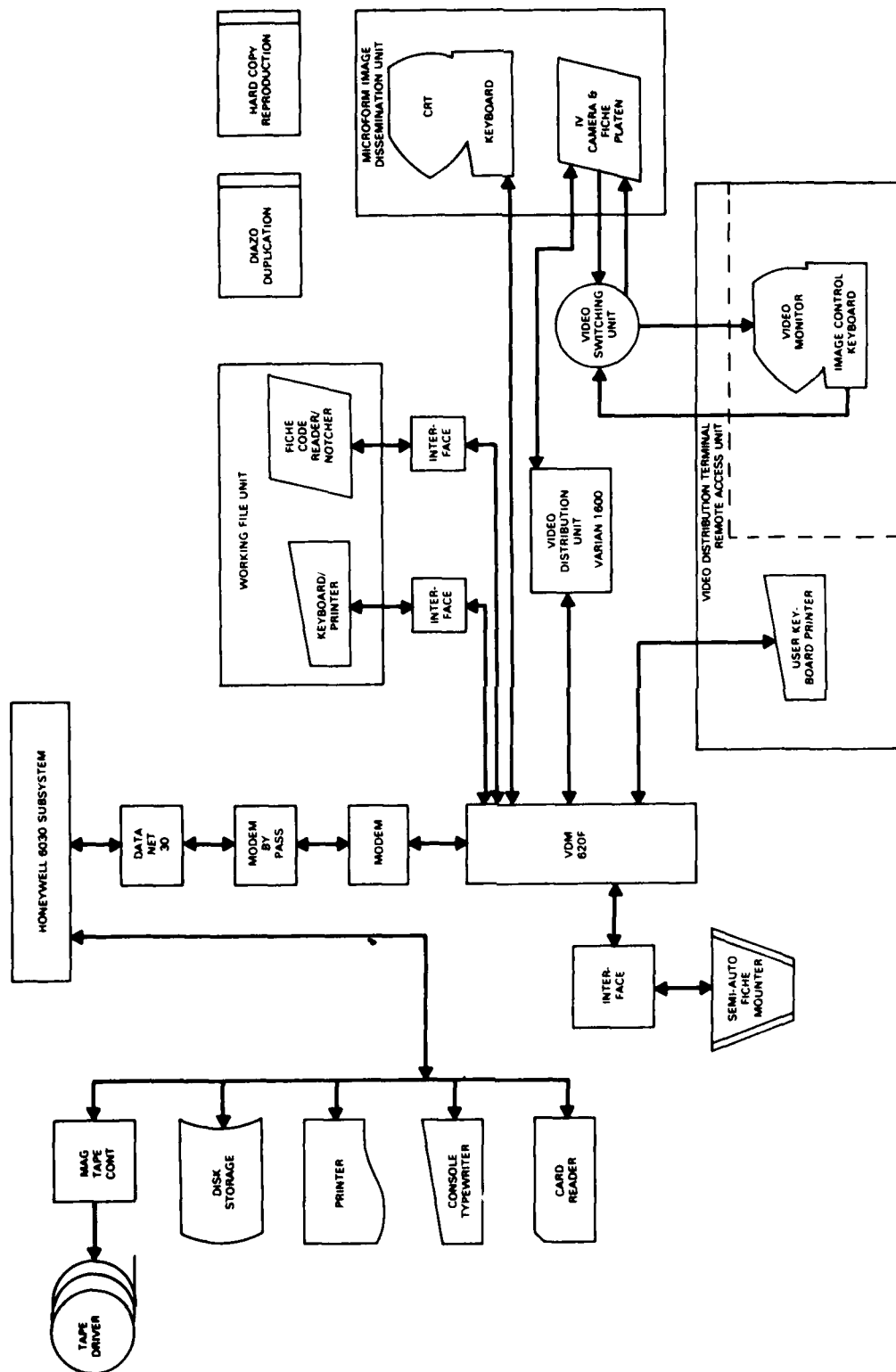


Figure 11-2. AOP Subsystem Configuration

b. ADP Software Configuration

The microform software system consists of a multiprogramming computer operating system, supplied by the computer manufacturer, and application programs that execute within the multiprogramming environment. The software is depicted in Figure II-3.

JOVIAL was selected as being best suited for the control language (On-Line Monitor) and COBOL was used for the balance of the application programs.

(1) On-Line Monitor

The On-Line Monitor consists of a series of interrelated program modules that operate as a single program under the control of the computer operating system. The On-Line Monitor provides full control of the on-line system and interfaces with the computer operating system, the on-line users, the image storage unit and the image index records.

(2) On-Line Application Programs

The On-Line Application programs are designed to respond to the unique characteristics of the on-line user-requested actions. Generally a single user action is related to a single on-line program. The on-line programs do not execute as batch programs controlled by the computer software operating system but as batch or time-shared programs controlled by the On-Line Monitor. The on-line programs have a single external interface that provided by the common routines contained within the On-Line Monitor.

(3) Off-Line Application Programs

The Off-Line Application programs are batch-mode programs operating under the control of the computer software operating system and designed to respond to the unique characteristics of the off-line user-requested actions.

(4) Support Programs

Support programs are standard batch-mode programs designed to support the Microform IOC System requirements. These programs access the Microform IOC System files such as the image index records and the image storage devices by using the standard file access and I/O capabilities provided by the computer operating system. The file maintenance and management accounting programs are in the category.

(5) Utility Programs

Utility programs are standard batch-mode programs generally consisting of the manufacturer-supplied support software such as compilers, assemblers, sort-merge programs, tape copy, tape dump programs etc.

ON-LINE MONITOR/APPLICATIONS

On-line Monitor
Terminal Control
Index Retrieval Control
System Software Management

User On-line Application
File Action

User Off-line Application
Fiche Reproduction

SUPPORT PROGRAMS

File Maintenance
Index Record Generation
Document Assignment
Master File Maintenance
Working File Update

Management Reports
Accounting Reports
Documents Suspense/PDS
File Conversion Management

UTILITY PROGRAMS

Compilers	Sort/Merge
FORTTRAN IV	
COBOL 68	File Copy
JOVIAL	
	File Dump/print
Assemblers	

IS&R PROGRAMS

Device Control	Device Functions
IS&R Terminal	View
Semiautomatic Image Mounter	Duplicate
IS&R Control	Print
	Infile
	Purge

FIGURE II-3 ADP SOFTWARE CONFIGURATION

(6) Image Storage and Retrieval Subsystem Program

The IS&R subsystem programs are divided into two groups. Group one programs, executing within the IS&R subsystem, schedules all main computer requests for viewing, duplicating, infiling, purging and printing of microfiche images. The other group of programs, executing within a mini-computer used as a non-standard I/O peripheral controller, serve as a focal point for handling all main computer subsystem, user terminals and semi-automatic image mounting devices.

2. The File Conversion and File Maintenance Subsystem

The primary function of the File Conversion and File Maintenance subsystem is to convert the paper documents to microform. The chief elements of this subsystem are the 16mm photography process, the mounting of this film on 4" x 6" microfiche, the inspection and certification of the images, the creation of an index to control the conversion and maintenance process and the retrieval of the microfiche from the IS&R subsystem.

The File Conversion and File Maintenance subsystem equipment and work flow chart is shown in Figure II-4. Each function in the subsystem is performed at a station.

a. Document Preparation Station

Personnel records are manually sorted according to prescribed sequences to facilitate document image positioning on master silver halide microfiche. In addition, the records are conditioned for input to the microform production line--unstapled, taped, etc.

b. Indexing and Coding Station

Index entries are generated through key-to-tape techniques to capture on magnetic tape individual name, social security account number (SSAN), document number, date, and number of pages. Index and document sequence data are stored on an index tape and input to the ADP subsystem for editing, verification, and index record creation for storage in a mass storage device.

c. Document and Index Review Station

The control index is reviewed and compared with original sequenced documents to verify concurrency. This is but the first of three quality inspection stations which are used in this subsystem to maintain a high degree of conversion accuracy.

d. Microfilm Camera Station

Paper documents enter the file conversion system through 16mm planetary microfilm camera stations. Documents are photographed in a prescribed order on 16mm silver halide roll film, with a Binary Coded Decimal (BCD), SSAN code and centering mark entered on each image frame. Just prior to photographing the documents the operator enters the last six digits of the SSAN, creating an optical pattern on the film which is used at the Certification station later in the processing line. The film is then processed on site.

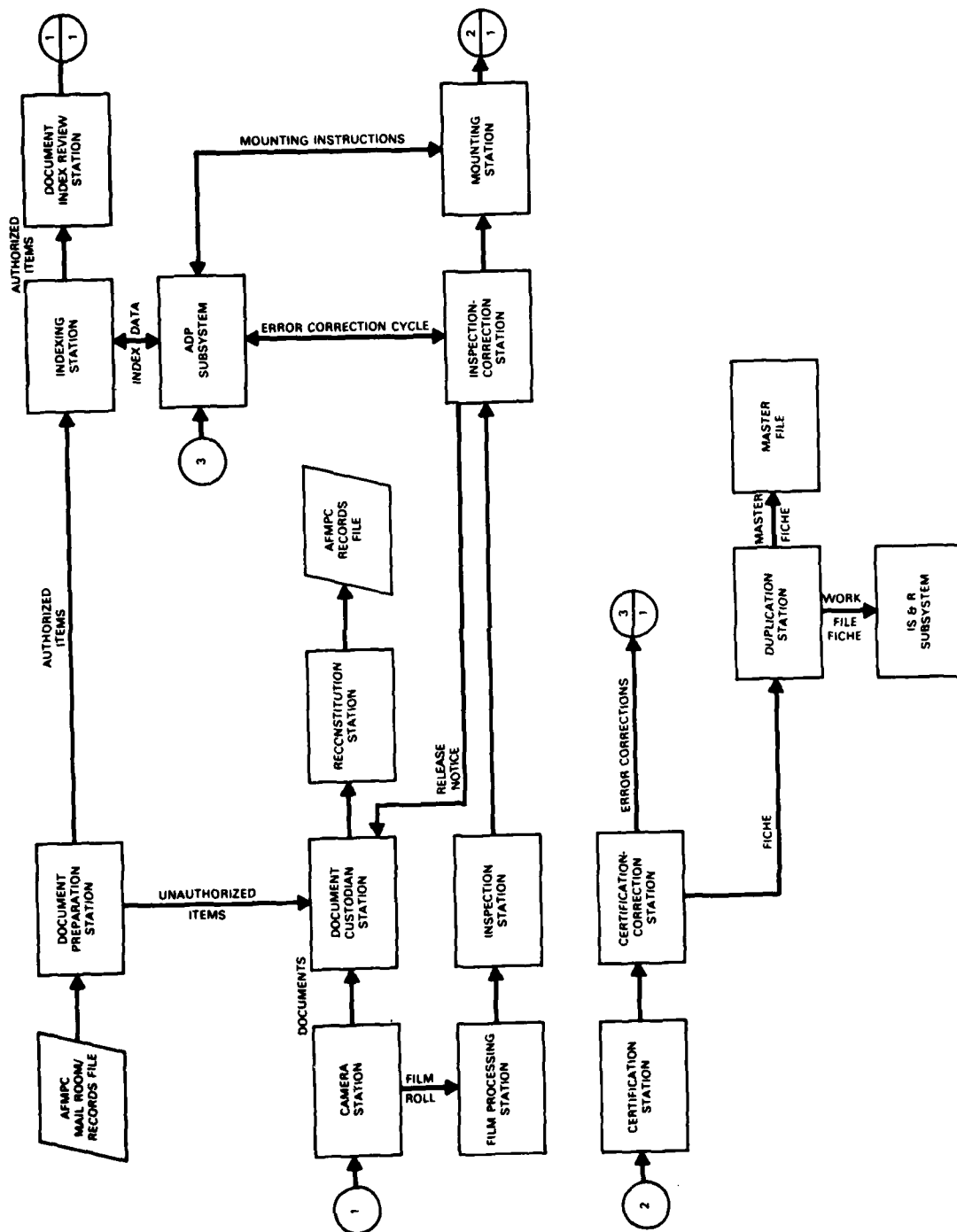


Figure 11-4. File Conversion/File Maintenance Workflow

e. Inspection Station

A quality inspection and numerical verification of images is performed along with any necessary corrective action. Equipment required includes a 16mm film inspection viewer and film quality control devices.

f. Master Microfiche Production Station

The roll film goes to a microfiche master production station. During this operation, silver halide base microfiche masters are produced by computer-controlled, semi-automatic image mounting equipment. The computer-controlled image sequence data indicate (via panel lights) the exact frame location on the folio to place images from the roll film. The computer actually advances and cuts the film and directs the positioning of the film via the panel lights to the operator. The operator then picks up the precut film utilizing a vacuum probe and places it as directed.

g. Master Microfiche Certification Station

The completed microfiche master is inspected to certify that the correct range and type of documents are on the master and that the individual frames are in their correct location. In this inspection process the certification viewer reads the BCD code of the first image and then compares that to the BCD code of every other image on the fiche. The machine also counts the number of images on the fiche. Assuming that no errors have been indicated, the operator places a certification chip on the fiche.

h. Microfiche Duplication Station

The masters are then duplicated on microfiche diazo printing/processing equipment to produce diazo working file microfiche.

i. Master File Storage Station

The silver halide masters are stored in manual rotary (power) files and retrieved only for update purposes.

j. Document Reconstitution Station

Since this program was a pilot test system, the documents were reordered in their original form. The functions of the reconstitution station were to receive, for temporary storage, the residual, duplicate and unauthorized (not authorized to be microformed) documents from the Document Preparation Station, to replace the microfilmed files to their original order and to return both groups to the Air Force Military Personnel Center for refiling.

3. Image Storage and Retrieval (IS&R) Subsystem

The primary functions of the IS&R subsystem are as the name implies-- storage and retrieval. This equipment provides the physical storage of the working file microfiche which are used for retrieval. The outputs of these retrieval actions can be either video, hardcopy, or duplicate microfiche.

The IS&R subsystem equipment consists of: Working File Storage, a Video Transmission System, and Duplication Printers.

a. Working File Storage

Diazo duplicates are stored in electromechanical image storage equipment. The IS&R subsystem provides random access to designated images and manual transport of the images on demand to TV camera, hardcopy printers, or microfiche duplicators located at the various output stations of the subsystem.

b. Video Transmission System

(1) TV Camera Station

The file system is manually interfaced with video camera transmission stations. Assuming that a query results in an image to be displayed, the camera scans and transmits the image to the on-line video display requestor station.

(2) Keyboard Unit

The keyboard/printer forms part of the user's terminal. It is used to input retrieval query data to the stored digital index and to receive digital messages originated by the ADP subsystem.

(3) TV Display Monitor

The TV display monitors are the other components of the user's terminal. The TV monitors display the document images transmitted from the video camera stations. Each display has an associated keyboard that controls the presentation of images from the camera station and display characteristics such as brightness and contrast.

c. Duplication Printers

The majority of the hardcopy printout and duplicate microfiche requests are processed utilizing an off-line batched input request method. However, the system is designed to accommodate direct on-line duplicate requests from the central file's master control station. The computerized file processes the request and directs the routing of the microfiche to either the hardcopy printout station or the microfiche duplication stations.

C. Test and Evaluation

1. Objectives

The objectives of the Microform System test and evaluation phase were threefold: to quantitatively and qualitatively assess the extent to which the IOC system met the technical and operational design objectives; to determine specifically where and why constraints exist, with particular emphasis on system balance and man/machine interactions; and to provide and substantiate recommendations for system improvements in the form of technical design requirements, and cost and time estimates. The first objective was to verify and confirm the performance effectiveness, availability and capability of the Microform IOC System document data base to support their personnel management function. The second objective was to verify that functional support can be expanded and that the document data base can be enlarged in content and structure. The third objective was to determine the costs and benefits of the Microform System in supporting the performance of the stated personnel management functions.

Effective evaluation of the IOC pilot system was conducted in two separate but related stages. The initial and baseline stage was static and established the performance capabilities achieved by the implemented system prior to the actual on-line test and evaluation phase. The second stage was a dynamic test and required operating the Microform IOC System in parallel with its existing manual counterpart. In this latter test, both systems operated against the same input stimuli (task-initiating events) to achieve the same task goals.

