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Micromation and Micrographics

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Introduction

Commercial data processing systems of all generations, first, second and third, have been plagued by a serious imbalance of speeds. While all functions of information systems input, processing, and output are interrelated they have been sadly out of balance in speed relationships one to the other. A major objective of the Non-Impact Printing Project (NIPP) (now titled Micromation) was to devise a solution to the crucial imbalance on the output side of the computer. Providing adequate on-time information to operational levels is solving only part of the output problem. Management, while leaning heavily on computers to answer their day to day operational needs with thousands of lines of data, is still looking for a system which will reduce this data to a format which facilitates a review and analysis of current status and trends. Concepts now under development during Phase III of NIPP will approach this problem toward a solution.

Frequently referenced in this document will be the term "Micromation System." It can be considered as a system which combines the technology of computers and high speed microfilm recorders to solve major problems in information management. Discussions further in the text will indicate how Micromation has afforded a practical solution to fill the speed gap between fast automatic data processors and slow output printing systems, much to the satisfaction of both the data processing manager and his customer.

To eliminate confusion on the part of the reader, it should be understood that unless otherwise qualified, the media of microfilm which will be under discussion throughout this document will be 16mm roll film, in cartridges. The advantages of compactness, low cost, and ease of use make this media particularly suitable to business information systems. The term "business" is used here to indicate information systems designed to support the management and operational aspects of logistics, finance, personnel, and other similar areas which are computerized and non-scientific.

Background

Faced with continuously mounting computer print requirements at many Army Materiel Command Data Processing Installations and Activities, the Directorate of Management Systems and Data Automation of the Army Materiel Command initiated studies to determine the full scope of the problem and to develop recommendations to alleviate the problem. The initial step was to conduct a survey among the commodity commands and depots of AMC to determine what resources were being used annually to produce reports requiring one hour or more each of computer print time. Analysis of the data received from the seven largest computer facilities indicated that annually 41,762 hours of computer print time were being used to produce 505 reports on 128,261,512 pages of standard computer paper. The cost of standard stock computer paper to support the above reports amounted to $1,209,315.00 annually.

With this avalanche of paper into functional areas it could be assumed that the information requirements of data processing customers would be satisfied. This was not the case, however, as printing backlogs continued to mount. Oddly enough, it was found that those applications with the largest data base usually received the least service. Customers in this category were usually serviced on a quarterly, and in some cases, an annual basis. In such cases the lack of reports and the untimeliness of those reports that they did get created serious operational problems. Attempts to overcome these deficiencies by adding more computer printers has resulted in increased ADP operating costs and in many cases a creeping "paper paralysis" (see Figure Number 1) within the functional areas. Like "having a Bear by the tail," other approaches such as exception reporting, resulted in thousands of inquiry transactions hitting the central processor thus impeding cycle turn around time.

Results of these early studies concluded in December 1966, indicated that use of high speed microfilm recording of computer output could solve most of the inefficiencies imposed by the so called "high speed" impact printing systems. Although it was evident that there was merit in the microfilm approach, there was no single company in the microfilm industry, at that time, that could supply all the equipment components needed to implement a micromation system. Likewise, to our knowledge, no single firm had developed and documented the complete guidance required for planning and implementing a micromation system in a data processing environment. It was decided therefore, that it would be to the Army's advantage to prototype test the system before implementing on a broad scale.

Plans for Prototype Test

During January 1967 the Army Materiel Command developed a three phase plan for conducting prototype tests of Micromation Systems at three major subordinate commands. The plans were approved by the Office of the Chief of Staff, Headquarters, Department of the Army on 24 February 1967.

Selection of the test sites was based on the

ABOVE SCENES ARE FROM TWO SEPARATE COMMANDS. THE WALLS OF PAPER, FROM FLOOR TO CEILING, TYPIFY THE HORRENDOUS PROBLEMS CREATED IN FUNCTIONAL AREAS BY THE OUTPUT OF COMPUTER PRINTERS.

FIGURE 1

size of the command's computer print load, computer configuration, and level of activity. Testing at multi-sites was planned in order to provide findings in many diverse application areas and ADP environments. The test sites selected and model of computer interfacing the high speed microfilm recorder were as follows:

(1) US Army Tank Automotive Command, Warren, Michigan — RCA 3301

(2) US Army Electronics Command, Philadelphia, Pennsylvania — IBM 7080

(3) New Cumberland Army Depot, New Cumberland, Pennsylvania — IBM 7074

After consultations with manufacturers of micromation equipment, film developers, film reproducers, and film readers and printers, subsequent analysis of the equipment capability, and based on the findings of studies and comments solicited from other government agencies, it was decided to obtain the test equipment from the following manufacturers:

(1) Stromberg-Carlson - SC 4400 High Speed Microfilm Recorder with edit, reread, and Polaroid options.

(2) Kalvar Corporation - Model MMR 401 Film Reproducer.

(3) Eastman Kodak - Viscomat (film developer), Readers (Recordak Model PB-1), Reader/Printers (Recordak Model PES-1), and Portable Readers (Recordak Model P20).

(4) Datamec - Model 3029 Tape Station.

Installation of the equipment to support Phase I of NIPP was made on the following dates:

(1) US Army Tank-Automotive Command, 7 April 1967.

(2) US Army Electronics Command, 11 May 1967.

(3) New Cumberland Army Depot, 30 June 1967.

System Concept: General

The prospect of introducing microfilm into a data processing environment may appear, at first glance, to be complicated. This, however, is not the case. As amplified in later discussions, the installation and implementation of a Micromation System is fairly simple. The state of the art has developed, equipment-wise, in the last two years to a point where data processing managers can integrate microfilm recording equipment into their output handling system as easily as any peripheral printing gear. Properly selected, all of the system components are available with features adaptable to an ADP environment.

The heart of micromation system is the high speed microfilm recorder. It, however, is a single element and must be supported and complemented by two other major components, a film processor and a film reproducer. The fourth major component in the system is the microfilm reader or reader printers which are used as data retrieval stations within functional areas. Figure 2 shows a typical system which includes these elements.

The high speed microfilm recorder is a device which records computer data on microfilm in human readable form. Of the four major components cited above, the recorder is the only device considered as ADP equipment. It is a computer output device which may be connected directly to the computer for "on-line" operation or to a magnetic tape unit for "off-line" operation. The "off-line" mode was used at all three prototype sites and, discussions in this report will reflect that mode of operation only. The magnetic tape units interfacing the IBM computers were switchable to afford use of the tape drive with peripheral computers when not in use with the recorder. The standard tape drives "read" information into the microfilm recorder from magnetic tape previously prepared by a computer in the same manner that a standard "print tape" would be prepared.

The recorder produces computer reports directly from magnetic tape with no intervening paper copy. This is achieved by converting digital signals to voltages which are applied to a cathode ray tube (CRT). This conversion process results in the information being displayed on the CRT screen in readable alpha numeric form. The microfilm record is produced by photographing the information displayed on the CRT screen. The basics of this process are illustrated in Figure 3.

The recording speed of the recorder, selected for the system test, was geared to match that of the magnetic tape drives used on the peripheral computers at the test sites. The recorder was capable of accepting and recording data at a rate of 62,500 characters per second. On a line per minute basis this is a recording speed of over 15,000 lines per minute. Experience during the test indicated six (6) to eight (8) minutes were required to record one (1) 2400' reel of magnetic tape data.

The camera magazine of the recorder holds 400 feet of 16mm film, normally enough to record the contents of four (4) 2400' reels of magnetic tape. The resultant ratio of one reel of magnetic tape data to 100 feet of film, (the contents of one film cartridge used in the readers) is used effectively as a control to facilitate reconstruction when excessive tape parity errors are experienced during recording.

After each 400 feet of film, or segment thereof is recorded, the "exposed" film in a take-up magazine is attached to a leader of a film processor and developed as a positive film (black print on a transparent background). The developing is completed at a speed of 36 feet per minute, after which the film is ready for duplication.

As indicated in Figure 2, the third process in the micromation system is the reproduction of the original processed film. All reproduction during the system test was handled on Kalvar film reproducers. Simply stated, the reproduction process is as follows: The roll of

TYPICAL MICROMATION SYSTEM

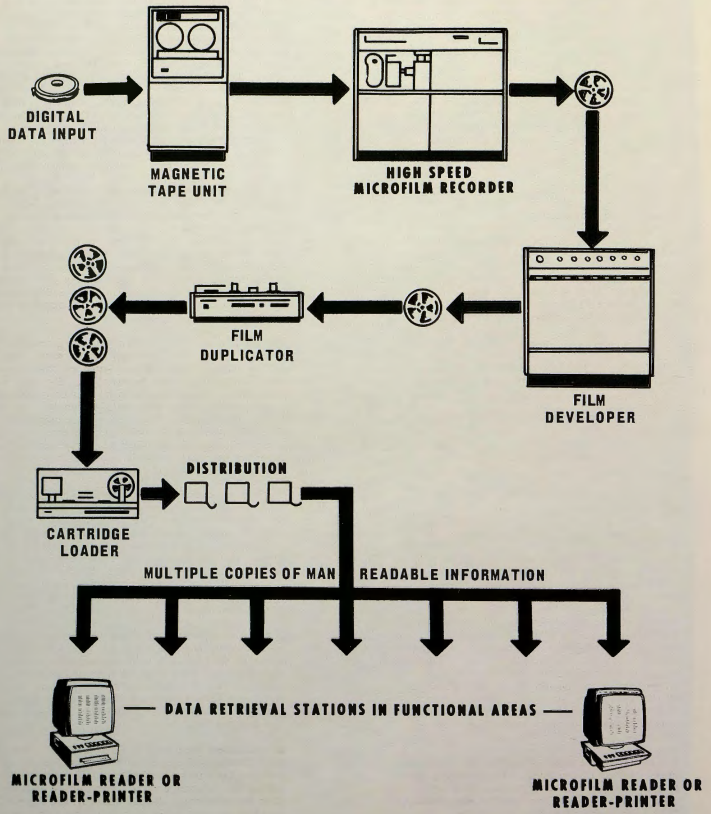
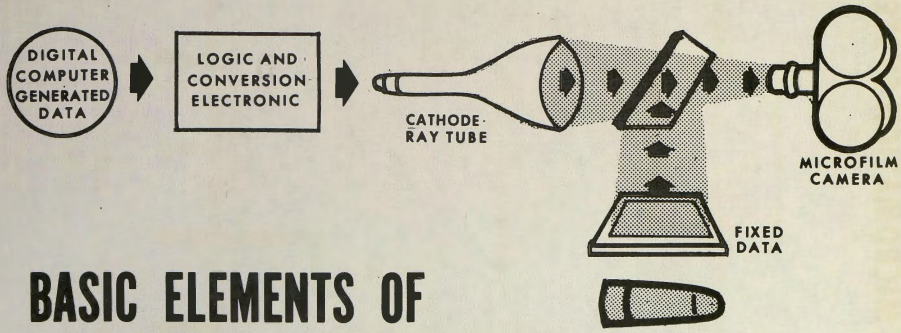


FIGURE 2



BASIC ELEMENTS OF HIGH SPEED MICROFILM RECORDER

FIGURE 3

positive film passes a roll of Kalvar copy film at a point where it is exposed to ultra-violet light and heat. The use of light and heat alone obviates the need for chemical processing, thus, making this reproduction process particularly adaptable to an ADP environment. The film is reversed (negative) in the reproduction process so the output is a high contrast viewing film (transparent characters on a dark background). The speed of the reproduction process is 60 feet per minute, affording rapid production of the required numbers of copies.

The final steps of the film handling procedure involves inspection, film cutting, splicing to a leader attached to the core of a film cartridge and loading into the cartridge.

Distribution in-house of microfilmed computer reports is much simpler than with previous paper systems. When mailing of the report is required, considerable savings in time and cost can be recognized as microfilm is about 1/50th the volume and weight of paper forms.

In the user area, use of the computer data is greatly simplified by use of the cartridge and microfilm reader. With the cartridge approach, film loading problems are eliminated as the cartridge can be slipped easily into the reader, with only 10 to 12 seconds required to pass 2000 pages of information.