2. Test Results

The test and evaluation operational findings and recommendations, included in the following summary, constitute the baseline requirements for many of the actions performed under contract no.: F30602-74-C-0325.

a. Test Findings and Recommendations

(1) Microform File Maintenance Subsystem

(a) The image index record correctly reflects the contents of the microform MPerR.

(b) Duplicate imagery is not identified at the front of the file maintenance line (Doc. Prep., Indexing); however, it is eliminated at later processing stations (Mounting, Cert. Corr.). It is recommended that duplicate document edits be established at Indexing which will enable discovery of duplicate imagery at that point. Such procedure would eliminate non-productive manpower at succeeding stations resulting in a cost saving and increased document throughput.

(c) Throughput for selection folder material does not meet the required five day maximum. It is recommended that improvements be effected within the File Maintenance Subsystem to improve selection folder throughput. A major problem in file maintenance processing are delays experienced at ADP-oriented stations. These delays can be overcome by eliminating the batch processing ADP requirement and institute real time processing. The eliminated queue times should bring throughput for selection folder documents within the required limits.

(d) Throughput for documents other than selection folder material are within the required time limit of 15 days.

(e) Throughput of newly accessed records does not meet the required time limit of 15 days. The same procedures are recommended as outlined above.

(f) Equipment reliability is acceptable with the exception of Mounters, Cert. Viewers, Duplicators, and Code Strip Mounters. Technological improvements based on operational data concerning types and numbers of failures should be implemented to improve the reliability of these hardware items.

(g) The Microform File Maintenance Subsystem has the capability to expand to meet the requirements of an increasing force size.

(2) Microform IS&R Subsystem

(a) During tests for multiple access, two users of the same microform record were satisfied within a short time period. This was not the case with users of the Paper Records System.

(b) The response time of the on-line microform retrieval system was within the 15 second maximum required.

(c) Document retrieval time of the on-line microform system was two minutes, 37 seconds. This was not within the limits established as a requirement.

(d) The retrieval of a record or portion of a record is much faster in the Microform System than in the Paper Records System. The microform on-line retrieval system is 56 times faster than the paper retrieval system.

(e) All unauthorized users were denied access to the microform retrieval system.

(f) The physical security of the Microform System exceeds the physical security of the Paper Records System.

(g) The quality of paper copies produced from microfiche (hardcopy) was not acceptable in the majority of instances. The high frequency of occurrence of poor paper copies highlights this as a significant problem area. Recommendations for improvement in this area would be the installation of an image enhancement device which would enable a uniform density of all imagery. Once this is accomplished, paper copy reproduction of high quality could be obtained.

(h) Selection board members generally rated the microform medium and associated viewing equipment as an acceptable substitute for the paper selection process. Several board members indicated the microform MPerR was preferred over the paper MPerR.

(i) Reliability of IS&R equipment is sufficient with the exception of fiche code reader and duplicators. It is recommended a design improvement for the fiche code reader be implemented which would relax the required code read tolerances.

(j) The Microform IS&R Subsystem has the capability to expand to meet the requirements of an increasing force size.

(3) Microform ADP Subsystem

(a) System software reliability for both File Maintenance and IS&R Subsystems are within required system standards.

(b) ADP utilization is becoming saturated and the processing time required will soon exceed the processing time available. The recommendation solution is to enhance the ADP facility with upgraded equipment and memory capability.

b. Operational Findings and Recommendations

(1) Master File Accountability

Implementation of board support processing requiring the use of master microfiche emphasizes the requirement for a Master File Accounting and Control System which will permit immediate access to master fiche which may be out-of-file for update purposes. Immediate action should be initiated to develop and implement a Master File System to control the placement of fiche in, and their subsequent removal from, the Master File. The Master File Accounting System could be a duplicate of the Work File System in that fiche code identification, fiche code readers, and computer suspense files would be used; however, Master File routines should also include processing batch identification and processing station location. These two additional elements could be applied to resolving problems arising as a result of the receipt of a second update for a particular fiche prior to the completion of processing for the first update.

(2) Improved Hardcopy Production Equipment

Investigations must be pursued within the area of filmed image to paper conversion equipment to identify and procure a device which will restore documents to their original (8" x 10 1/2") size and quality. This capability is specifically required in instances where a correction or change must be accomplished on the original document and the "updated" document must then replace the "old" document within the microform record. Current investigations include the feasibility of using a photographic process to produce acceptable imagery; however, results to date have been negative.

(3) Restrict Hardcopy/Duplicate Fiche Production

Retrieval and dissemination software should preclude the production of both a duplicate microfiche and the conversion and output of all of the same imagery as hardcopy. Essentially, if the user specifies a requirement for a duplicate fiche, selected images could also be obtained as hardcopy; however, the user could not obtain two identical sets of imagery--one in hardcopy and one as a duplicate fiche. In instances where both a duplicate fiche and hardcopy production are valid requirements, both dissemination modes should be included on a single fiche pull message sent to the Work File operator.

(4) Cassettes for Board Use

Selection Board processing requires the use of hundreds of fiche per day; consequently, the board member must perform a fiche load and unload action with significant frequency (300-400 times per day). A modification to the board viewers to accept cassettes would eliminate the fiche load/unload function for board member.

3. Conclusions

The objective of the Microform System, as established by the initial development plan to define and develop methods and procedures utilizing microform technology and ADP techniques to satisfy the AFMPCs operational requirements, was achieved as evidenced by the results of the Test and Evaluation Program. It was shown conclusively that the Microform System provides a significant improvement in the accessibility and utilization of the Master Personnel Record thereby providing more effective force management of active duty officer personnel. The system ensures integrity of the officer file and provides multiple copies or direct on-line view of any given personnel record to resource managers thereby enhancing the timeliness of personnel management decisions. The capability to microfilm, index, store, retrieve, purge, and transfer MPerR's to remote users was demonstrated during operation and testing of the system.

Results of the Test and Evaluation Program show that the Microform System equals or exceeds the Paper Records System in all aspects of operation. In addition, the Microform System enables the enhanced capabilities of on-line direct inquiry and multiple access to records the Paper Records System cannot perform. The activity of the File Maintenance Subsystem does not degrade the

Master Personnel Record and existing procedures and controls ensure that all records are maintained at a high standard. The utilization of the Microform IS&R Subsystem significantly enhances overall record utilization by AFMPC personnel record users. The Microform System has also demonstrated that availability of computer generated management information reports allows for more effective workload management.

The test of the Microform System enabled the qualitative and quantitative assessment of the extent the design criteria was achieved. All specified criteria was achieved with the exceptions of a file maintenance throughput times and retrieval times for on-line activities. These deficiencies can be overcome as the quantitative test results are applied to system calibration activity. The constraints on the system were identified with the ADP Subsystem configuration being the most active constraint. Additional constraints were identified in the areas of system activity expansion, but these constraints will not be active within the foreseeable future. The test results showed that the benefits received by the use of the system enhance each users ability to perform his personnel management function thereby increasing the benefits derived by AFMPC as a whole. As compared to the Paper Records System the Microform System components were shown to be more cost-effective, both as separate component subsystems and as a total operating system. The system showed its ability to support a promotion board utilizing microfiche. In addition, the board members indicated acceptance for the microform media. Tests showed that the ability to promote from the microform selection folder was equal to the ability to promote from the paper selection folder. An informal test of system users in the AFMPC showed a uniform acceptance for the microform media and a high confidence in the reliability of each record's content.

The primary deficiency of the Microform System was the ability to produce acceptable paper reproductions of microform imagery. This deficiency is a hardware problem rather than a deficiency in system design. The ability to overcome this deficiency is dependent on the development of adequate hardware. Lack of acceptable hardcopy reproduction will decrease the systems usefulness and acceptance in some areas of personnel management. Therefore, this area should be given priority in plans for future system improvements.

The Microform System is a viable and workable alternative to the paper media and provides numerous capabilities the Paper Records System does not possess. It was concluded, therefore, that the conversion to microform should be continued and additional segments of the Air Force Personnel System should be added such as Airman, National Guard, Reserves, Retirees, and other archival records. These additional personnel records will decrease the unit record cost of the system as well as provide a more effective overall form of management of all service members.

D. Events Summary

The following summarizes the more salient study, design, and implementation events in chronological order:

- o June 1969. Contract F30602-69-C-0354 was signed and the selected contractor acquired a project staff and began performance of analysis and initial design studies.

- o March 1970. The initial analyses were completed, documented, and published. Specific system design tasks under Change A to Contract 0354 was initiated.
- o October 1970. Published technical reports covering system design, hardware acquisition, and facility requirements.
- o November 1970. Published the System Implementation and File Conversion Technical Report. This report included a recognition that the original planned conversion of all images on all EAD officers was not necessarily a viable alternative in view of the budgetary limitation which had been imposed. The system recommended for implementation established the data base as consisting of specifically selected high-use documents rather than the total MPerR content.
- o December 1970. Completed actions under contract F30602-69-C-0354 and began work under contract F30602-71-C-0157, dated 31 December 1970.
- o April 1971. Reassessed the file conversion schedule in terms of an anticipated delay in the availability of a fully automated information storage and retrieval (IS&R) subsystem.
- o June 1971. Began system implementation and cost schedule replanning requiring as a result of the delay in the start of file conversion, for publication in revisions to the Hardware Acquisition, System Implementation and File Conversion, and Facility Requirements Technical Reports originally published under Contract 0354.
- o December 1971. Started actual file conversion operations for the selected high-use document data base.
- o April 1972. Received notification of additional delay in acquisition of the IS&R subsystem.
- o June 1972. Began an implementation of alternative IS&R subsystem. Instituted a file maintenance processing line to operate in parallel with the file conversion line.
- o December 1972. Cancelled the IS&R Subsystem Contract and commenced development of a revised IS&R subsystem.
- o January 1973. Completed high-use document conversion and received direction to begin residual document file conversion operations.
- o May 1973. Completed the design plan for the revised IS&R subsystem. Commenced file maintenance operations at Randolph AFB.
- o March 1974. Completed residual document file conversion.
- o April 1974. Completed and distributed Test and Evaluation Plans and Procedures Manual (TM-14).
- o July 1974. Began Test and Evaluation (T&E) data collection under Implementation Contract 0157.
- o September 1974. Completed system user training; moved the on-line terminals to selected sites throughout AFMPC.
- o January 1975. Completed the T&E data collection effort.

III. SYSTEM DESIGN AND IMPLEMENTATION

A. Overview

In effect, performance under the current contract (number F30602-F-74-0325) was divided into the phases and tasks identified in Figure III-1. This section discusses each of the indicated phases in terms of the established task objectives, performance techniques, and procedures, and the results derived from each of the analysis, design, development, or implementation actions.

B. File Conversion and Maintenance

Primarily, this initial contract phase concentrated on the conversion of Airman records to the Microform System file environment. This phase also required the performance of various systems analysis tasks. The file conversion and maintenance actions also necessitated the performance of various management control, hardware engineering, and ADP Software, and Equipment Maintenance functions. Finally, this initial phase required the operation of an officer record file maintenance activity and the performance of various IS&R support functions.

1. File Conversion Operations

File conversion identified the process through which selected Air Force Personnel paper records are initially converted to the microform file media.

a. Objective

The objective of this task was to effect the conversion of Airman Master Personnel (MPerR), Temporary Disability Retired List (TDRL), and General Officer correspondence and Miscellaneous (C&M) Records to the Microform record file media.

b. Implementation and Performance

Specific actions performed during this implementation phase included the publication of appropriate processing procedures and training documentation, personnel acquisition and training, and the creation and implementation of the software and ADP operational procedures modifications. Generally, implementation of this file conversion task only required that the software and procedures be expanded from the original "EAD Officer Unique" context to provide an officer and airman on Extended Active Duty (EAD) microform record creation capability. The basic file conversion, Image and Index data, Quality Control, and Audit Trail requirements were identical to the established file Maintenance capability; consequently, the file conversion operation implemented duplicated the stations and functions identified and described in the project history (Section II).

Task/Sub-Task	1974					1975					1976								
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
File Conversion and File Maintenance	←──																		

1

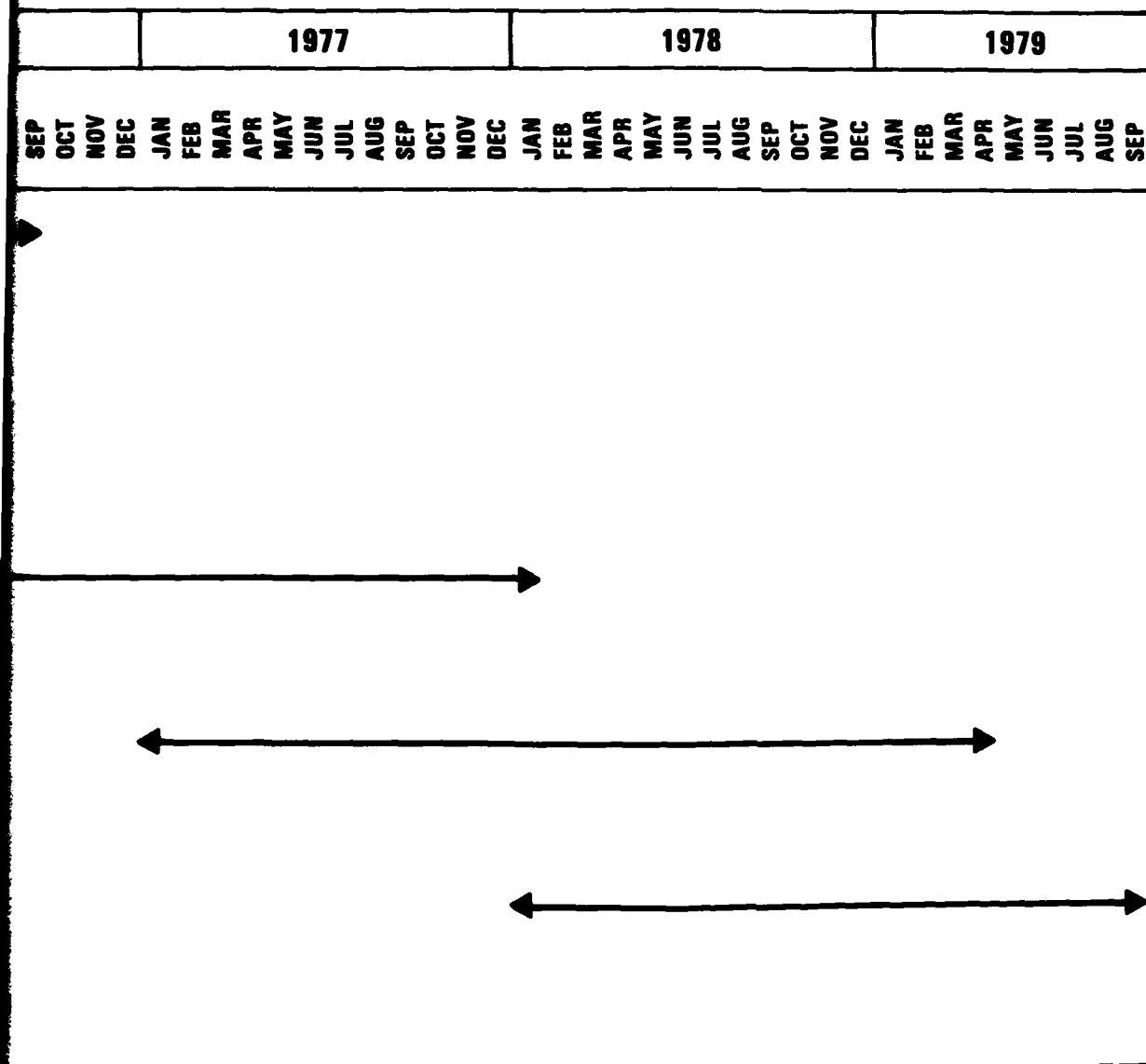


Figure III-1. Summary of Contract F30602-C-74-0325 Tasks Performed

c. Production Volumes

The file conversion was actually performed incrementally in that the initial effort, limited to the processing of ten million Airman MPerR images, was expanded to provide for the conversion of any additional Airman MPerR images and, in sequence, the TDRL, General Officer C&M, and Senior NCO (E7, E8, E9) Selection Records. Management, equipment maintenance, and file conversion production personnel expended a total of 453,892 manhours during a 16 month period (June 1974, through September 1976) to accomplish the actions identified in Figure III-2.