Test Objectives

Phase I

In view of the world-wide program envisioned for the Army, it was deemed appropriate that the concepts stated above be tested in various ADP environments and levels of activity to determine advantages, major problems, if any, and the degree of compatibility of each major component to various computer configurations, applications, and system environments.

Determine and transfer the maximum number of voluminous computer printed reports to the micromation system.

Free up computer time for more essential processes than printing.

Reduce computer turnaround cycle time.

Improve responsiveness of functional areas by vastly improving the timeliness of reports.

Determine the feasibility and scope of possible usage of microfilm media for dissemination and use of the U. S. Army catalog and supply management data, including other computer generated reports, produced in support of U. S. Army continental United States and overseas, at both the wholesale and retail supply operations levels.

Improve emergency relocation procedures through utilization of key microfilm files and portable readers.

Effect reduction of space requirements for active and inactive computer reports.

Reduce service contract costs and utilization of peripheral computers and EAM equipment consistent with efficient ADP operational practices and contingency requirements.

Transfer large EAM processing jobs, on a selective basis, where needed for responsiveness to peripheral computers. For example, eliminate large EAM and tub files currently maintained by some activities for MILSTRIP requisition history and MRO history files.

Phase II

Based on results of prototype tests determine the total AMC micromation requirements.

Develop guidance and disseminate information regarding test results and system planning criteria for other Army activities.

Phase III

Develop at a selected AMC installation the system and programming techniques required to produce, on a cathode ray tube printer/plotter, management reports in graphic format.

Determine feasibility of adapting a Graphic Facsimile Communication System for inter and intra command utilization.

Exploit experience gained during Phase I and II and develop AMC-wide implementation procedures and standardization of equipment.

Findings from System Tests

General

Acceptance of Microfilm. The most significant aspect of the NIPP test has been the enthusiastic acceptance of microfilm as an information media. Included in this acceptance are the customers of computer services at the three prototype sites and soldiers in the United States Army throughout the world. The findings cited below explain the causes for this enthusiasm. Detailed back-up data pertaining to the findings summarized below are included in this report.

Improved Information Flow. Improvement in the flow of computer information from the machine room to the customer was probably the most important achievement during the test. This pertained to data sent overseas as well as information generated for in-house use. At the Army Tank-Automotive Command one copy of a large report, Figure 4, previously produced quarterly on the computer printer, required four to five weeks to be bound in book form and placed on the shelves of the customer. After installation of the micromation system this elapsed time was dramatically reduced to 24 hours. Further, eight copies of the report are now produced on a Kalvar reproducer, affording immediate access to the file by hundreds of clerks at widely dispersed locations within the Command. No computer print time is now required to produce this report.

Reduced Computer Print Requirements. While improvements afforded the functional areas by micromation are of prime importance, hard pressed managers of computer facilities are also pleased with its advantages. For example, over 11,000 hours of RCA 301, IBM 1401, and


U.S. ARMY TANK—AUTOMOTIVE COMMAND
COMPUTER PRINTOUT OF SWORDS MASTER
FILE 230,000 PAGES. COMPUTER PRINT TIME 138 HOURS


U.S. ARMY TANK—AUTOMOTIVE COMMAND
SWORDS MASTER FILE ON MICROFILM
88 MAGAZINES-RECORDING TIME 15 HOURS

FIGURE 4

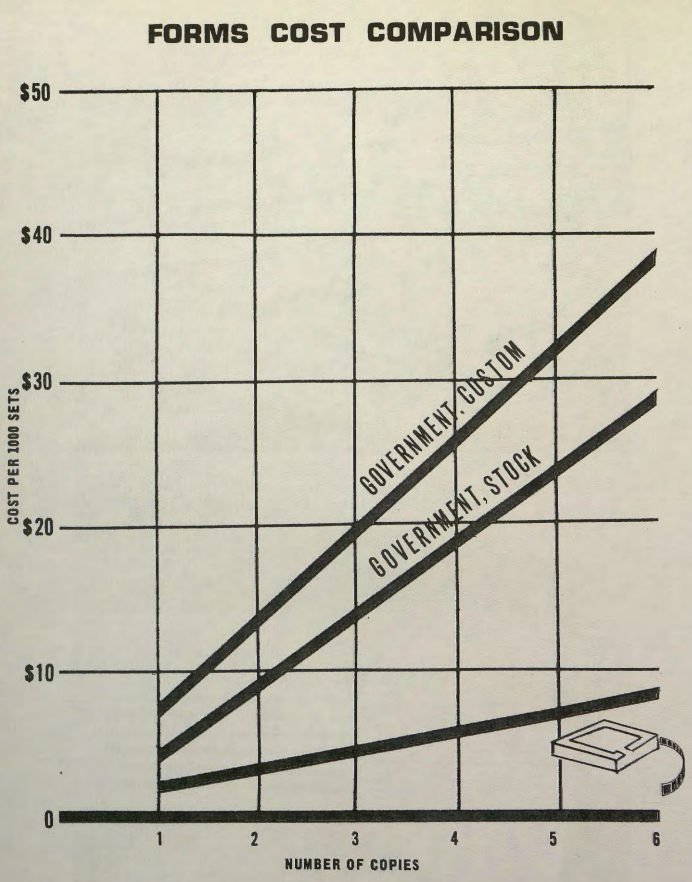

FORMS COST COMPARISON
$50
$40
$30
$20
$10
0
COST PER 1000 SETS
GOVERNMENT, CUSTOM
GOVERNMENT, STOCK
1
2
3
4
5
6
NUMBER OF COPIES

FIGURE 5

IBM 1460 computer hours will be freed during the first year of operation at the three prototype sites. These figures are based on less than a dozen applications implemented during the test phase at each site, and constitute only a fraction of the applications which are candidates for micromation. The peripheral computer hours made available by the micromation process can of course, be used for more essential processing or set aside for contingency requirements. It should be noted here that the magnetic tapes used in the micromation system are prepared on the central processor as with the paper print system. However, since no paper copy is needed, the tapes bypass the peripheral computer and become input to the off-line microfilm recorder.