2. File Maintenance Processing

File maintenance encompasses the addition of new or replacement documents and imagery to the system and to individual microfiche and records, the entry of new records to the system, the deletion of documents and images from specific microfiche and records, and the removal of entries and records from the system files.

a. Task Objective

Performance of this task included a requirement to maintain both the record categories being converted and the EAD officer records which had been previously converted. In addition, the file maintenance activity was to provide a duplicate of each updated officer microfiche to the IS&R work file. This task was expanded, when AFMPC instituted the Preliminary Operating Capability (POC) System, to include the production of duplicate microfiche to support system users requirements.

b. Task Performance

The file maintenance processing accomplished during the period from June 1974 through September 1976 was essentially an extension of the established officer record maintenance processing line configuration, functions and capabilities previously described. Specifically, file maintenance processing implementation and on-going performance only required that, as the processing requirement increased, additional personnel be acquired, trained, and integrated into an established and operational processing function.

c. File Maintenance Production

A total of 210,984 man-hours of effort were expended to accomplish the processing specified in Figure III-3.

Document Converted:	6,501,878
Images Filmed:	13,458,887
Microfiche Created and Filed:	1,689,595
Index Records Created	
Headers	535,033
Groups	1,649,595
Documents	6,501,878

FIGURE III-2. FILE CONVERSION PRODUCTION VOLUMES

Additions To File	<u>Officer</u>	<u>Airman</u>	<u>Total</u>
Microfiche Updated	915,920	528,970	1,444,890
New Fiche Created	102,132	181,286	283,418
Images Created	2,233,345	1,841,474	3,074,819
Documents Processed	1,078,911	889,601	1,968,512
Purges From File			
Microfiche	231,590	232,601	463,618
SSANs	34,409	69,709	104,118
Microfiche Duplicated			
For Work File Support	1,018,052	---	1,018,052
POC Support			
Microfiche Duplicated	---	---	204,216
SSANs Requested	---	---	100,458

FIGURE III-3. FILE MAINTENANCE PRODUCTION

3. File Duplication

The initial file duplication charter provided for the creation of both a working and alternate site file which would contain a copy, on diazo film, of each master microfiche; however, this effort was modified to provide only for a work file containing EAD officer records. This initial officer work file creation effort, performed between August and December 1974, resulted in the production and filing of approximately 750,000 diazo microfiche.

4. ADP and Software Maintenance

Basically, this task involved the initial creation and implementation of modified file conversion support software and the continuing administration of the total ADP operation. The specific ADP and software maintenance actions and functions, performed during the conversion period (June-September 1974), are identified in the following summary.

- o Modified existing software and the associated ADP operating instructions, as required, to support the Airman, TDRL, and General Officer C&M Records Conversion and Maintenance efforts
- o Produced software specifications and operating instructions as integrated extensions of existing and comparable documentation
- o Monitored ADP operations and equipment maintenance activities to effect the AFMPC directed priorities, reliability, and quality control requirements
- o Monitored software maintenance actions performed by AFMPC personnel

5. Hardware Engineering

The objective of this hardware engineering effort was to effect the timely acquisition, installation, testing, and integration of the standard and non-standard equipment required to support the file conversion and file maintenance operations. This task primarily involved the: acquisition of rotary file devices which would house the Airman Master Microfiche Records; modification of the existing mounters to provide for the proper display of additional microfiche identifiers; development and acquisition of a high speed document camera; upgrading of the Microform System computer to accommodate the expanded processing and storage requirements; and acquisition of additional film processing equipment.

6. Procedures and Training

The by-processing-station and System Management operating procedures and training documents, published at the start of the Airman File Conversion, were updated to reflect any and all changes in file maintenance requirements and procedures. This documentation update and the ensuing classroom and on-the-job operator, supervisor, and management training sessions provided the specific support necessary to permit AFMPC to absorb and continue the file maintenance function.

7. Systems Analyses

The major plans developed and analyses performed during the June 1974 to December 1975 period are discussed in the following presentation in terms of specific objective(s), scope, and results (i.e., conclusions, recommendations, constraints, etc.). The results of the test and evaluation, addition of airman records and the privacy act were major areas requiring analysis. Methods to alleviate the labor intensiveness of the file maintenance update operations were also considered the basic objectives. The basic objectives are as follows:

- o Privacy Act Implementation task was performed due to the establishment, through Federal regulations, of additional records maintenance, utilization, and dissemination controls and requirements
- o Retrieval and Dissemination analysis was performed to identify the initial utilization requirements for the Airman records being corrected
- o The File Maintenance analysis was accomplished to identify techniques which would resolve the document control, throughput, and system expansion problems and constraints identified during the System Test and Evaluation

a. Privacy Act Implementation

The privacy act of 1974, in summary, defined the types of data which could be maintained on an individual, established specific rules to control the release of this data, specified requirements for maintaining a record of any data released, and provided individuals the means, under certain circumstances, to file a written statement relative to data which, in the individuals opinion, was erroneous or misleading. The basic objectives of this privacy act effort were to design and implement a Microform System record release accounting control capability which accommodated the established requirements and properly interfaced with the comparable facets of the Advanced Personnel Data System. This implementation effort was rather easily incorporated into the existing Microform System due, primarily to the previously established modification techniques and procedures. Basically, this implementation task is documented herein because of the nature of the change rather than as a result of the effort expended. The analysis, design, and implementation tasks actually performed as a part of this effort are identified in the following summary.

- o Expanded the Microform System analog record to include a Dispute (designated E) fiche family which provides a file area for any Statements of Dispute submitted by an individual
- o Amended the existing software and procedures, as required, to permit these E fiche documents to be: accepted, processed, and entered into the digital and analog records; properly linked to the disputed document or data; and included in the retrieval and dissemination along with the basic (i.e., disputed) document

- o Developed and published appropriate software documentation changes and modified the various File Maintenance, System Management, and User procedures and training documents

b. Retrieval and Dissemination

This analysis was designed to identify, by type and volume, Airman and satellite records access requirements and provide specific design recommendations for both an interim and final retrieval and dissemination system. Several interim and a final EAD Airman and satellite records access system configuration were identified during the data synthesis and analysis phase; however, a totally integrated EAD Officer and Airman Image Storage and Retrieval (IS&R) System was established as the optimum, final, and recommended configuration. The summary data presented within this section identified the task related actions actually performed, establishes the interim system capabilities, and specifies the final and recommended system functions, characteristics, and processing requirements.

(1) Interim System

The interim EAD Airman Record retrieval and dissemination system capabilities, established during the user requirements analysis, ranged from an initial to a final configuration. In summary, the:

- o Initial system provided only for off-line (i.e., written request) retrieval and off-line (i.e., duplicate microfiche or hard copy dissemination
- o Interim system established an on-line (i.e., direct user terminal-computer, communication) and off-line retrieval capability which would provide only for off-line dissemination
- o Final system added the on-line (i.e., video display) dissemination capability to the Interim System with the result that this final Airman system effectively duplicated, but did not become a part of, the existing officer IS&R configuration

(2) Recommended System

In effect, this final system is the result of combining all record retrieval and dissemination actions into an up-graded and expanded IS&R System.

(a) Characteristics and Functions

The integrated retrieval and dissemination system should include the following characteristics and functions:

- o Microform and APDs integration which provides direct communications

- o APDS unique retrieval and dissemination terminals which provide for on-line inquiry with on-line or off-line dissemination of APDS digital data
- o Microform System unique retrieval and dissemination user terminals which provide for on-line inquiry with on-line dissemination of microform digital and off-line dissemination of microform analog data
- o Combined user terminals which will provide on-line inquiry and on-line or off-line dissemination of microform analog and APDS digital data
- o Integrated file which provide computer controlled random access to an individual tray of microfiche
- o Microform Image Distribution Units which can transmit video imagery, under computer control, to user terminals
- o System Management and user accounting data compiled and disseminated as required

(b) Processing Requirements

The average monthly integrated system retrieval and dissemination requirements are identified, in Figure III-4.

c. File Maintenance

The basic objective of this effort was to identify specific methods for optimizing the file maintenance operational capabilities. The established requirement necessitated the development of interim measures to provide immediate processing throughput improvements and a final design which would further enhance the document throughput improvements and a final design which would enhance the document throughput and reliability levels and, at the same time, significantly reduce the operational manpower requirements. The specific recommendations resulting from this effort are summarized within this section for both an interim and a final File Maintenance System.

(1) Interim System

The suspected and potential problem areas, identified and investigated during the Interim System development, are discussed within this section in terms of a specific problem and the recommended solution. Background information and detailed documentation regarding alternative solutions are published in the Microform Interim System File Maintenance Optimization Plan dated 31 January 1975.

(a) Utilization of Certification Chips

The certification chip is designed to verify that all imagery present on a fiche belongs to the same SSAN; affirm that all planned imagery is, in fact, present as of the certification date; and identify the

Number of Retrievals (Inquiries)	
On-line video terminal	2,936
On-line non-video terminal	16,311
APDS-Microform Direct communication	16,479
Total	35,726
Number of Microfiche Retrieved	110,683
Dissemination	
On-line View Minutes	75,275
Off-line View Minutes	
Selection Boards	126,878
Other Boards	26,559
Other Users	593,546
Total Off-line View	746,983
Total Viewing Minutes Required	822,258
Number of Hard Copy Images Produced	75,570
Number of Duplicate Microfiche Produced	99,542

FIGURE III-4. Retrieval and Dissemination Requirements

technician who performed the certification. This chip also provides a capability for work file maintenance personnel to select the most current edition when two or more diazo duplicates contain the same SSAN and fiche identifier. The printing and application of certification chips to each Master Microfiche requires a large time and resource expenditure; consequently, this analysis was designed to determine if the savings resulting from discontinuing certification chip use would outweigh the established benefits. The recommended solution was to continue utilizing the certification chips.

(b) Duplicate Document Processing

Preliminary Test and Evaluation Program results indicate that an average of 331 duplicate documents enter the file maintenance line daily. Approximately 70.5 percent, or 1.77 officer update batches, of these duplicates are filmed and mounted on fiche as replacement documents. This activity necessitates the performance of 466 Master File pull and refile actions daily and, in terms of resources, expends approximately 173 hours (1.1 man/months) per month. The recommended solution was to modify the software to provide a comparative check between the indexed documents and the data base and reject all detected duplicate documents at the Indexing Station.

(c) Batch by File Bank

Whenever a Master File device is inoperable, all file maintenance batches that contain SSANs within that particular device must either backlog at the Master File (pull or refile) or have the imagery for those SSANs mounted on "Dummy Fiche." Both situations are undesirable. The first decreases activity within the file maintenance fiche production facility while the other doubles the workload at Mounting. In addition, batch processing time. The solution recommended for adoption is to continue the current technique of photographing all imagery within a batch serially; however, this solution assumed that the production scheduling algorithm would be implemented.

(d) Index Tape Processing at the ADP Facility

The current procedure of submitting each index tape to the ADP facility for processing is extremely time-consuming since the computer operator must process the tapes serially and communicate with the software for each batch processed. This basically inefficient method is further complicated by the relatively small file maintenance batch size and tape pickup and delivery factors. An average of 14.15 hours per batch elapses, after the initial keying is completed, while indexing station personnel either await ADP processing and processing results or await correction cycle completion. These delays account for 14 percent of the total average queue time for the file maintenance line. The solution to this problem involved the performance of three distinct tasks. First, install a tape pooler in the file maintenance indexing facility and furnish an ADP facility a single tape containing the index data for several batches. This pooling technique will increase the indexing station effort by two minutes per batch; however, it will reduce the ADP processing time by 59.8 percent. Secondly, coordinate the courier and ADP production control schedules to permit the index correction action to commence as soon as the ADP processing is completed. Finally, institute a training program

for file maintenance indexing personnel which will stress data capture accuracy requirements and result in a reduction of the number of batches requiring two or more corrections.

(e) Production Scheduling

The most significant problem documented during this study involves the time each batch of update documents spent in a non-processing status; consequently, the greatest potential for improved file maintenance processing lies in the ability to significantly reduce this non-processing, or queue, time. Queue time is, in this case a function of the quantity of documents input, the frequency of inputs, the number of separate operations to be performed, the batch size, and the processing rate of the slowest station. The problem is one of production scheduling in which the exogenous variables are the quantity and frequency of inputs, while the number of operations to be performed and the rate at which they are performed are relatively constant. Batch size is then a controllable factor; however, it is possible to establish effective control over the input quantity and frequency by allowing documents to backlog, if necessary, before entry and then be released to the maintenance line at a predetermined rate and in a predetermined quantity. The same is true of station production rates which can be varied; as necessary, by changing the number of personnel working in an update station. Basically, this is the underlying philosophy of the production scheduling algorithm which should be implemented to attain the following objectives:

- o Create a balanced flow to smooth the work performed within the line and thereby minimize dead or non-productive time
- o Effect a more efficient personnel utilization capability
- o Provide a high degree of management control over production and personnel

(2) Final System

The recommended File Maintenance System is described within this Section in terms of the System configuration and the responsibilities established by the optimization study.

(a) System Configuration

The recommended File Maintenance System includes the following functional components: System Management; Management Information System; Index Record File Processing; Image Production and Processing; Fiche Production and Processing; and Storage and Retrieval. Each of these last four components includes one or more of the ten (10) specific processing stations established for the final system. Generally, these station and component relationships are established on the basis of the primary media processed (i.e., paper, film, or fiche handling). Figure III-5 describes the total system flow. Significant system configuration characteristics, established in the final design, are identified in the following summary.