Paper Cost. Paper output from a computer, until now, has been considered as a way of life. Few of us, even those directly involved with the NIPP project, realized the cost of computer paper. The startling facts, however, developed in the course of the project indicates that in some cases we pay more for computer paper than we do for computer rent. As indicated in Figure 5, the cost of 6 part standard computer-forms paper is about $30.00 per 1000 pages. When one considers 1000 pages as roughly equal to the hourly output of the average computer printer, it becomes quite evident what an expensive part paper plays in the operational cost of a computer facility. For example, purchases of computer paper during FY 66 by one computer installation within the Army Materiel Command amounted to over $338,000. Significantly the reports from the three prototype sites reveals that savings in paper alone are exceeding the cost of the micromation systems. Below are listed several "behind the scene" cost factors which collectively equal or exceed the original purchase price of the computer paper.

Purchasing
Receiving
Storage
Physical Handling
Waste
Obsolete pre-printed forms
Decollating
Bursting
Binding
Reports Distribution

Cost Savings. In addition to the fact that micromation has significantly improved the physical dissemination of computer generated data, a major benefit has been the vast reduction in ADP operational costs accrued by recording the information directly on microfilm.

For example, Figure 6 illustrates an analysis of costs related to printing the Electronics Command's Depot Balance Report on a computer printer and costs related to recording the same application directly on microfilm. A savings of $2,179.05 a month was realized by using the micromation method. This represents an annual savings of $26,148.60.

This method of cost comparison, developed jointly by the Army Materiel Command and the Army Audit Agency, also indicates that 772.8 hours of computer time are freed each year for more productive computer processing, and 2,880,000 pages of paper are eliminated from functional areas by this single microfilm application.

Under the paper system only 4 copies of the report were distributed. With microfilm, 8 copies are now distributed affording a 100% improvement in dissemination of the report's data. Cost factors used in the cost analysis are listed in Appendix B.

Budget Impact. A news release from the House Post Office and Civil Service Subcommittee, Figure 7, illustrates the impact of paperwork on departmental budgets and the national economy. The $8 billion a year price tag for paper and its auxiliary handling and filing cost is a staggering sum. While computers influence only a part of this cost, they nevertheless outstrip other sources in sheer volume. "Understanding and control of this new paperwork influence is urgent," the committee said of computers. The committee's detailed report, however, reflects the volume of paper from one computer only and no cost factors. Therefore, it appeared appropriate to devise a chart to reflect the total impact of government computer printers on paper volumes and costs. As indicated in Figure 8, the 2600 government computers, operating at about 50% of the reported utilization factor of 333 hours per month, dump 4.83 billion pages of print into the functional areas each year. Considering that the average computer report is produced on 4 part paper this figure jumps to a staggering 19 billion pages. The cost of the 4 part paper alone is $96,561,760. Considering the auxiliary handling costs listed in the above paragraph, this cost is increased another 100%, and when added to computer leasing costs which run into the billions of dollars one can appreciate and support the House committee's comment on the urgency of understanding and controlling computer printing. Recommendations on this aspect accompany this report.

Improvement in Personnel Efficiency. Without exception every area into which microfilm has been introduced, the efficiency of the personnel has been increased from 30% to 100%. This aspect is applicable to in-house use of microfilmed reports and use of the microfilmed Army Master Data File by Army Direct Support Units world-wide. The increase in efficiency arises from the fact that a clerk's average lookup time for a line of information on microfilm is about 30 seconds. Lookup time on paper reports was difficult to measure, for the larger the report the longer it took to find first, the correct book and second, the correct line of information. The spread on lookup time on paper reports ranged from 2 minutes per line to 15 minutes per line. The Stock Activity Register application at the Electronics Command, Figure 9, vividly illustrates the browsing technique required with large paper reports and the finger tip convenience of the microfilmed report. With scores of clerks looking up thousands of lines of data daily the increase in efficiency afforded by microfilm is important from both a labor force and cost point of view.

Improved Control of Information. Not one

COMPARATIVE COST ANALYSIS - COMPUTER PRINTOUT vs MICROFILMED OUTPUT

WORKSHEET

OUTPUT IDENTIFICATION (If new application, describe on additional page)	FREQUENCY	PERIOD COVERED
TOTAL ITEM BLUE STREAK DEPOT BALANCE REPORT	WEEKLY	1 OCT 67 TO 31 OCT 67

SECTION A - COMPUTER PRINTOUT COSTS

1. MATERIAL COSTS ... 4 COPIES ... $ 1200.00
   A. 4 - PART PAPER, 240,000 PAGES @ $ 0.005 PER PAGE.

2. EQUIPMENT COSTS ... $ 2576.00
   A. *64.4 HOURS PRIME SHIFT RENTAL @ 40.00 PER HOUR, $ 2576 .
   B. ____ HOURS PREMIUM SHIFT RENTAL @ ____ PER HOUR, $ ____ .

3. LABOR COSTS ... $ 2285.76
   A. 64.4 HOURS COMPUTER OPERATOR SERVICES @ 3.00 PER HOUR, $ 193.20 .
   B. 60.0 HOURS DELEAVING & BINDING SERVICES @ 3.00 PER HOUR, $ 180.00 .
   C. 2.0 HOURS MESSENGER SERVICES @ 3.00 PER HOUR, $ 6.00 .
   D. 576 HOURS RETRIEVAL TIME @ 3.31 PER HOUR, $ 1906.56 .

TOTAL COMPUTER PRINTOUT COSTS --------4 COPIES---------- $ 6061.76

TOTAL MICROFILM COSTS ----------8 COPIES---------- 3882.71

NET SAVINGS EACH MONTH---------- 2179.05

* COMPUTER HOURS FREED FOR OTHER PROCESSING

SECTION B - MICROFILM OUTPUT COSTS

1. MATERIAL COSTS ... 8 COPIES ... $ 646.11
   A. 3000 FEET ORIGINAL FILM @ $ .02613 PER FOOT, $ 78.39 .
   B. 24000 FEET DUPLICATE FILM @ $ .01833 PER FOOT, $ 439.92 .
   C. CHEMICALS FOR 3000 FEET FILM @ $ .0026 PER FOOT, $ 7.80 .
   D. 1500 COPIES OF MICROFILM PAGE PRINTOUTS @ 0.08 COPY, $ 120.00 .

2. EQUIPMENT COSTS ... $ 519.30
   A. 5.0 HOURS COMPUTER DOCUMENT RECORDER TIME @ 20.00 HOUR, $ 100.0 .
   B. 4.8 HOURS PROCESSOR TIME @ 2.50 HOUR, $ 12.00 .
   C. 12.3 HOURS DUPLICATOR TIME @ 1.00 HOUR, $ 12.30 .
   D. 200 HOURS READER TIME @ 1.75 HOUR, $ 350.00 .
   E. 200 HOURS READER-PRINTER TIME @ 0.225 HOUR, $ 45.00 .

3. LABOR COSTS ... $ 2717.30
   A. 22.1 HOURS RECORDER, PROCESSOR, DUPLICATING OPERATOR SERVICES @ 3.00 PER HOUR, $ 66.30 .
   B. 1.0 HOURS MESSENGER SERVICES @ 3.00 PER HOUR, $ 3.00 .
   C. 800 HOURS RETRIEVAL TIME @ 3.31 PER HOUR, $ 2648.00 .

TOTAL MICROFILM OUTPUT COSTS $ 3882.71

AMCMS FORM 20 SEP 67 43 FIGURE 6

FIGURE 7

Annual Tab for Uncle Sam

Paperwork Costs $8 Billion

WASHINGTON, Oct. 29 — (AP) — A congressional subcommittee says if one government record was burned each second, it would take 2,000 years to destroy them all.

Government paperwork costs $8 billion a year, the House Post Office and Civil Service Subcommittee added in a report this week on its study of the situation. It also came up with these staggering statistics:

● It takes 15 billion copies of 360,000 government forms to operate federal agencies.

● Some 225,000 employes spend most of their work day tucking documents into 25 million cubic feet of files. The executive offices alone have two million file cabinets.

● The government spends $1.5 billion annually writing about 1 billion letters. The panel said $100 million to $200 million could be saved each year by writing shorter, more concise letters.

And computers threaten to intensify the paperwork blizzard, the committee said. One computer can churn out a stack of records 20 feet high each day, it added, and with the government's 2,600 computers working weekly shifts — holidays off—this stack can be 1.3 miles high in a year.

"Understanding and control of this new paperwork influence is urgent," the committee said of computers.

THE GOVERNMENT could lighten its paperwork load, the report said, if agencies would simply throw away some of the directives — those memos, instructions and communications inside the Government — which fill up 2.6 million pages a year.

Not to be lopsided, the report hailed some "success stories." Among them, the Navy and Marine Corps eliminated 18,402 directives and the Federal Aviation Agency reduced its files by 5.5 million pages.

"There are hopes of paperwork savings," the committee said.

Its report was 70 pages long.

FIGURE 8

IMPACT ON
PAPER VOLUMES AND PAPER COSTS
BY
GOVERNMENT COMPUTERS

NUMBER OF COMPUTERS	PER HOUR VOLUME PAGES	PER HOUR COST 1 PART PAPER	PER HOUR COST 4 PART PAPER	PER DAY (7 HOURS UTILIZATION) VOLUME PAGES	PER DAY COST 1 PART PAPER	PER DAY COST 4 PART PAPER
One Computer	1,050	$3.00	$20.80	7,350	$22.05	$147.00
100 Computers	105,000	$300.00	$2,080.00	735,000	$2,205.00	$14,700.00
1000 Computers	1,050,000	$3,000.00	$20,800.00	7,350,000	$22,050.00	$147,000.00
*Total Govt. 2600	2,730,000	$8,190.00	$56,784.00	19,110,000	$57,330.00	$382,220.00
	PER MONTH (22 WORK DAYS X 7 HRS)			ANNUALLY (253 WORK DAYS X 7 HRS)		
One Computer	161,700	$485.00	$3,234.00	1,859,550	$5,578.50	$38,677.60
100 Computers	16,170,000	$48,500.00	$323,000.00	185,955,000	$557,850.00	$3,867,760.00
1000 Computers	161,700,000	$485,000.00	$3,230,000.00	1,859,550,000	$5,578,500.00	$38,677,600.00
*Total Govt. 2600	420,420,000	$1,261,260.00	$8,408,400.00	4.83 Billion	$14,504,490.00	$96,561,760.00

Factors used in developing above figures:
1. Average computer print speed: 875 lines per minute. (Low 550 LPM & High 1200 LPM $\div$ 2 = 875 LPM)
2. Average lines of print per page = 50.
3. Pages Per Hour = 1050
4. Average paper prices in 1000 page sets: 1 Part paper $3.00, 4 part paper $20.80

NOTE: The impact figures reflect only 154 hours of utilization per month.
Average utilization per Government Computer is 333 hours per month.

*July 1966 Bureau of the Budget "Inventory of ADP Equipment in the Federal Government" indicated over 2600 computers were in use by Federal Government Agencies.

cartridge of microfilm has been reported lost since the NIPP tests were implemented. Prior to installation of microfilm, however, those functional areas receiving large computer reports frequently lost pages, posing serious audit trail problems. The film cartridges are usually kept in a rack or desk drawer next to the microfilm reader.

Elimination of Massive EAM Card Files. A solution to the management of massive EAM card files can be considered as a major fallout benefit afforded by micromation. Files supporting such applications such as cataloging, history data, etc., range in size from hundreds of thousands to millions of EAM cards. They are almost impossible to manage when update maintenance and numerous references to the updated file via either printouts or interpreted card is required. Prior to micromation the merge of update transactions on a computer while possible, imposed intolerable print requirements. With the introduction of micromation, these files are now updated on a computer and the entire file recorded on a few cartridges of microfilm. One such catalog application at the Army Tank-Automotive Command, Figure 10, resulted in the release of 42 file cabinets used to maintain a 2.5 million EAM card file. The TACOM catalogers now receive the complete updated file each month in 12 microfilm cartridges. The microfilm cartridges occupy 26 cubic inches of storage space. The same information on EAM cards required one (1) million cubic inches of space. A similar application at the New Cumberland Army Depot is illustrated in Figure 11.

Relief from the Space Squeeze. This improvement has been effected by microfilmed data wherever used during the test. This includes the NCR 500 used at Army Direct Support Units in the field and crowded office areas at the three prototype sites. On a comparative basis 100,000 pages of computer printed reports require about 28 cubic feet of special (because of its dimensions) storage space, while the same report on microfilm requires about $\frac{1}{2}$ cubic foot of space. Steel shelving of filing cabinets are required for the paper as each 100,000 pages weighs 1400 pounds--the same data on microfilm weighs 25 pounds.