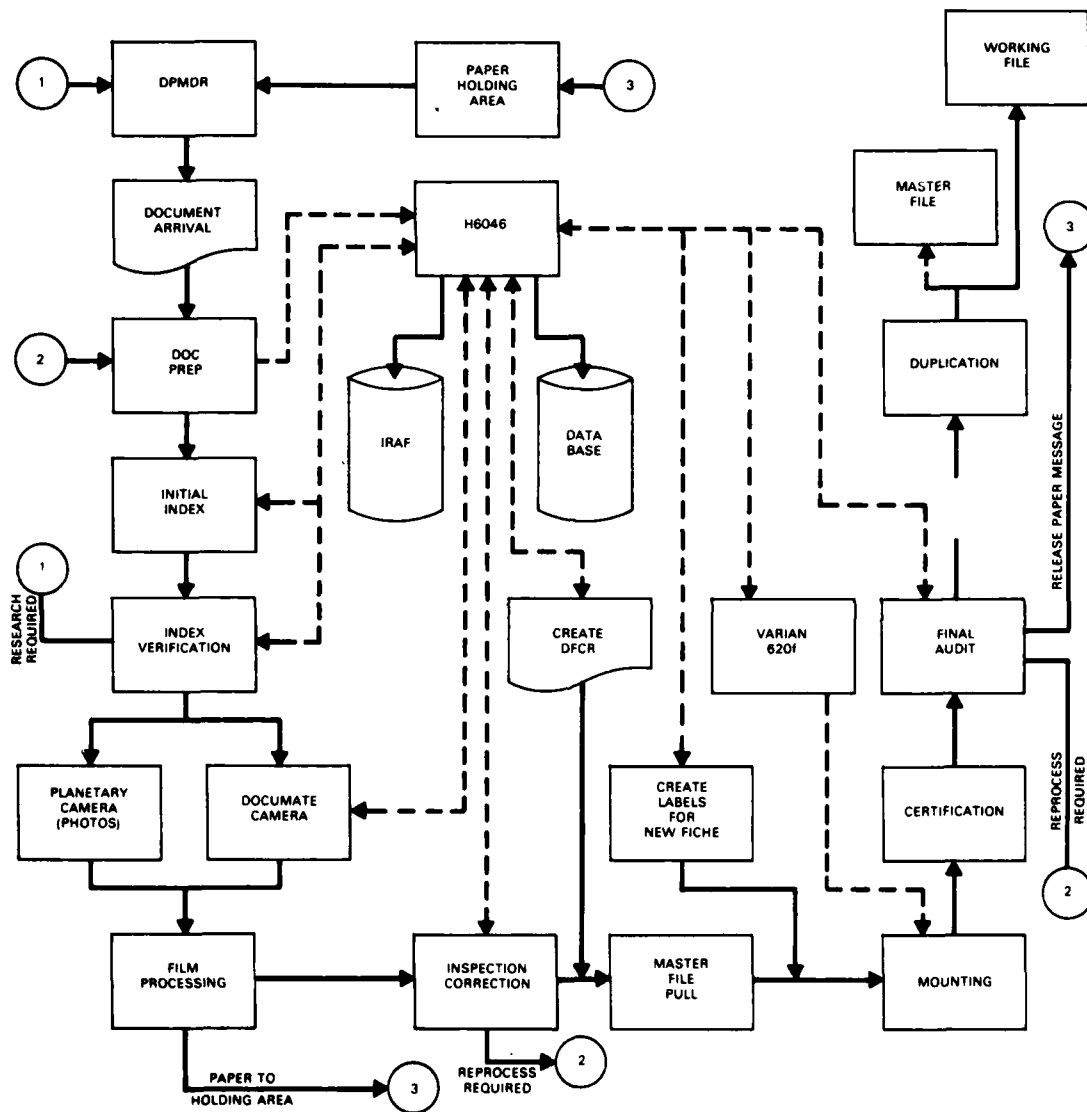


Figure III-5. System Flow

- o The number of processing stations is reduced from 10 to 14
- o The Document Index Review Station is eliminated
- o The current Indexing Station is divided to provide both an Indexing and an Index Verification Station
- o The current Inspection and Inspection-Correction Stations are combined to provide only an Inspection Correction Station
- o The current Certification-Correction Station is redesignated to more accurately identify the actions performed and thus becomes the Final Audit Station
- o The Document Custodian Station is eliminated; however, some of the actions performed are assigned to the Document Preparation Station
- o The Mounting and Certification Stations are combined and become the Mounter-Certification Station; however, implementation of this recommendation is contingent upon the development of the proposed Mounter-Certifier device

(i) Document Preparation Station

The currently assigned responsibilities of document selection, sequencing, conditioning, research, batch control document generation, and batch number assignment will continue to be performed at this station. In addition, this station assumes the temporary document hold file maintenance responsibility formerly performed at the Document Custodian Station. Finally, a CRT terminal and a remote output printer will be assigned to the station for use in accomplishing the tasks and processing indicated.

- o Batch Number Assignment
- o Document Reprocess Report
- o Reprocess Batch Creation
- o Document Research

(ii) Indexing Station

The functional and operational modifications recommended for this station provide, in the main, that the current off-line, background program, batch oriented data collection capability be replaced by an on-line (i.e., direct CRT terminal and computer communications) digital record creation and modification system. Additionally,

- o Batch processing sequence priorities will be specified by System Management
- o The indexing operator obtains the assigned batch; completes the required fields and transmits the data

- o The System edits the data input; identified each field containing an error and the operator re-enters and re-transmits the data. The data entry, error notification, and re-entry cycle is performed until all errors are resolved
- o The data capture requirements are expanded to include specific elements associated with camera control, special orders and citation identification, and amended and associated document relationships

(iii) Index Verification Station

The processing requirements established for the Indexing Station are also performed, using identical equipment and procedures, at this Station. The additional edit requirements established for this Station include:

- o Validity edits to ensure that each required data element is complete, appropriate, and logical
- o Verification edits to ensure, on an element-by-element basis, that the Index and Index Verification Station input are
- o Authorization edits which ensure that the specific document is authorized both as a file component and as an entry into a particular record
- o Duplicate document edits are performed as part of the specific image location and fiche identification determination process to insure that the input data does not duplicate an existing entry in the members record

(iv) Inspection Correction Station

This Station combines the functions currently assigned to the Inspection and Inspection-Correction Stations. The major difference will be the replacement of the current punched card input error correction technique with CRT terminals which will provide digital data base access in an on-line processing environment.

(v) Final Audit Station

This Station will perform the same error reconciliation and correction actions which are currently accomplished at the Certification-Correction Station. The only significant procedural and processing change involves the use of a CRT terminal to access and update the digital data base.

(vi) Camera Station

The basic requirements of capturing the image content on film and general batch processing are not changed; however, the specific techniques and procedures are modified to provide for additional equipment utilization in that:

- o A CRT is provided which permits actions such as batch assignment, processing interrupts, and batch completion to be reported or received through direct on-line computer-terminal communications
- o The majority of the actual document filming actions will be accomplished via a semi-automatic computer controlled camera identified as the DocuMate II. Based on specific computer generated instructions and an operator performed page placement action, the DocuMate II camera will transport and position the page under the camera head, automatically perform the necessary BCD-display and fiducial mark placement actions, film the image, perform any necessary page turning and film the second image, and transport the page to an output hopper

(vii) Film Processing Station

The only change in the current requirements and procedures at this Station involves the use of a CRT terminal to notify the System that film has been developed and the batch is either accepted and forwarded or rejected and returned to the Camera Station.

(viii) Mounter-Certification Station

The actions to be performed at this Station are a consolidation of the current Mounting and Certification Stations processing requirements. The recommended processing is contingent upon the development of an operator loaded device which will, under direct computer control, automatically mount imagery on the master fiche and then perform the associated certification action. The development, acquisition, and utilization of this fully automated on-line computer controlled Mounter-Certifier constitutes the major modification included in the recommendations for this Station; however, the established design also provides for a CRT terminal to permit direct request for batch assignment and batch selection and notification.

(ix) Fiche Duplication Station

The proposed Fiche Duplication Station differs from the current station only in that operators will be required to notify the system, via an on-line CRT terminal, when duplication of a batch of master fiche is complete.

(x) Master File Station

Basically, the proposed Master File Station performs the currently assigned tasks in that the microfiche storage, retrieval, and header label mounting actions continue as assigned responsibilities. The specific operational procedures and techniques will be modified, as required, to accommodate and implement the following recommendations.

- o Utilize computer controlled, automated storage and retrieval devices which will: Accept on-line commands from the ADP System; transport the requested tray of microfiche to a specified work area for manual fiche insertion or removal action; provide multiple work ports which can be dedicated to a specific function; and provide a per port queuing capacity of a least one tray in addition to the tray being worked
- o Provide CRT terminals which will permit system generated microfiche retrieval and refile instructions, and operator responses thereto, to be communicated in an on-line operational mode
- o Use a fiche reader to log microfiche in and out of the master file

(b) Management Information System

The proposed management information system provides for reports to be generated in any of three modes, a number of specialized data files, specific data generation and collection parameters, and a number of report generation requirements and criteria. A detailed description of each indicated factor is provided in the File Maintenance Design Plan, October 1975. In summary:

- o Management information will be available as: CRT terminal displayed exception reports presented as specified critical events occur; generalized on-line system status, personnel performance, production, and batch content inquiries; and predefined reports produced periodically or as required during low system utilization period

- o The following files will be maintained and used for the report generation: Employee Record; Batch Status; Production Accounting; Equipment Status; Station Record; Table; and Event Accounting
- o Files will be maintained as a result of normal processing actions; however, the following data will be input, in an on-line mode, at specifically designated terminals: Employee identification, accounting and status; batch processing status for stations with no ADP interface; and equipment status
- o Exception reports will provide, as automatic actions, a By-Station Excess Backlog Report and an Equipment Status Report
- o The generalized on-line inquiry capability permits query for Personnel Reassignment; Query of Employee Production; Next Batch Assignment-Operator; Next Batch Assignment-Manager or Supervisor; Query of File Maintenance Line Content; Query of Station Production; Query of Equipment Status; and Query of User Action, and Document Tables requests to be input through and received at the management CRT terminal
- o Background Reports, produced on a high speed printer as processing time is available or on a specific schedule, include: Employee Production Report; Document Input Graph; Batch Production Throughput Report; Station Production Report; Exception Reports; Equipment Reliability; Audit Trail; Document Suspense; and SSAN Mismatch Report

(c) System Management

The proposed integrated File Maintenance System did not include specific management requirements and procedures; however, certain facets of system design were forecast to be of particular importance to the System Manager. These "management benefits" include the established capability for the manager to:

- o Establish and modify batch processing priorities and monitor the associated scheduling actions performed by the batch assignment routines
- o Analyze system operations on the basis of the audit trail provided by the batch accounting and control system
- o Obtain system status data, when and as required, through an on-line inquiry capability
- o Be provided salient historical data which is structured to facilitate it's use for predictive purposes

(d) Implementation Alternatives and Priorities

The alternative system configurations, established in the design plan, are described in the following summary in a general order of importance (i.e., implementation priority). This sequence considers the effort required to effect implementation, the time required to develop hardware, and the benefits to be gained. It must be noted that the by-station design factors cited in the preceeding paragraphs are, in fact, associated with the optimum configuration described as alternative four.

- o The first alternative is to implement an on-line processing capability at the Indexing, Index Verification, Inspection Correction, and Final Audit Stations
- o The second alternative provides for the implementation of a system which combines the on-line processing, indicated for the first alternative and the computer controlled camera (DocuMate II) capabilities
- o Essentially, the third alternative provides for the addition of a semi-automated storage and retrieval capability to the configuration described as the second alternative
- o Finally, alternative four combines all of the previously indicated capabilities with the automated Mounter-Certifier processing and the Management Information System

C. System Implementation

The requirements established for this phase are separated into three distinct segments. The first segment, identified as DATANET 355 Implementation, summarizes the software development actions actually performed to upgrade the computer system communications controller. The second, or Microform and APDS Interface, segment concentrates on the identification and specification of the recommended communications link requirements, characteristics, and capabilities. Finally, segment three File Maintenance System Implementation, summarizes the tasks (i.e., Hardware development and acquisition, Software development, Personnel Subsystem, etc.) performed to implement the selected on-line Indexing, Management Information System, and Image Production and Processing capabilities.

1. DATANET 355 Implementation

The objective of this task was to upgrade the existing ADP subsystem hardware and software configuration to permit the addition of new devices. In addition, DATANET-30 with a DATANET-355; however, the VDM 620f was still to be used for Microfiche Mounter control purposes. The performance of this task included specific and necessary hardware acquisition and installation actions; however, the effort expended was concentrated on the modification of existing software and the development of additional software required to support the

Microfiche System operation. In summary, the contractor staff, working in conjunction with AFMPC support personnel,

- o Developed software routines which modified the peripheral device communication command structure and provided the necessary system expansion (i.e., the addition of new devices) capability
- o Developed software which permitted terminal identification, facilitated sign-on, provided more effective user to ADP subsystem communication through the DATANET-355, incorporated the existing VDM 620f command interpretation logic; and effected the associated and required application program changes
- o Produced the associated program specifications and computer operator procedures documentation

2. Microform and APDS Interface

The primary and stated objectives of this task were to perform the analyses and develop the techniques and procedures necessary to establish a direct communications link between the Microform and Advanced Personnel Data System (APDS) ADP subsystems. In effect, this effort was designed and performed to develop alternatives to the existing manually controlled and executed magnetic tape and punched card interface between the two systems and, if appropriate, to identify and define additional interface applications. The established communications link design is described in terms of concepts, hardware requirements, software components, data communication formats, data transmission volumes, and specific applications. This design was the result of actions performed by contractor and Air Force representatives of the ADPS and Microform Systems. The following summary of tasks completed does not account for APDS software coding, compiling, and check out actions which were an Air Force responsibility since APDS is an Air Force developed and controlled system. Again, the major tasks completed are identified in the following summary.

- o Verified and documented the existing Microform and APDS interface techniques
- o Verified and documented the current interface applications
- o Identified and analyzed data and data utilization factors which were common to the two systems
- o Identified and defined potential applications
- o Identified the communications link hardware capability requirements
- o Identified and developed specifications for the required Microform and APDS Systems Software
- o Developed and published a design and implementation plan
- o Coded, compiled, checked out, and delivered the required Microform System software components

a. Concept

The philosophy of the system design is predicated upon the dedicated single-station contention-line concept with the computers communicating in the direct-access interactive conversational mode (DAC normal mode). Under this concept, one system initiates communication and the other system immediately reacts by providing a logical connection to dedicated software which will begin interactive communication. After a logical connection is established, both systems perform message write and read operations in communicating with each other. In application, transactions such as SSAN mismatch data and OER supplemental data are placed in disc files in the Microform System as a result of processing by these application areas. The data is then transmitted to the APDS and placed in disc files until required. Similarly, document suspense, on-line fiche request, and selection board transactions are placed in disc files in the APDS during processing and then are transmitted to the Microform System where they are placed in disc files until processed.

b. Hardware Requirements

The direct link consists of a high-speed modem-connect full-duplex non-switched line capable of synchronous bit-serial transmission up to 2,400 baud terminated by modems at both the Microform and APDS ends.

c. Software Components

The software system required to effect the direct-link interface includes the major components described in this section. Figure III-6 is an overview of the software. The common software functions are described and the Microform System and APDS components are specified.

(1) Existing Software Description

(a) Data Communications Software

The data communications software is that which defines the communication network and performs the data communication control and code translation functions. It resides in both of the following communication processors.

- o GRTS (General Remote Terminal System) - Microform System communication software which operates in the Honeywell DATANET-355
- o DATACOM (Data Communications System) - APDS communication software which operates in the Burroughs Data Communications Processor

(b) Operating System Software

The operating systems maintain control of all input/output processes within the central processors. The two systems are:

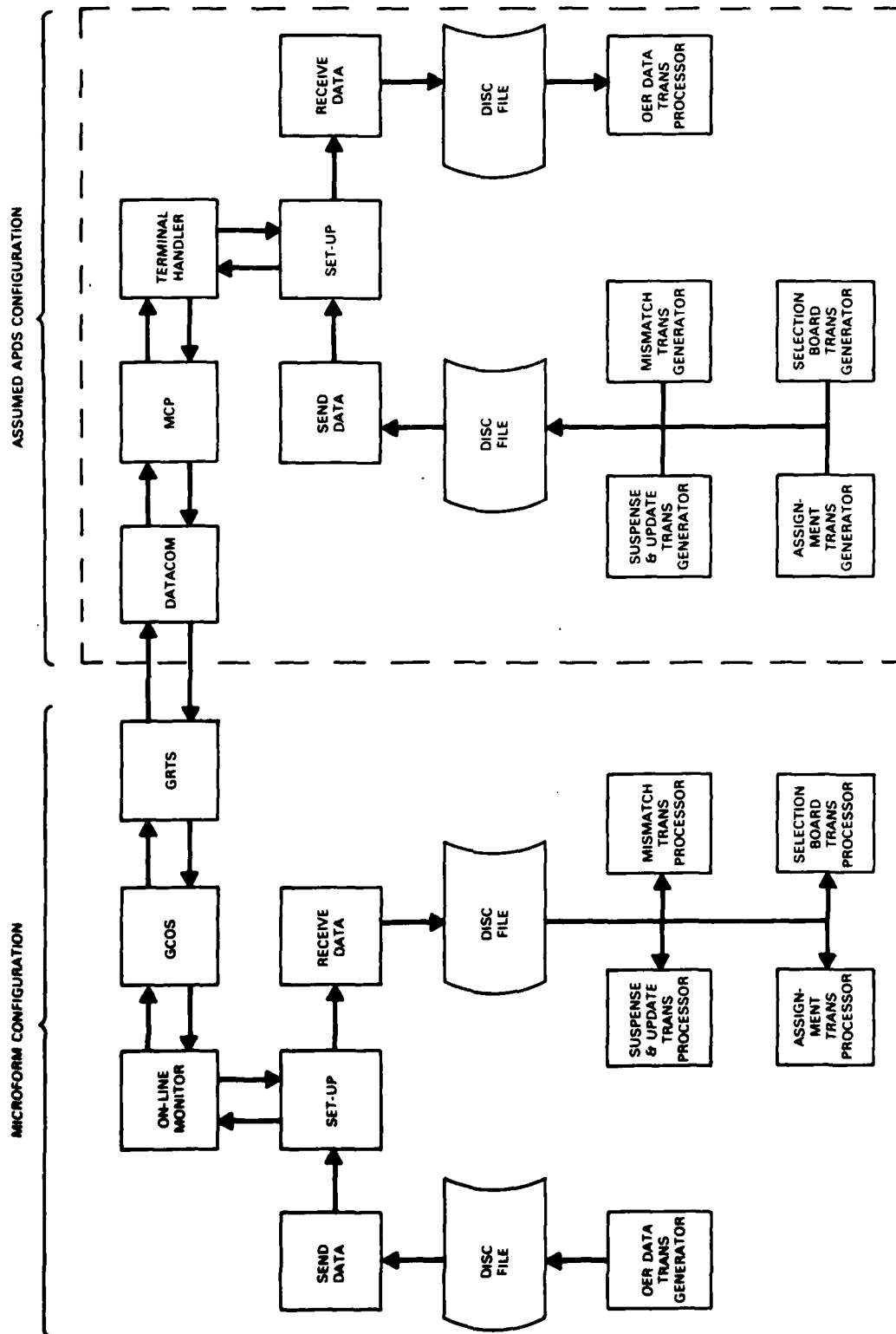


Figure III-6. Software System Overview

- o GCOS (General Comprehensive Operating System) - Microform System operating system which operates in the Honeywell 6000
- o MCP (Master Control Program) - APDS operating system which operates in the Burroughs 6700