World-Wide Dissemination of Catalog Data.

(1) The use of microfilm as a media for the dissemination of U. S. Army Catalog and other supply management data to U. S. Army activities world-wide has proven an unqualified success. See Figure 12. At the user level, 40,000 to 50,000 pages of hard copy catalogs of supply data are changed quarterly. This has proven an almost unmanageable task particularly in combat zones. The microfilmed catalogs have solved this problem as it is a maintenance free system. Posting of changes at the user level is not necessary as the entire file is exchanged each quarter. Wherever microfilm has been used it has improved supply responsiveness and is effectively preventing tens of thousands of "garbage" transactions from entering the logistic system each month. On the basis of the "garbage prevention" only, the cost of the microfilm readers is amortized daily. Of paramount importance, however, these transactions also represent many pieces of deadlined equipment for which the user would have waited interminably for repair parts.

(2) As a result of the enthusiastic response from field trials, conducted in USARPAC, USAREUR, and CONUS, the Directorate of Supply, Headquarters, AMC, has implemented an Army Recorder Microfilm System (ARMS). The ARMS System provides, as stated in Change 1 of AR 700-1, for distribution of selected supply management data on microfilm. The film is recorded, packaged and air mailed directly to the users once each quarter.

(3) The ARMS data is produced by the Data Systems Directorate of the New Cumberland Army Depot, and distributed on a quarterly basis by the AMC Catalog Data Office to over 200 locations throughout the world. Based on rapidly expanding demands from both CONUS and overseas commands, it is anticipated that this requirement will continue to increase. Expansion is contingent upon activities acquiring microfilm reader equipment.

(4) Response from the Army in the field to a TAG questionnaire on this aspect of the NIPP project has provided unanimous indorsement to this concept of disseminating supply catalog data.

(5) As of the date of this report the following supply management data is being distributed on microfilm:

(a) Army Master Data File Selected Management Data. 12 cartridges containing information on 1.2 million Army interest FSN. File is in Federal Item Identification Number (FIIN) sequence.

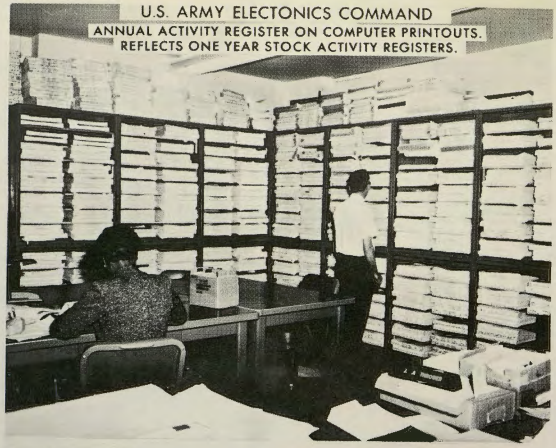
(b) Army Master Data File - Interchangeable/Substitute Item Data. Two cartridges containing information on 178,000 FSNs. File is in FIIN sequence.

(c) Defense Supply Agency (DSA) Non-Army Interest Items. Six cartridges containing information on 973,000 FSNs. File is in FIIN sequence.

(d) General Service Supply (GSA) Non-Army Interest Items. In one cartridge containing information on 26,000 FSNs. File is in FIIN sequence.

(6) Detailed and audited cost analysis data reflecting accurate production costs of the current paper system versus a fully implemented ARMS system is being prepared by the New Cumberland Army Depot. All preliminary estimates indicate sizeable savings are possible by utilizing microfilm. These estimated savings are reflected in Appendices E, F, and G. There is evidence that distribution of microfilmed data within CONUS could be limited, in some cases, to central property activities, thereby reducing distribution requirements of selected hard copy catalogs and microfilm. This aspect will continue under study by the AMC Catalog Data Office.

Use of Microfilm at Alternate Headquarters Sites. Improvements to emergency relocation procedures have been afforded by the use of


U.S. ARMY ELECTONICS COMMAND
ANNUAL ACTIVITY REGISTER ON COMPUTER PRINTOUTS.
REFLECTS ONE YEAR STOCK ACTIVITY REGISTERS.


U.S. ARMY ELECTRONICS COMMAND
ANNUAL ACTIVITY REGISTER ON MICROFILM
EACH SET CONTAINS 82,000 PAGES.

FIGURE 9

42 FILE CABINETS AND MANAGEMENT OF 2.5 MILLION EAM CARDS ELIMINATED BY MONTHLY LISTING IN 12 CARTRIDGES OF MICROFILM. SEE ITEM 9 UNDER FINDINGS.

FIGURE 10

APPLICATION: COMMON USER HIGH PRIORITY LIST AT NEW CUMBERLANR ARMY DEPOT, USED IN SCREENING OF COMPUTER REJECTED "UNIDENTIFIABLE REQUISITIONS." ON THE RIGHT ARE 75 VOLUMES, CONSISTING OF 15,073 PAGES OF COMPUTER PRINTOUT, ON THE LEFT IS THE SAME INFORMATION, NOW PRODUCED ON EIGHT 100 - FOOT REELS OF MICROFILM.

APPLICATION: MATERIEL RELEASE ORDER (MRO) HISTORY AT NEW CUMBERLAND ARMY DEPOT. AT THE LEFT, PRIOR TO CONVERSION TO MICROFILM, 438,000 EAM CARDS WERE STORED IN SEVEN CARD CABINETS AND LISTED ON COMPUTER PRINTOUT SEVEN FEET HIGH. THE SAME INFORMATION IS NOW AVAILABLE ON SEVEN 100 - FOOT REELS OF MICROFILM.

FIGURE 11

LAST COMPUTER PRINTED ISSUE OF THE ARMY MASTER DATA FILE (AMDF), DATED 1965, BESIDE FIRST ISSUE OF MICROFILMED AMDF ISSUED UNDER THE ARMY READER MICROFILM SYSTEM (ARMS). THE MICROFILM FILE CONTAINS SUPPLY MANAGEMENT DATA ON 1.2 MILLION "US ARMY INTEREST" ITEMS OF SUPPLY. LOCATION: 7TH ARMY ICC, USAREUR.