(2) Developed Software

(a) On-Line Terminal Message Control Software

This software handles the on-line terminal communication processing in the Microform and APDS central processing units. It consists of two systems as follows:

- o On-Line Monitor - Microform System terminal message control system which operates in the Honeywell 6000 under the control of the GCOS System
- o Intercomputer - APDS computer terminal message control system which operates in the Burroughs 6700 under the control of the MCP System

(b) Application Software

The application software is that set of programs in both the Microform System and APDS which generate or process transactions. The APDS accumulates microform document suspense and update, on-line microfiche request, and selection board microfiche request transactions on disc as a result of its processing and periodically transmits these transactions to the Microform System which will store them on disc until required in its processing. The capability also exists to flow transactions from the Microform System to the APDS in support of SSAN mismatch and OER data capture.

d. Data Communication

Logical data is transmitted between the Honeywell 6000 On-Line Monitor (OLM) and the Burroughs 6700 Intercomputer Message Control System (MCS). This logical data consists of two types:

- o Control Messages - Messages which are used by the software in one system to give instructions to the software in the other system
- o Data Messages - Data messages are those in which application data records are transmitted between the two systems. The messages are variable in length with a maximum logical data block size established as 324 characters (54 words) of text. Data messages contain the following types of data: Data transmission Header; Data Records (Unblocked or Blocked); Data Transmission Trailer

e. Data Transmission

The data transmission volume estimates for EAD officers and airmen are based upon respective file sizes of 104,000 and 470,000. The figures for Reserve and ANG are extrapolated from EAD activity and record ratios and are based upon Reserve Officer and Airmen Files of 15,512 and 39,826 respectively, and ANG Officer and Airmen Files of 8,286 and 79,000 respectively. The maximum APDS microform communication requirement, occurring on days when airmen update is performed, is 4,217,600 characters per day or 33,740,800 bits. With a bit-serial transmission rate of 2,400 bits per second, the data requires 14,059 seconds or 3.9 hours to be transferred from one system to another.

f. Applications Software

This section presents the discussion of all application software associated with the Microform-APDS interface. Application data generators and processors are existing application programs in each system which produce or process transactions which are sent to or received from the other system, respectively.

(1) Microform Document Suspense and Update

Document suspense involves the use of APDS transactions to suspense receipt of documents into the Microform System. Microform update involves the use of APDS transactions to effect update or personnel identifier information contained in the index records. In operation, an APDS Program extracts, from daily update files, all Personnel Transaction Identifiers (PTIs) which change data elements also contained in the Microform System. A Microform System Program matches the APDS extract data to the Microform Suspense File and appropriate records are created to identify both the documents due and scheduled status changes. Records created during the APDS and Microform File match are deleted when the applicable document entries appear on an Index Record Accounting File (IRAF) indicating receipt of the documents. The IRAF processing causes Microform Suspense file records to be created in instances where the documents enter the file before APDS update occurs. For this type of suspense, the APDS extract data is used as a confirmation device and causes record removal. Changes to personnel identifiers in the Microform Index Files are generated on Index Data Files, which in turn, are processed to enter the data changes into the appropriate index records.

(2) SSAN Mismatch

Periodically, at management discretion, an extract data file containing the name and SSAN of all records in microform is produced. This extract file is then compared to the APDS files. Any mismatches are identified and then used to effect a file reconciliation.

(3) APDS Update - OER Data

Data capture of officer selection folder data is performed in the Microform File Maintenance Section. In the Enhanced Microform System,

OER data is input to the Microform System through on-line CRT terminals at the Index-Verification Station. Data records are created on the Index Data File and these data records are then converted to standard APDS transactions and transmitted. The following information is collected and transferred for each OER type:

- o OER Class - OER correction, update or delete
- o Data Capture Type - Basic OER data only or basic data plus duty history supplementary data

(4) APDS Request for Fiche

On-line requests for microfiche can be made through the APDS. Requests are input on APDS on-line terminals and then transmitted to the Microform System for processing.

(5) Selection Board Support

The APDS produces a file containing the names and SSANs of all personnel eligible for screening. This production is motivated by functional area manager input of an APDS inquiry or request for program execution. APDS output of the Board Support File causes the Microform System periodic task processing routines to: translate the APDS data into specific retrieval and dissemination instructions; produce the required duplicate microfiche; and forward reproduced microfiche to requestor (Board Secretariat).

3. File Maintenance System Implementation

This effort encompassed the actual implementation of selected on-line Indexing, Management Information System, and Image Production and Processing capabilities. In effect, this section summarizes the analysis and design, hardware acquisition and development, software development and modification and personnel subsystems tasks performed to effect the required implementation. In summary:

- o The Document Custodian Station was eliminated; however, the functions of this Station were added to the Document Preparation Station operation
- o An Index Verification Station was established
- o The Certification-Correction Stations were consolidated into a single Inspection Correction Station
- o Camera Station processing was amended to provide for computer controlled camera utilization
- o Direct, on-line computer communications requirements and capabilities were established for the Document Preparation, Indexing, Index Verification, Camera, Film Processing, Inspection Correction, and Final Audit Stations
- o Management procedures and reports were modified to reflect the amended processing requirements and capabilities and an on-line management data access capability was instituted

a. Analysis and Design

This initial implementation effort concentrated on the publication of an Enhanced Microform System Design Plan. The plan produced, in effect, converted the previously published Integrated officer and Airman File Maintenance Design Plan into specific instructions for implementing the selected processing capabilities. In summary, this Enhanced System Design Plan

- o Provided detailed System and Station functional descriptions
- o Established System and Station operational requirements and capabilities in terms of specific equipment and procedures, documented report and report format requirements factors, and identified the necessary CRT display and Station relationships
- o Established software design and development requirements and schedules
- o Established personnel acquisition and training requirements and provided an organizational structure for sustaining the Enhanced Microform System Operation
- o Identified hardware component acquisition and testing requirements and schedules
- o Established documentation publication requirements and schedules
- o Provided a master schedule which includes all of the implementation tasks

b. Hardware Acquisition and Development

Five major hardware acquisition or implementation activities were actually performed. Each of these activities is discussed below and is followed by a general description of hardware acceptance testing.

(1) ADP Hardware

This activity included the acquisition and installation of a DATANET-355 to replace the existing DATANET-30 in the current Honeywell computer system and the addition of a 64K memory unit. The exact ADP hardware to be acquired and installed are:

- o DATANET-355, Model Number SPB 355
- o Upgrade of Honeywell 6044 to 6046
- o Two modems (communication interface devices) to interface the Honeywell 6046 System with the Burroughs 6700 System
- o Three disc drive units, DSU-190

(2) Cathode Ray Tube (CRT) Terminals

Interactive CRT terminals are utilized to provide on-line communication between the ADP Subsystem and specific operators within the enhanced file maintenance subsystem.

(3) Remote Output Printer

A remote printer is employed in the system to produce hardcopy documents. The printer operates directly with the ADP subsystem.

(4) DocuMate II Camera Implementation

The DocuMate II camera was modified to operate under computer control. The camera is controlled by the computer on the basis of previously captured document data. A BCD code is automatically generated on each image. The camera flips the document (head-to-head or toe-to-toe), if required, by executing instructions determined and collected at Indexing.

(5) Equipment Testing

The equipment required to implement the Microform File Maintenance System is divided into one of the following groups and the associated testing requirements were as indicated below.

- o Off-the-Shelf Hardware includes all hardware presently available from equipment sources whose manufacturer's specifications indicate satisfaction of the requirements of the Integrated Microform System
- o Modified Hardware includes all system hardware presently available from equipment sources but which must be modified to meet Integrated Microform System requirements

Site acceptance tests of crucial performance criteria were performed on each hardware item prior to its incorporation into the Microform System. Specific test procedures were developed to evaluate the ability of the hardware to perform its operating functions correctly with uniform quality and without negative impact on other system components. Site acceptance tests were conducted in the environmental confines of the microform facility. All vendor-supplied hardware and software was installed and certified as ready for operational use.

c. Software Development and Modification

The major software development and modification actions performed to enable and support the Enhanced System Implementation are identified and discussed within this section.

(1) Microform On-Line Monitor

Multiple access to the storage devices, containing the document data base must be permitted and this capability is provided by the microform on-line monitor, which monitors and controls the multiple access for retrieval and dissemination or index record modification. The microform on-line monitor functions as a subset of the computer operating system and is written mainly in the JOVIAL language. The categories of modules and routines for this system include:

- o Control Modules
- o I/O Modules
- o Common Routines
- o System Subroutines

(2) On-Line File Maintenance

File maintenance is related to the system management application programs for maintaining the document data base and image storage units, including the management scheduling and accounting of these activities. Application programs relegated to this category include:

- o Index Record File Processing
- o Image Production and Processing
- o Fiche Production and Processing
- o Background Processing

(3) Retrieval and Dissemination

Retrieval and dissemination programs permit functional AFMPC user access to the document data base index and the image storage units for display or reproduction of the document images. Retrieval and dissemination programs operate in an environment controlled and monitored by the microform on-line monitor, administered by the computer operating system. Application programs, within the purview of the retrieval and dissemination system are:

- o Retrieval Inquiry Processing
- o Fiche Retrieval
- o Display Control
- o Material Production

(4) System Management

The system management software is used to control the file maintenance operations and maintain status of the total system. Programs within system management are:

- o Data Collection
- o Data Manipulation
- o Report Generation
- o Management Control
- o APDS Interface

d. Software Testing and Integration

Each program was subjected to a series of validity checks to ensure conformance with the detailed specifications and general design requirements. Special efforts were applied to ensure priority program interface capabilities. The on-line monitor-control modules, system routines, and programs were tested and debugged on the ADP equipment. After the final logical program within each functional area was tested and debugged, the related complement of the programs were integration-tested to verify the reliability and validity

of the function's operations and capabilities. Integration was implemented in part by the inclusion of support simulation modules and test techniques. After verification of the component integration capabilities, the entire ADP subsystem software and hardware interface capability was validated. During this period, the actual interfacing hardware was included in the integration test. The program specification documentation was updated to reflect final, post system integration, program capabilities.

Problems encountered during this validation included the following:

- o Special interface with DocuMate II Camera requiring changes to DN-355 software
- o Insufficient time scheduled for system integration
- o Timing and core allocation problem relating to multiple terminals
- o Data Base maintenance problems created by multiple access to adjacent records in same disc sector
- o Special requirements for communicating with CRT's required DN-355 software changes

e. Personnel Subsystem

Tasks performed within the context of Personnel Subsystem requirements (i.e., personnel, organization, training, and documentation) are identified and discussed within this section.

(1) Personnel Selection Factors

Wherever practical, the personnel identified for new or modified stations should be selected from those personnel performing similar tasks in the current system. In those instances where manpower reductions will occur, selection of personnel to man the new or modified stations should be based on the manager's evaluation of the best qualified to fill the available position, irrespective of station assignment.

(2) Manning Factors

Manning estimates for the Enhanced Microform System are based on an estimated monthly update activity volume of 114,450 fiche and 252,600 images. Also included is the requirement to provide approximately 7,700 duplicate selection records per month to support various selection boards. All manning estimates are based on the operation of a two-shift, five-day-week for all functions. Wherever practical, individual station manpower levels were selected to both minimize total equipment requirements and maintain the maximum amount of flexibility within the station.

(3) Organization

The Air Force was furnished a recommended organizational structure for the Enhanced Microform System. This structure is, in the main, now purely academic; however, the primary criteria applied to the organizational development remains valid and could still be applied. Specifically, the recommended organizational structure,

- o Provided for a two-shift operation which would increase system efficiency by optimizing equipment utilization
- o Utilized the concept of working first-line supervisors in that each major organizational entity was assigned a supervisor who performed as a production worker and also insured the smooth operation of a particular production area

(4) Training

An intensive File Maintenance training program was conducted for all personnel prior to full operation of the enhanced system. The training courses presented generally consisted of formal classroom training, which covered procedures, system operations, etc., and the actual hands-on training for participants. Training was geared to the individual trainees; consequently, the length of the training periods and the division of time between classroom and hand-on training was varied. The determinants included such factors as the number of training sessions to be conducted, the level of knowledge of the trainees and the complexity of the training courses being conducted. In all cases, training was scheduled to insure that the required training was complete prior to system implementation. All personnel received the portion of the training program dealing with the operation and application of the new system; however, only those assigned to the new or modified stations received the entire training course.

(5) Documentation

This section identifies the documentation produced to support the implementation and on-going operations of the Enhanced Microform System.

- o Management Procedures
- o Operator Procedures
- o Operator and Management Training Manuals
- o Software Documentation and Maintenance Manual
- o Computer Operations Manual
- o Equipment Specifications
- o Site Acceptance Test Procedures
- o Site Acceptance Test Reports

D. Fiche Coding Change

The Fiche Coding change involved the implementation of a revised Microfiche Header Label System. The specific implementation tasks are identified and discussed within this section; however, the basic task objectives, implementation reasons, and other salient design and development factors are highlighted in the following summary:

- o The use of machine readable microfiche and personnel identification data had been previously established as a necessary component of an effective record management and control capability
- o The original machine readable system, which used 5mm Binary Coded Decimal film strips, had not provided the desired ease of maintenance and level of accuracy characteristics
- o The revised system provided that each microfiche label would contain the member's name, SSAN, and the fiche identifier as alphanumeric characters and that the fiche identifier and SSAN would also be provided in a Universal Product Bar Code format which was established, in a separate study, as the most viable option available
- o The task objective involved the performance of Hardware Acquisition, Personnel Acquisition, and Software Modification and Development tasks necessary to implement the revised system

1. Label Conversion

The basic objectives of this label conversion effort were, as previously indicated, to replace the existing master fiche labels with UPC coded labels, and to verify that the label was correct and placed on the proper fiche. Basically, this effort involved the performance of various personnel acquisition, report generation, and monitoring (i.e., production quotas; equipment reliability and maintainability) actions on a continuing basis. However, for purposes of this report the primary considerations are the capabilities implemented and the results achieved which are documented within this section.

a. Implementation

The label conversion operations actually implemented included six (6) distinct functions, or stations, which performed all of the necessary processing. Figure III-7 depicts the label change workflow. The established implementation Station and processing relationships are summarized below. For File Maintenance purposes, all of the indicated requirements and processing are incorporated into the Master File activities since this station has, historically, performed the necessary header label mounting actions.