STOCK CONTROL PERSONNEL, USAREUR, USING FIRST ISSUE OF MICROFILMED AMDF ISSUED UNDER ARMS.

FIGURE 12

microfilm at alternate Headquarters sites. This aspect of the microfilm program is still in the formulative stages, however, some commands are now using copies of selected microfilm files for this purpose. Computer output in paper form requires several days of handling, mailing and storing before it is ready for use. The microfilm files are forwarded by first class mail and are available for use at the alternate site within 24 hours after recording. The files can be used with portable microfilm readers using batteries or A/C current. No microfilm files have been lost. With paper reports, however, shipping cartons have been broken in transit and reports damaged.

Impact on Computer Programming. Only minor program modifications are required to change ongoing computer edit and print programs to accommodate the requirements of the high speed microfilm recorder. As with mechanical impact printers, the recorder accommodates 132 print positions on each line, therefore, for quick conversion purposes current edit instructions need not be changed. The only program change which must be made is to the carriage control characters which are used to control frame (page) advance and to space and skip lines. In most cases only few program instructions need to be altered to ready a program to prepare input for the recorder. During the NIPP test all programs except one were successfully altered and made operational after only one assembly, thus, attesting to the simplicity of conversion.

Equipment

High Speed Microfilm Recorder. No major operating problems have been encountered with the Stromberg SC 4400 recorder, Figure 13. It has been determined that improved operations result when clean magnetic tapes are used for input to the recorder. Voiding of characters on some film records can result when parity errors are incurred due to excessive dirt or oxide dust on the magnetic tapes.

Vendor support from Stromberg has been satisfactory in all respects. On site training of operators was effected with minimal interference to ADP operations. Computer operators operate the recorders at the three test sites. There has been only one case of extended down time during the six month test. A CRT and some circuit panels were replaced on the New Cumberland Army Depot's recorder during December 1967. The service engineer remained on the job for about four days until the equipment was repaired and placed in an operational mode.

Film Processor. The Eastman Viscomat film processor, Figure 14, has proven to be a most reliable component throughout the system tests. Its push button operation, compact design and automatic features are particularly adaptable to an ADP environment. A Cubitainer system for handling the chemicals in collapsible polyethylene containers in cardboard boxes eliminated all problems normally encountered in mixing and handling film processing chemicals. The film processing speed of 36 feet per minute precludes queuing of film from the High Speed Recorder. The ability to process 3600 feet of film with one gallon of developer and one gallon of fixer at a total cost of $8.34 reflects the low cost of this aspect of the system.

Vendor support and on site training of Viscomat operators by Eastman has been satisfactory.

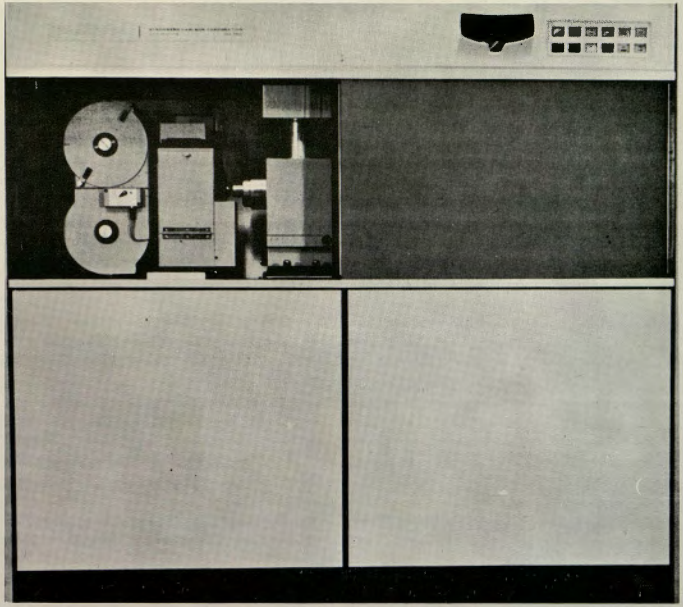
Film Reproducer. The Kalvar reproducer, Model K 92 (formerly MMR 401) performed satisfactorily throughout the test. The reproducer, Figure 14, operates in a daylight environment, however, precautions must be taken to control dust and dirt in the reproduction area. This aspect was not properly emphasized to operating personnel at the outset of the tests and resulted in excessive dust and dirt on the copy film. Simple dirt controls in the reproduction area corrected this problem. Daily cleaning of the Kalvar glass exposure drum will also improve the quality of the copies. It was found that Kalvar copy film type 16 provided the best quality viewing film. In addition it was found that replacement of the reproducer's heat lamp at about 5000 hours assured continuance of high quality reproduction. The reproduction speed of 60 feet per minute assures rapid reproduction of even the largest reports.

Microfilm Readers.

(1) At the outset of the NIPP test, March 1967, the microfilm reader industry was not ready for micromation. Cartridge type microfilm readers were in short supply and all were designed to accommodate images in standard 8 X 10½ inch text size. The 16mm microfilm readers at that point in time were used mainly to display graphic data such as specifications, diagrams, illustrated parts and textual data. No cartridge readers were specifically designed to accommodate 14 X 11 inch computer images. The industry has adjusted to the demands placed on it and as a result readers are now in ample supply. One manufacturer is now producing a cartridge reader specifically designed to display computer output, and other manufacturers indicate that readers with larger image areas are under development.

(2) The U. S. Army Electronics Command and the U. S. Army Combat Development Command are now engaged in developing military specifications for a Standard Microfilm Reader. It is anticipated, however, that commercial, off the shelf, readers will be used for all immediate requirements. In view of the private industry and governmental efforts to develop new reader equipment, all U. S. Army Commands have been advised by a TAG letter, to lease, wherever possible, rather than purchase readers. This policy will afford upgrading as improved readers come on the market.