(1) Master File Pull and Refile

With the exception of work file supplemental processing the master fiche were removed from the master file and processed by tray. A listing was provided for each tray and accompanied the tray through all processing stations. Trays were returned to the master file at the end of processing.

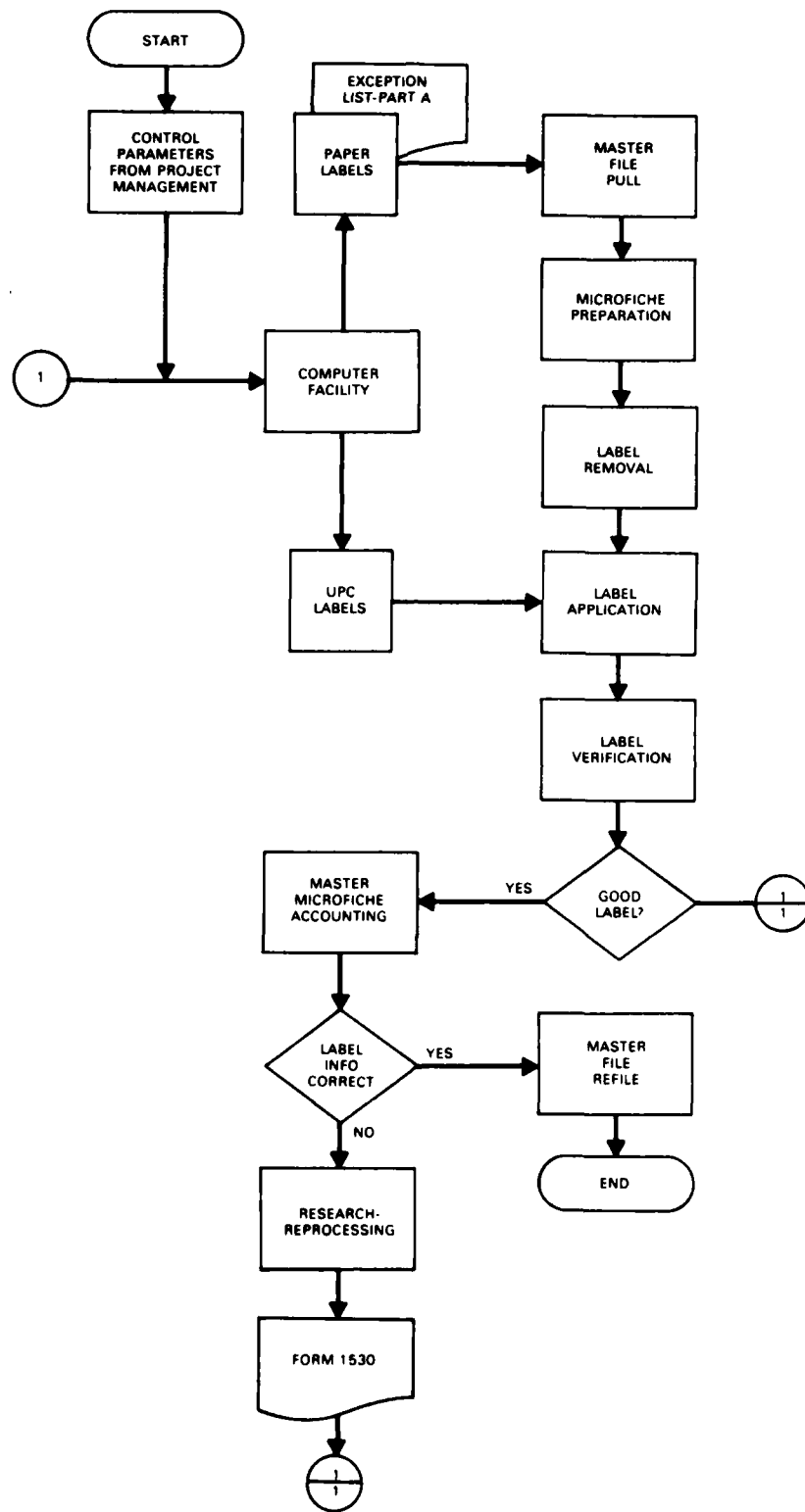


Figure III-7. Microfiche Label Change Workflow

(2) Fiche Preparation and Inventory

This station inventoried each tray against the provided listing and prepared the fiche for application of the new label which included both the removal of the existing label and the cleaning of the label area.

(3) Fiche Labeling

This station applied the label from a set of computer generated labels. An automated label applicator was used for this mounting process.

(4) Label Verification

This station verified that the correct label was placed on each fiche processed since the name, SSAN, and fiche type from the applied label was actually verified against one or more documents on the fiche.

(5) Master Fiche Accounting

After duplication, all master fiche were forwarded to master fiche accounting. At this station each label was read by a code reader to verify that the label could be read and thus provide an accounting for all good labels within the ADP System. Fiche with labels which indicated a read error were rejected to the research station. The list of processed fiche inside the computer was compared to the Withdrawal List and a Supplemental Withdrawal List was produced. This supplemental list was also used to process fiche missing during the initial processing.

(6) Research

This station was provided the initial withdrawal and supplemental lists for use in researching and resolving all errors or abnormalities discovered during processing.

b. Processing Volume

The label conversion staff actually performed the implementation mounting actions, corrected labels on rejected microfiche, and placed the initial labels on microfiche created as a result of the File Maintenance processing performed by AFMPC personnel. The total man-hour expenditure and processing accomplishments are specified in Figure III-8.

2. Software Development and Modification

The specific software modification and development tasks performed to support the fiche label conversion and maintenance activities were:

- o Modified the Label Generation program to interface with the new label generating device
- o Modified the Work File Inventory program to provide a Withdrawal List by master file tray

	<u>Conversion and Correction</u>	<u>Update</u>	<u>Total</u>
Number of SSANs Processed	498,182	---	498,182
Number of Microfiche Labelled	1,828,831	331,559	2,160,390

FIGURE III-8. LABEL CHANGE PROCESSING VOLUME

- o Rewrote the Label Control program which controls the actual label production
- o Developed a UPC Read Program which would provide a code read and verification capability and operate independent of the on-line monitor.
- o Developed a Mismatch Program which would compare the list of fiche read to the initial Withdrawal List and provide the basic file required for Supplemental Withdrawal List production

3. Hardware and Supply Acquisition

This task involved the acquisition of the hardware components and supplies required to support the timely conversion and maintenance of UPC labelled master microfiche. The hardware acquisition effort involved 2 label mounters; 2 code printers; 2 code readers.

The earliest problem encountered in the development of a bar coded microfiche label was the identification of a substance that would yield high quality print from an impact printer, and be relatively transparent to UV light so the bar coded data could be reproduced directly on diazo duplicate fiche. An extensive search for a suitable label material led to the conclusion that the only suitable medium for label stock was a clear plastic base with a semi-transparent coating that would accept print. Avery Label Company's Mark-on White durographic ink silk screened on 0.0015 inch thick mylar was selected as label stock. Avery Label subsequently proved unable to reproduce in their Chicago plant the initial sample production run on which material selection was based. Development efforts were initiated at Avery's corporate offices in Azusza, California and resulted in the development of a coating whose characteristics were reproducible in a production atmosphere. Avery's development efforts also led to a change in printing ink from Markem Corporation's Scanblack to Columbia Carbon and Manufacturing Company's Poly C-1, stock number 3311-60500, and a change from a paper web material to mylar web material. Factors that have proven significant in attaining high print quality are:

- o Silkscreen size
- o Matting agent particle size and consistency
- o Label web material
- o Ink ribbon used
- o Ink ribbon temperature

Another problem encountered was low resolution of bar codes on diazo duplicate fiche. This problem resulted from the master microfiche label being on the reverse side of the mylar carrier as the imagery. During reproduction, the image bearing film was in contact with the duplicating film, but the label surface was not. The resulting duplicate had bar code with indistinct transitions from black to white and with excessive narrowing of dark bars and resultant widening of white bars. Label placement was changed to the same side of the mylar carrier as the imagery bearing film and printing was reversed so that the label surface, with the fiche in its envelope, would be protected from scratching by the envelope flap and the mylar carrier. This

change meant that for optical sensing of the label to occur, light from the reading pen must pass first through the mylar carrier, through the label adhesive, through the label base material, through the label coating, reflect off the envelope flap, then make the return trip to the pen sensor. A certain amount of light was absorbed by each material and scattering occurred at each material interface. The intensity of light returning to the reader for sensing was somewhat attenuated, but was still great enough for reliable sensing and interpretation.

Experience gained in label printing indicates that there is a difference in the printability of Columbia's Poly C-1 produced in plants other than in Cucamonga, California. It is therefore recommended that ink ribbon be procured only from the Cucamonga plant unless further testing indicates a ribbon that yields equal or better print quality.

Supply acquisition was based on the placement of a single order, per vendor, which included both specific delivery dates and the capability for immediate shipments in the event of unusual or unpredictable supply utilization.

4. Personnel Subsystem

Personnel Subsystem tasks were performed, as required, to support both the conversion to, and subsequent maintenance of, the revised Microfiche Header Label System. Specifically,

- o Procedures were developed and published to provide for the efficient and timely initial replacement of fiche labels and the production of the duplicate microfiche for the IS&R Subsystem
- o Appropriate header label production and mounting procedures were incorporated into the existing file maintenance procedures
- o A training course was conducted for file conversion operators; however, this course was primarily an on-the-job training effort which utilized the procedures, rather than a training document
- o Conversion manpower requirements, based on the estimated total processing volume and hourly production ratio, were established
- o Conversion processing station configurations and an organizational structure was developed and functional descriptions were prepared for each of the established entities

E. Development Integration and Special Studies

This contract phase, which has also been identified under the title Microform Integration Software and Test (MIST), encompassed the two major efforts described within this section. Each description includes a statement of the established objectives and a summary of the various analysis, design, and development tasks performed; however, the discussions actually concentrate on a conclusions, recommendations, and results presentation.

1. Analysis and Support Studies

The established objectives were to conduct operational systems requirements analyses and operational system concept studies in the areas of Long Range Microfiche and Image Transmission and Source Data Automation techniques. Both of these efforts were to be performed in support of the Microform Advanced Micrographics Development Program. Generally, the same actions were performed to complete each of the indicated studies in that the necessary baseline data was collected, compiled, analyzed, and translated into specific recommendations and concept presentations. These results, conclusions, recommendations, and concepts are unique to each study; consequently, these factors are discussed, by study, in the following summary. The results of these operational studies are being utilized by RADC to perform detailed technical analyses which will be published in late 1979.

a. Long Range Image Transfer System

This study was designed to identify requirements and advanced techniques to support records utilization actions performed by agencies and activities geographically separated from the Master Microform File at AFMPC. Detailed information relative to the data collected, affected records keeping and utilization agencies, data syntheses and analyses performed, concepts advanced is presented in the Study Report.

(1) Conclusions

The personnel record access requirements and utilization procedures data indicated that, within certain constraints, the Microform Record is a viable replacement for the Master Personnel Record components currently maintained as paper, by Major Air Commands (MAJCOMs), Consolidated Base Personnel Offices (CBPOs), and comparable activities. Discussions with personnel at selected MAJCOMs, CBPOs, and Hq USAF staff functions indicated a definite concern about certain aspects of Microform Record utilization; however, the design and implementation of a Long Range Image Transfer System may, in fact, be contingent upon the resolution of the following constraints and problem areas:

(a) Dual Media

The microform record can only replace a portion of the Field Record; consequently, certain personnel actions require the use of both a filmed and paper record within the CBPO.

(b) Security

Current Air Force Directives require compliance with stringent administrative and physical safe-guards, which include control to limit records access to a minimum number of official users. The microform record is subject to the same requirements. Consequently, any Long Range Image Transfer System implemented must also preclude records access by unauthorized personnel and these safeguards must be applied while the record is in file and during any transfer process.

(c) Records Accuracy

Erroneous or incomplete information could have either a positive or negative affect on the end result of certain personnel actions in that, depending upon the type of magnitude of the problem, a deserving individual might be overlooked or an undeserving member might be selected for a particular purpose (i.e., promotion, assignment, special recognition). The physical transfer of microfiche via courier or mail essentially precludes record and document accuracy problems; however, the accuracy and reliability of any equipment and data transmission systems has not been established within the Military Personnel Records system environment. In summary, the scanning, buffering, printing, and display equipment and any associated data transmission system, must include an edit capability or other safeguards which will prevent input, transmission, or output errors which would either compromise records utilization or affect the legality of the transmitted record, image or data element.

(d) Acceptability

Discussions with command and base level personnel revealed a general readiness to accept the use of the microform record in the performance of the required personnel actions. However, actual acceptance remains contingent upon the resolution of specific questions relative to the:

- o Propriety of using microfiche in the MAJCOM selection board process since microfiche are not currently used by boards convened at AFMPC and ARPC
- o Ability of the microform to maintain a timely update cycle which would insure the availability of the most current data at both the command and base level personnel functions
- o Use and acceptance of microfiche by senior staff members who are totally conversant with the configuration, content, use, and acquisition characteristics of the current paper records/records system

(e) Record Purges

The transfer of records between AFMPC or ARPC poses certain problems which are not totally resolved by the long range image transfer system outlined in this document. Specifically, the updatable silver halide microfiche can be scanned, transmitted, and duplicated electronically; however, it cannot be output in the current updatable microfiche format. In addition, the paper Field Record Components, which are currently merged and transferred with the Master Record paper documents, pose other problems in that many of these field record documents are not authorized for file in the Microform Record. This imbalance between the Microform Record content and the documents warranting permanent retention could be resolved in any one of several ways; however, the fact that an electronically transmitted microfiche could be output, at NPRC, on 105mm silver halide film through

buffer and microfiche printer equipment is a prime consideration. In summary, AFMPC and ARPC could transfer records to NPRC, on a new-term basis, as follows:

- o Transfer paper records via mail or courier
- o Create Field Record silver halide non-updatable microfiche
- o Transfer the Master and Field records to NPRC electronically
- o Destroy the updatable and "created for transfer" microfiche upon successful transmission

(2) Concepts

Basically, the Microform Record can be provided to all or selected distant location through any one of several systems which range from the maintenance of duplicate microfiche containing selected images to the use of an on-line retrieval and dissemination terminal which could provide a video display, duplicate microfiche, and hard copy (paper) output capability. There are a number of options through which the non-AFMPC and non-ARPC locations can be provided access to the Microform Record Components; however, the two options identified in the following summary are considered to be the most viable alternatives. Each option is described in terms of capabilities and requirements parameters. The general equipment characteristics of the communications network to service either option are described as a separate entity.

(a) Satellite Files

This concept provides that each of the EAD, Reserve, and Air National Guard Consolidated Base Personnel Officer (CBPOs) be designated as a file location for a duplicate copy of all Master Microfiche applicable to assigned and serviced officers and Airmen. The Consolidated Reserve Personnel Offices (CRPOs) within each mobilization assignment MAJCOM and USAF Reserve field record maintenance locations at Bolling AFB, D.C., and in Denver, Colorado, would function within the same context as a CBPO. Duplicate microfiche files would also be established at other locations, as required, to provide these locations access to the same record components which they now maintain. The various maintenance locations, file size projections, equipment requirements, expected processing requirements, and the detail file utilization and maintenance concepts and procedures are presented in the Study Report.

(b) On-Line Retrieval and Dissemination

The on-line concept provides, in summary, that each geographically separated records-using location would be in direct (i.e., on-line) communication with the central file location computer. Requests transmitted through the users on-line terminal could result in the receipt, at the same terminal, of: digital index data; duplicate microfiche; paper copy of a document or image; or an image display on a video screen. The development and implementation of a comprehensive on-line retrieval and dissemination is not justified on the basis of the currently available requirements data.

An on-line system which incorporates the established on-line Microform Record Utilization requirements, an APDS inquiry capability, and any required source data automation processing is deemed to be a viable future requirement. For these reasons, a phased on-line system development and implementation program is suggested.

- o Phase 1 - This initial phase, operating in conjunction with the Satellite File System, will provide each repository the capability for direct access to the Microform System digital (Index) data.
- o Phase 2 - This phase would provide a complete Microform System on-line retrieval and dissemination capability for Major Air Command and comparable or high levels
- o Phase 3 - The phase 2 MAJCOM and CBPO capabilities would be retained as previously stated; however, all records users would be provided the additional capability to effect any required APDS and/or Microform System update in an on-line operational mode

(3) Communications Network

A key element to the use of Microform Record Components within agencies and activities external to AFMPC and ARPC is the timeliness, accuracy, and legibility of the records being used. These elements are, in turn, dependent upon both the reliability and security of the communications between the central file and each Satellite File or record user. Essentially, and without regard to the type, communications must insure that accurate data is both dispatched and received and that such data is not disclosed or otherwise compromised during transit. In the main, Satellite File support may be accomplished through the transfer of microfiche via mail, courier service, or by the conversion of the filmed image into an analog or digital signal and the use of electronic transmission equipment. Obviously, the on-line retrieval and dissemination capabilities are dependent upon an electronic communication capability. The remainder of this communications network description is limited to an identification of the general types of equipment which could provide the necessary electronics transmission capability for both the near (phase 1) and long term (phases 2 and 3) requirements.

The actual transfer of digital data from the central file to the Records Repository could be accomplished through any of the currently available systems. In summary, and without additional comments or discussion, the available systems include:

- o Telephone lines
- o Public Digital Data System
- o Terrestrial Microwave
- o AUTOVON/AUTODIN
- o Dedicated lines
- o Satellite communications

b. Source Data Automation

The basic objectives of this study were to identify documents and/or data elements which could be electronically or mechanically: Collected or created during either Microform or APDS processing; transferred between the two Systems; and used to update the appropriate digital and filmed image file.

(1) Conclusions

Basically, the data collected during this study identified requirements for the collection of Microform System and APDS digital data and the direct input of APDS output documents into the Microform filmed record.

(a) Microform Data Collection

Microform System document identification and processing control data must be either extracted from, or established for each of the 257 current and 681 non-current documents authorized for file in the filmed record. The established requirement, which necessitates the collection of from six (6) to nine (9) data elements per document, are identical to the capability currently provided within the File Maintenance function. The data element and type of document relationship data established during this study was, in effect, a summary of both the established requirements and the current data collection system capabilities.

(b) APDS Data Collection

The established requirements indicates that 137 data elements could be collected for, and transferred to, APDS during Microform filmed record update processing. Currently, the Microform File Maintenance Subsystem data collection and transfer requirement includes the Officer Effectiveness Report (OER) and Training Report Period of Supervision and overall rating data elements; however, an additional 21 data elements are collected, when required, from specifically identified training reports. The Microform System File Maintenance function also collects but does not transfer other APDS data.

(c) APDS Output Document Processing

This phase of the study was primarily concerned with the identification of techniques which would provide for the direct entry of APDS output documents into the Microform filmed record. This direct entry stipulation effectively limited the study to the identification of those APDS output documents which are generated as total entities ready for immediate entry into either the filmed or paper record. The established requirements identify a total of 19 documents which can be effectively generated as APDS output products; however, of this number only four (4) are produced as complete, ready to file, documents. Currently, these APDS produced documents are processed by the Microform File Maintenance activity at AFMPC in exactly the same way as provided for any other document; however, the four (4) complete documents could be included in a computer output microfilm system.

(d) Document Availability

Currently, 11 of the 104 documents identified as authorized for file in both the Microform and Base Level records only are, for the most part, not available for Microform System processing. Specifically, the established policy requires that the complete documents be immediately filed in the Field Record Group at Base Level but the policy does not currently direct that the documents be forwarded for entry into the Microform record. This non-availability condition is particularly significant since these eleven documents contain 52 data elements which are not repeated on any other current document. Further, these 11 documents are considered to be the proper source for 72 of the 137 data elements identified for inclusion in a Microform data capture for APDS System.

(e) Data Timeliness

The basic data timeliness requirement is to insure that each element in the APDS data base is both current and accurate. This requirement validates a need for an appropriate data update transaction to be created and processed as an action is finalized and becomes a matter of record; however, this requirement also necessitates a processing sequence control to ensure that outdated data does not replace a more current APDS data base entry. In the main, the 104 documents associated with this APDS data base collection system are finalized within either a Headquarters Air Force (HAF) or Base Level function. However, some of these documents are created and finalized within Air Force Recruiting offices. Still others are created at Base Level and become final documents upon completion of the required Major Command processing.

(f) Processing Volumes

The number of data elements and documents ultimately included in a Microform data collection for APDS system is directly related to the resolution of the document availability and data timeliness factors previously discussed. The collection of 137 data elements is contingent upon the availability of the associated documents; consequently, if any of the 104 documents is excluded because of these availability and timeliness factors there must be a corresponding reduction in the number of collectable data elements. In summary, the APDS data collection efforts may:

- o Remain as presently constituted (3 documents and 2 data elements)
- o Be expanded to provide for the transfer of the additional data elements currently collected (35 document identifiers and 22 data elements)
- o Be expanded or modified to include all of the current documents presently authorized for file in both the Microform and Headquarters Air Force (HAF) paper records (93 document identifiers and 85 elements)
- o Be expanded or modified to support the total requirement involving 104 document identifiers and 137 data elements

- o APDS output documents, on 16mm silver halide film, at AFMPC and ARPC
- o Automated Document Transfer System images, on 16mm silver halide film, at AFMPC and ARPC
- o Control File and APDS data element records, recorded on disk or magnetic tape files, at AFMPC

(b) ADEC System

Functionally, this System will identify, extract, and record all of the Microform and APDS data elements which must be collected for each document. Operationally, this data collection will be accomplished by an automated document or image reading process which includes, as a secondary capability, provisions for an operator to record the necessary data when and if required. The Microform and APDS data elements collected will be written to the appropriate file maintained, at AFMPC, as disk records. In summary, the ADEC System data collection devices must be available at both AFMPC and ARPC; however, the associated digital data should only be recorded on a disk file at AFMPC.

(c) ADT System

This System is intended to provide both for the expeditious movement of personnel documents between the final authority and the records repository location and the collection of all required Microform and APDS data elements as an integral part of the transfer process. Functionally, the System must provide a document scanning capability at each of the locations which finalize personnel documents and must reconstitute the images and documents at the AFMPC and ARPC records repository. Operationally, the document will be scanned, digitized, entered into a buffer storage at each final authority location, and subsequently transferred to a buffer at the records repository. This ADT System required the acquisition or development and utilization of three major types of each in that,

- o Each designated final document authority must be provided a capability to convert images, through a document scanning process, to a digital data configuration; store and subsequently transfer the digital data created
- o AFMPC and ARPC must have the capability to reconstitute the documents in either a filmed image or paper output media
- o AFMPC must receive the necessary Microform and APDS data elements files either as a part of the document transfer process or as the result of COM or ADEC System Processing
- o The data transfer must be accomplished through a communications network which minimizes, but preferably precludes, chances for any unauthorized persons gaining access to the data

(g) Document Readability

The types of equipment identified within the concept discussions are not particularly unique in that COM devices, various code and optical character readers, and image transfer systems currently exist and are used in a variety of applications. Factors associated with equipment availability and the applicability of current equipment to the requirements established within this study have not been specifically established since neither an equipment survey nor any specific tests were performed. These equipment availability and applicability factors will be analyzed in the RADC study. There are as indicated in this summary, a number of other potential Source Data Automation System design and implementation problem areas; however, the document readability factor is considered to be the major constraint. These specific and major constraints include factors such as: the type and amount of extraneous (i.e., NOT REQUIRED) data; hand written or missing data elements; inconsistent data element locations within a specific document identifier; data element clarity (i.e., the degree of contrast between the required element and the background); and data element definition (i.e., the extent to which a required element overlays either a portion of another element or the document format). For the reasons indicated, it is unlikely that any Source Data Automation System can effectively process all of the documents currently received and processed by the Microform System File Maintenance activity. This conclusion, and the resulting System application constraint, would be negated if all of the documents which might be received for Microform System processing were specifically designed or re-designed to conform to current "machine-read" capabilities. This document design and re-design effort could be applied to each of the 257 current documents; however, it could not be effectively extended to include all of the predecessor and historical documents authorized for file in the Microform System.

(2) Concepts

The concepts are predicated on the establishment of a Source Data Automation System definition which requires the collection of Microform and APDS digital data and a direct APDS to Microform document processing capability. These requirements are the basis for establishing specific System parameters which provide for: the continuation of the current Microform digital data collection effort; expansion of the APDS collection capability to include the total established requirement (i.e., 137 data elements and 104 documents); and direct APDS to Microform transfer of, at least, the four (4) items currently generated by APDS in a complete document configuration. The required Microform and APDS data will actually be collected as documents are processed for entry into the Microform record. Consequently, the final system must provide for the expeditious transfer of documents between the final action echelon and the data collection agency. In summary, the stated requirements can probably be efficiently supported by a Source Data Automation System which includes the Computer Output Microfilm (COM), Automated Data Element Collection (ADEC) and Automated Document Transfer (ADT) capabilities identified and discussed in the following presentation. The COM System, operating within the SDA System environment must provide for the production of:

- o APDS output documents on 16mm silver halide film, at AFMPC and ARPC
- o Automated Document Transfer System images, on 16mm silver halide film, at AFMPC and ARPC
- o Control File and APDS data element records, recorded on disk or magnetic tape tiles, at AFMPC

(b) ADEC System

Functionally, this System will identify, extract, and record all of the Microform and APDS data elements which must be collected for each document. Operationally, this data collection will be accomplished by an automated document or image reading process which includes, as a secondary capability, provisions for an operator to record the necessary data when and if required. The Microform and APDS data elements collected will be written to the appropriate file maintained, at AFMPC, as disk records. In summary, the ADEC System data collection devices must be available at both AFMPC and ARPC; however, the associated digital data should only be recorded on a disk file at AFMPC.

(c) ADT System

This System is intended to provide both for the expeditious movement of personnel documents between the final authority and the records repository location and the collection of all required Microform and APDS data elements as an integral part of the transfer process. Functionally the System must provide a document scanning capability at each of the locations which finalize personnel documents and must reconstitute the images and documents at the AFMPC and ARPC records repository. Operationally, the document will be scanned, digitized, entered into a buffer storage at each final authority location, and subsequently transferred to a buffer at the records repository. This ADT System required the acquisition or development and utilization of three major types of equipment in that,

- o Each designated final document authority must be provided a capability to convert images, through a document scanning process, to a digital data configuration; store and subsequently transfer the digital data created
- o AFMPC and ARPC must have the capability to reconstitute the documents in either a filmed image or paper output media
- o AFMPC must receive the necessary Microform and APDS data elements files either as a part of the document transfer process or as the result of COM or ADEC System Processing
- o The data transfer must be accomplished through a communications network which minimizes, but preferably precludes, chances for any unauthorized persons gaining access to the data

(3) ADT Hardware

The document transfer system will provide an automated capability for the transfer of documents between Base and Command level functions and the appropriate records repository. This document transfer capability also can be expanded to encompass the movement of documents between the various recruiting offices and the records repository. System implementation will actually require the acquisition or development and subsequent utilization of the following major components:

(a) Document Scanner

This device will scan each image to be transferred; will convert the image to a transmittable format; and will store the data in a buffer along with appropriate image, document, and routing control identifiers. This control data will permit each image to be specifically and sequentially associated with a document identifier and record when the data is received at the record repository.

(b) Communications Network

The actual transfer of digital data between the collections point and the records repository could be accomplished through the communications network such as identified and discussed in the Long Range Image Transmission Study.

(c) Image Reconstitution Terminal

The digital data, created and transferred as a result of the document scanning process, will be stored in a digital data buffer as it is received at the record repository. The actual image reconstitution can then be performed on either a "scheduled" or "as data is received" basis. Images could be reconstituted in a paper document configuration. However, COM technique production of images on 16mm silver halide film would facilitate Microform System File Maintenance processing and is therefore the preferred image reconstitution and recording media for the records repositories.

(4) Automated Data Element Collection (ADEC)

The ADEC System could be implemented in any of several different configurations. The application parameters advanced in the following presentation identify some of the ADEC System alternatives which will provide for the collection of data elements from additional, but not all, documents as they are processed for file in the Microform System record.

(a) Alternative One

The scope of the ADEC data collection system could be limited to the processing of Officer Effectiveness and Airman Performance Reports. This alternative would provide a total automated data collection capability for a limited number of documents; however, it would accommodate that single group of documents which represents the highest Microform System processing volume.

(b) Alternative Two

Five (5) of the current documents are used as the means for effecting and recording a change to 68 of the 137 APDS data elements. The ADEC data collection effort could be effectively limited to these five documents with the result that the Microform System would become the input source for 68 APDS data elements.

(c) Alternative Three

The expanded data collection effort could be defined to provide that the ADEC processing be limited to the 27 documents which enter the Microform System on the basis of an alphanumeric document identifier. The use of only the structured documents would facilitate ADEC device operations in that the required data element location would be consistent for a specific document; however, it is probable that at least some of these documents will require reformatting either to permit or optimize the ADEC System processing.

2. Hardware Integration

The objectives of this task were to provide appropriate integration services, develop test software, and to otherwise participate in and support the Site Acceptance Test program applicable to additional items of equipment developed under the Microform Advanced Micrographics Equipment Development Program. This section identifies the tasks performed and briefly summarized the Automatic Mounter-Certifier and Fiche Sorter-Reader prototype equipment Site Acceptance Tests performed.

a. Performance

The following tasks were performed in support of the Microform Storage and Retrieval design and the development of the Mounter-Certifier Sorter-Reader equipment.

- o Provided engineering services and software required to perform integration tests of the Automatic Mounter-Certifier and Fiche Sorter-Reader
- o Provided technical assistance for the integration of the Automatic Mounter-Certifier and Fiche Reader-Sorter in the form of vendor liaison, factory acceptance tests, and site acceptance tests assistance and integration tests software
- o Provided preliminary operator and management procedures and preliminary training documentation to support the integration tests of the Automatic Mounter-Certifier and Fiche Sorter-Reader into the AF Microform System
- o Provided technical assistance for the review of the Microform Storage and Retrieval design

b. The objective of this task was to provide the software necessary to support the Automatic Mounter-Certifier and Fiche Sorter-Reader Site Acceptance Tests. In support of this effort, program specifications were produced and the required software was developed, coded, tested, and debugged.

c. SAT Performance Results

The Site Acceptance Tests are identified, by type of equipment, within this section. The presentation includes a statement of the test objective, test titles, and a summary of the testing techniques.

(1) Automated Mounter-Certifier

The purpose of this test was to determine whether or not the hardware and software interface between the H6000 ADP Subsystem and the Mounter-Certifier met the design specifications. The interface tests which were witnessed by PRC, AFMPC, and RADC personnel. The Mounter-Certifier responded properly to each test.

(2) Microfiche Sorter-Reader

The purpose of this test was to determine whether or not the Microfiche Sorter-Reader met the hardware and software design specifications. The testing was divided into the four phases described herein.

(a) Interface Message Test

The interface message test will use a CRT terminal to initiate the messages normally transmitted by the DN-355. A current loop power source will be added to the line between the CRT terminal and the Microfiche Sorter-Reader. This test will verify the Microfiche Sorter-Reader capability to accept and process the messages sent by the DN-355.

(b) Pre-Sequence Data Test

This test will verify the transmission of data by the ADP to the Microfiche Sorter-Reader and the receipt and processing of the data following receipt by the Microfiche Sorter-Reader. This test will be considered valid only if the Microfiche are sorted (sequenced) upon completion of the test.

(c) 5000 Transmission Test

This test will verify the transmission of data from the Microfiche Sorter-Reader to the ADP and the capability to pass 5000 fiche entries.

(d) On-Line Preprogrammed Sort Test

This test will verify the transmission of data from the Microfiche Sorter-Reader to the ADP and the capability to wait until the H6000 sort is complete and receive the data upon completion of the sort.

(e) Test Results

The tests as defined were successfully executed. Initially these tests were only successful when communicating at 300 baud. Modifications were required to both the microfiche sorter-reader software and hardware in order to successfully communicate at higher baud rates.

IV. DESIGN AND IMPLEMENTATION SUMMARY

A. Introduction

Each of the major design efforts resulted in specific recommendations relative to equipment, processing, and procedures to be included in the Microform System.

However, all design recommendations were not completely implemented. Some design recommendations were totally implemented, others were partially implemented, and still others were not implemented. The presentation within this section identifies each major design recommendation; reviews the objectives of each design effort; specifies whether or not the recommendation has been implemented; and assesses the impact. Each implementation effort necessitated the resolution of recurring hardware and/or software interface protocol problems which were caused by insufficient data being provided to the hardware vendors and the inconsistencies in the Honeywell communications software.

B. File Maintenance Design

Generally, the File Maintenance Design was forecast to provide a significant reduction in both the number of file maintenance personnel and in document throughput time. These projected personnel savings are summarized in Figure IV-1 and the document throughput data is detailed in Figure IV-2.

The recommended File Maintenance System includes the following functional components: System Management; Management Information System; Index Record File Processing; Image Production and Processing; Fiche Production and Processing; and Master Microfiche Storage and Retrieval. Each of these last four components includes one or more of the ten (10) specific processing stations established for the final system. Generally, these station and component relationships were established on the basis of the primary media processed at the station; paper, film, or fiche handling.

1. General Comments

- o The number of processing stations was reduced from 14 to 10
- o The Document Index Review Station was eliminated
- o The current Indexing Station was divided and now provided both an Indexing and an Index Verification Station
- o The Document Custodian Station was eliminated; however, some of the actions performed were assigned to the Document Preparation Station

2. Station Summaries

a. Document Preparation Station

The recommendations associated with the operators at this station have been totally implemented in that this station has assumed the temporary document hold file maintenance responsibility formerly performed at the

<u>SUBSYSTEM/FUNCTION</u>	<u>CURRENT SYSTEM</u>	<u>PROPOSED SYSTEM</u>
IS&R Subsystem		
Work File Operations	19	4
MIDU/Work File Operation	1	1
Duplication Operation	6	6
Hard Copy Operation	2	2
Product Distribution	1	1
SUB TOTAL	29	14
File Maintenance Subsystem		
Document Preparation	8	8
Indexing	9	7
Document Index Review	6	0
Index Verification	0	9
Camera	10	4
Film Processing	2	2
Inspection	2	0
Inspection-Correction	1	2
Mounting	6	0
Certification	8	0
Mounting-Certification	0	6
Certification-Correction	2	0
Final Audit	0	2
Fiche Duplication	8	8
Master File	16	6
Cross Trained Pool	9	6
Computer Support Personnel	2	0
SUB TOTAL	89	60
System TOTAL (Excluding the ADP Subsystem)	118	74

FIGURE IV-1. Projected Personnel Savings

<u>FILE MAINTENANCE</u> <u>SUBSYSTEM FUNCTION</u>	THROUGHPUT TIME-HOURS	
	<u>CURRENT</u> <u>SYSTEM</u>	<u>PROPOSED</u> <u>SYSTEM</u>
Document Preparation	1.82	1.82
Indexing	20.34	5.95
Document Index Review	13.66	0.00
Index Verification	0.00	6.56
Camera	20.89	9.04
Film Processing	1.98	1.98
Inspection	9.38	0.00
Inspection-Correction	20.71	9.42
Mounting	11.31	0.00
Certification	5.45	0.00
Mounting-Certification	0.00	11.25
Certification-Correction	3.24	0.00
Final Audit	0.00	3.24
Fiche Duplication	9.12	9.12
Master File	10.77	4.74
TOTAL	128.67	63.12

FIGURE IV-2. Projected Savings in File Maintenance Processing Times

Document Custodian Station and both a CRT terminal and a remote output printer have been placed in the station for use in accomplishing the required tasks and processing. The workload for this station has been increased, however, a more efficient and better control of the documents requiring special processing has been provided.

b. Indexing Station

Each of the functional and operational modifications recommended for this station have been implemented and provide, in the main, an on-line (i.e., direct CRT terminal and computer communications) digital record creation and modification capability. Additionally,

- o The System edits the data input on-line
- o The data capture requirements have been expanded to include specific elements associated with camera control and amended and associated document relationships

The benefits of the changes to the indexing station are dependent upon those of the Index Verification Station.

c. Index Verification Station

The processing requirements implemented for the Indexing Station were also recommended and implemented, using identical equipment and procedures, at the newly created Station. The basic differences between the Stations are the level of computer edits applied to the input data and the associated error recovery and correction procedures. Specifically, when the Index Station data input requirements have been completely satisfied, an operator at this Station then resolves all errors resulting from the additional edits and processing applied to the data. In many instances, the error is resolved by a data re-input action; however, certain error conditions require that the document either be rejected and reprocessed or removed from any further processing. The immediate update to the Index Record after passing edits eliminated the long turn-around times that had previously plagued this Station.

d. Inspection Correction Station

The primary changes recommended at this Station provided for the combining of functions currently assigned to the Inspection and Inspection-Correction Stations, and the replacement of the current punched card input error correction techniques with CRT terminals which will provide digital data base access in an on-line processing environment. Basically, the capabilities implemented, which provide for the System to assign the batch to be processed and for the results of the film inspection to be entered into the digital data control file, are identical to the design recommendations. Specifically, personnel at this Station identify requirements for, and initiate, the document reprocessing cycle by accessing, via the CRT terminal, and annotating the appropriate index data entry. Better controls were provided for document reprocessing. The input displays for designating corrections could be simplified, thus speeding up the correction process.

e. Final Audit Station

This Station performs the same error reconciliation and correction actions which were previously accomplished at the Certification-Correction Station. The only significant procedural and processing change involves the use of a CRT terminal to assess and update (i.e., add, delete, change) the digital data base and this capability has been implemented. The volume of corrections for this station was greater than anticipated. Because of this the correction procedures were modified to provide both an off-line and an on-line correction capability. With the software and procedural changes implemented, this station handles corrections in a more efficient and timely manner.

f. Camera Station

The basic requirements of capturing the image content on film and general batch processing were not changed; however, the specific techniques and procedures modifications were implemented. The majority of the actual document filming actions are accomplished via a computer controlled camera (identified as the DocuMate II) which, based on specific computer generated instructions and operator performed page placement actions, transports and positions the page under the camera head, automatically performs the necessary BCD-display and fiducial mark placement actions, films the image, performs any necessary page turning and films the second image, and transports the page to an output hopper.

The paper quality of the documents and problems with the document flipping mechanism of the DocuMate II camera, the throughput expected by use of the DocuMate II camera was not as great as expected.

g. Film Processing Station

The only change in the current requirements and procedures at this Station involves the use of a CRT terminal to notify the System that film has been developed and the batch is either accepted and forwarded or rejected and returned to the Camera Station. This data input is performed on any available CRT terminal. The batch and document control provided by this function was as expected.

h. Mounter-Certification Station

The actions recommended to be performed at this Station were a consolidation of the established Mounting and Certification Stations processing requirements. The recommended processing which is contingent upon the development of an operator loaded device which will, under direct computer control, automatically mount imagery on the master fiche and then perform the associated certification action has not been implemented. The utilization of a fully automated on-line computer controlled Mounter-Certifier constituted the major design modification included in the recommendations for this Station; however, the established design also provides for the additional items identified below. The recommended combination of the Mounting and Certification Stations

has not been accomplished; however, a prototype of the Mounter-Certifier device, required to permit this consolidation, has been developed and satisfactorily tested. AFMPC is currently performing full system operational testing prior to a commitment to further Mounter-Certifier device production. The initial testing of the prototype indicates that the Mounter-Certifier will achieve the savings as described and will become a valuable asset to the production line.

i. Fiche Duplication Station

The proposed Fiche Duplication Station differs from the current station only in that the operators will be required to notify the system, via an on-line CRT terminal, when duplication of a batch of master fiche is complete. This recommendation has not been implemented.

j. Master File Station

Basically, the proposed master File Station performs the currently assigned tasks in that the microfiche storage, retrieval, and header label mounting actions continue as assigned responsibilities. The specific operational procedures and techniques should be modified, as required, to accommodate the following recommendations which, as yet, have not been implemented.

- o Utilize computer controlled, automated storage and re-retrieval devices which will: Accept on-line commands from the ADP System; transport the requested tray of microfiche to a specified work area for manual fiche insertion or removal action; provide multiple work parts which can, at management discretion, be dedicated to a specific function; and provide a per port queuing capacity of at least one tray in addition to the tray being worked
- o Provide CRT terminals which will permit system generated microfiche retrieval and refile instructions, and operator responses thereto, to be communicated in an on-line operational mode
- o Use a fiche reader to log microfiche in and out of the master file

3. Management Information System

Nearly all elements of the recommended management information system have been implemented. The single major recommended facet not implemented involves the creation and use of the employee records. Management information is available as: CRT terminal displayed exception reports which can be requested as specified critical events occur: generalized on-line system status, production, and batch content inquiries which are produced periodically or as required during low system utilization periods. Files are maintained as a result of normal processing actions; however, at specifically designated terminals, batch processing status for stations with no ADP interface must be input in an on-line mode. Through the on-line aspect of the system design, the System Manager can:

- o Establish and modify batch processing priorities and monitor the associated scheduling actions performed by the batch assignment routines
- o Analyze system operations on the basis of the audit trail provided by the batch accounting and control system
- o Establish system operational parameters which, if not attained, will result in an exception report
- o Obtain system status data, when and as required, through an on-line inquiry capability
- o Be provided salient historical data which is structured to facilitate its being used for predictive purposes

C. Retrieval and Dissemination Design

The recommended Retrieval and Dissemination System design was forecast to reduce the manning requirement from 29 to 14 operators and provide access to Work File fiche within 19 rather than 38 seconds.

This recommended integrated officer and airman retrieval and dissemination system was, in effect, the result of combining all officer and airman record access requirements into an upgraded and expanded EAD officer IS&R system. The additional, modified, and to be developed hardware components required under these retrieval and dissemination design recommended and dissemination design recommendations have not been acquired. Further, no effort was specifically expended, under this current contract, to implement either an Airman or an Integrated Officer and Airman retrieval and dissemination capability. However, AFMPC merged the microfiche from the officer and airman files and modified the retrieval software to identify the microfiche by the rank of the individual. In summary, an integrated officer and airman retrieval and dissemination system which includes the following characteristics and functions should be, but has not been implemented.

- o Microform and APDS integration which provides direct communications
- o Integrated officer and airman files which provide computer controlled random access to an individual tray of microfiche
- o User accounting data compiled and dissemination as required

D. Microform and APDS Interface

Basically, the philosophy of the recommended system design is predicated upon the dedicated single-station contention-line concept with the computers communicating in the direct-access interactive conversational mode (DAC normal mode). Under this concept, one system initiates communication and the other system immediately reacts by providing a logical connection to dedicated software which will begin interactive communication. Within this context, the transmission of data between the two systems is initiated by operator action in both systems. In application, transactions such as SSAN mismatch data and DER supplemental data are placed in disc files in the Microform System as a result of processing by these application areas. The data is then transmitted

to the APDS and placed in disc files until required. Similarly, document suspense, on-line fiche request, and selection board transactions are placed in disc files in the APDS during processing and then are transmitted to the Microform System where they are placed in disc files until processed. The actual system implementation is not reflected as a task performed since this action was, and is, an Air Force responsibility and, in fact, has not been completed. In summary, the Microform System software has been completed; however, the APDS software, the associated hardware, and the on-line communications previously discussed have not been implemented.

E. Label Conversion

This design and implementation effort was performed to incorporate a Universal Product Code (UPC) machine readable header label into the Microform System. This UPC label had been identified and selected on the basis of a separate study as a viable replacement for the Binary Coded Decimal code strips originally placed on the EAD Officer Microfiche. The conversion to the UPC labels was successfully accomplished; however, as previously indicated, implementation necessitated the resolution of several hardware/software interface protocol problems. The equipment and processing procedures associated with this implementation effort are now being incorporated into the File Maintenance processing line by AFMPC.

F. Conclusions

The design facets implemented during this contract were not specifically subjected to a comprehensive test and evaluation; consequently, the following conclusions are the result of observations rather than the result of an empirical data collection and analysis effort.

1. File Maintenance

The personnel and throughput benefits expected to result from the File Maintenance design and implementation effort were not attained to the extent predicted. This diversity between expected and attained benefits can be attributed to a number of factors which include the following:

- o Only selected portions of the original design were actually implemented
- o The techniques for making corrections as specified in the design characteristics for the Inspection Correction and Final Audit Stations did not compensate for the volume of activity actually encountered
- o Interface protocol problems, identified and resolved during the training and implementation phase, significantly compromised System acceptance as an improved and viable capability. These problems did not get resolved during the System integration and test phase because insufficient time was allocated for testing
- o The processing and procedural changes initiated and implemented by the AFMPC upon System delivery further reduced the capability to compare the operational and planned processing. These changes were easier for their personnel to learn but they permitted the introduction of errors into the system thus creating a heavier workload on the Final Audit Station.

2. Retrieval and Dissemination Design

This subsystem was not implemented; consequently, none of the predicted benefits were either expected or attained.

3. Microform and APDS Interface

This capability was not implemented.

4. Microfiche Header Labels

This revised header label system was implemented; however, an analysis of the impact must be delayed until the process is integrated into, and used within, the File Maintenance and Retrieval and Dissemination processing.

G. Events Summary

The more significant contractual accomplishments are identified by event in the following chronologically ordered summary.

- o June 1974, Contract awarded for Airman Record Conversion
- o July 1974, Began Airman Master Personnel Record Conversion
- o December 1974, EAD Airman Retrieval and Dissemination System User Requirements (WP-A204-2) published
- o February 1975, Published Integration Plans and Procedures
- o May 1975, Converted the Honeywell 6034 processor to a Honeywell 6044 processor
- o August 1975, Published the File Maintenance Optimization Plan
- o November 1975, Initiated action to replace the DATANET 30 with a a DATANET 355; published Implementation Plan of the Integrated officer and Airman Microform System; published a Privacy Act Update to Training Manuals and User Guides
- o February 1976, Completed the Airman Master Personnel, TDRL and General Officer C&M records conversion; completed the DocuMate II installation; published Selection Board Support Procedures
- o April 1976, Initiated File Maintenance training for AFMPC personnel
- o June 1976, Received Air Force approval of the Implementation
- o August 1976, Conducted training course for additional AFMPC File Maintenance personnel
- o September 1976, AFMPC assumed the File Maintenance responsibility
- o January 1977, Distributed Requests for Proposal (RFPs) for the Fiche Coding Change equipment (including fiche code strip printer, fiche code strip mounter, and fiche code strip reader)
- o March 1977, Published the Microform System /APDS System Interface document
- o May 1977, Completed the Microform portion of the APDS/Microform System operators, supervisors, and managers; began hands-on training and equipment familiarization for these personnel
- o October 1977, Published updated Enhanced System Operator, Supervisor, and Management Procedures
- o November 1977, Completed the user acceptance test of the Enhanced Microform System

- o December 1977, Completed Enhanced System Software documentation
- o June 1978, Restarted the Fiche Code Label Change project on a single-thread low level basis
- o July 1978, AFMPC assumed equipment maintenance responsibility for all components except those directly involved in the Fiche Code Label Change effort; published Volume II, Detailed Analysis, of the Long Range Microfiche/Image Transfer System
- o August 1978, An initial design contract for the Microfiche Sorter-Reader was awarded; Fiche Code Label Change processing line manned and operational
- o November 1978, Published the Source Data Automation Study; received the Automated Mounter-Certifier device; published Mounter-Certifier Site Acceptance Test Report; published Fiche Sorter-Reader ADP Interface Site Acceptance Test procedure
- o May 1979, Completed Fiche Label Change project
- o October 1979, Performed Fiche Sorter-Reader Site Acceptance Test; published Site Acceptance Test Report
- o February 1980, Published Final Report on contract F30602-74-C-0325.