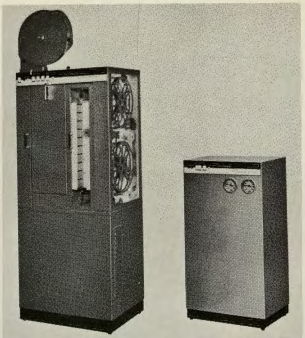
(3) Two major aspects which must be considered when selecting readers to support a system are: first, the cost of the film cartridge, and second, the time required to load the cartridges. When there is a wide distribution of a microfilm product, such as the AMDF, both factors become important system considerations.



Stromberg Carlson S-C 4400 High Speed Microfilm Recorder

Used in Army Materiel Command Micromation System Test

FIGURE 13



EASTMAN VISCOMAT FILM PROCESSOR
USED IN THE SYSTEM TEST.

KALVAR MMR401 DRY-PROCESS FILM REPRODUCER USED IN THE
SYSTEM TEST.

FIGURE 14

Facilities

The High Speed microfilm recorder was situated in the computer room at all three test sites. Its compact design requires only 12 square feet of floor space. Normally the recorder is attached to a tape drive of a peripheral computer via a switching control which affords switching the tape drive back to the computer as required. The film used on the recorder is protected by a magazine, therefore normal computer room housekeeping is all that is required in the vicinity of the recorder.

The film processing and reproduction area should be situated near the computer room. The full potential of micromation will not be realized if local policies dictate the use of non-responsive, outside film processing. Because of the turnaround requirements the processing and reproduction area was located within the computer facility and managed by computer operations personnel. The term "outside film processing" in this case implies use of film processing facilities not in the same building as the computer, or film processing facilities not administered by the same commander who is responsible for computer operations. Commands contemplating installation of a micromation system are encouraged to use ongoing film processing facilities, only when it has been determined that personnel resources and current workloads of the film processing facility will permit rapid turnaround of the computer output film.

When it is determined that the film processing and reproduction facility is to be established in or near the data processing area, the specification and procedures outlined in Appendix A should be considered.

A list of equipment and supplies required to implement a micromation system are listed in Appendix C.

Micro-Graphic Reports (MGR) Concept

As stated previously the major objective of Phase III of NIPP is to develop the technique of generating business reports in graphic format. Through the cooperation of personnel of the U. S. Army Missile Command, progress has been made towards this objective.

Briefly stated the MGR concept is designed to provide mid and top management, by means of a CRT printer/plotter, the information they need, in the format they need, in time to make effective management decisions. Or more appropriately, it is designed to tell them "whats the status" and "whats the trend" at the end of each computer reporting cycle, regardless of its frequency.

As illustrated in Figure 15, the concept encompasses the display of three segments of business systems data on microfilm. First, operational line item data for the day to day clerical needs is provided. The second segment, appropriate to mid management, displays in graphic format the highlights of a completed cycle and pinpoints workloads and problem areas resulting from the cycle. The third and final segment of the MGR report, provides top management with performance data over a wide time frame and displays, on trend charts, the impact of the last completed cycle. Collection of the data to be plotted as bar graphs, trend curves, etc., takes place during the regular edit cycle which prepares the operational level reports. Example of business graphs produced by commercial programmers of the U. S. Army Missile Command, on a cathode ray tube printer/plotter are included in this report, see Figures 16-19. It should be noted that the entire graph, outline lettering, etc., are drawn by the printer/plotter software routines. The performance factors in the shape of bars, lines, points, etc., are regenerated after each cycle.

It is envisioned that this approach will enable management to more readily define their information needs. Interfacing a facsimile transmission system the MGR concept will facilitate the implementation of advanced intra- and inter-command information systems. Plans for prototype tests of such a system are under development now.

MICRO GRAPHIC REPORTS (MGR) CONCEPT

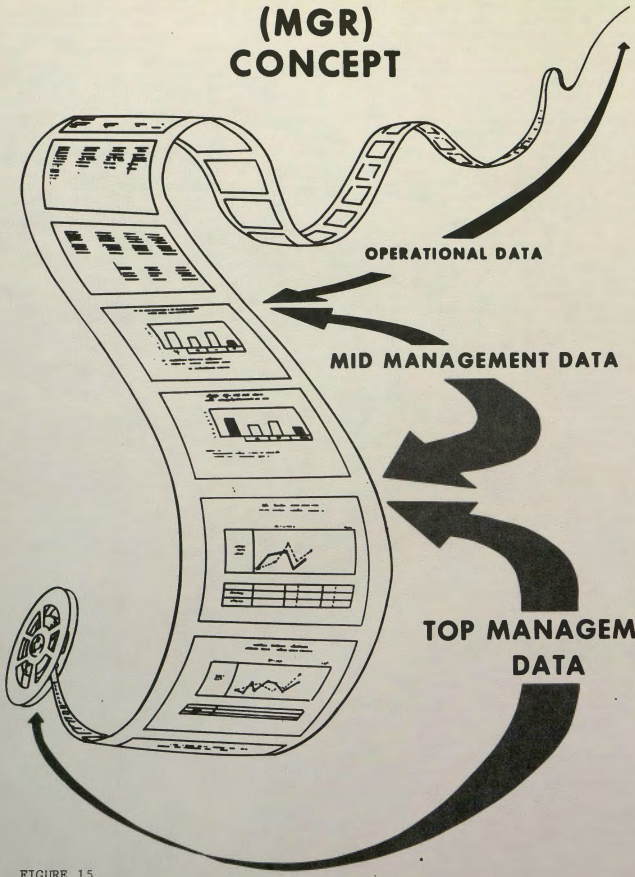


FIGURE 15

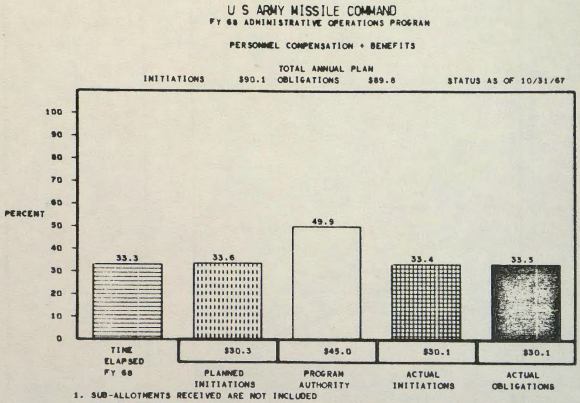
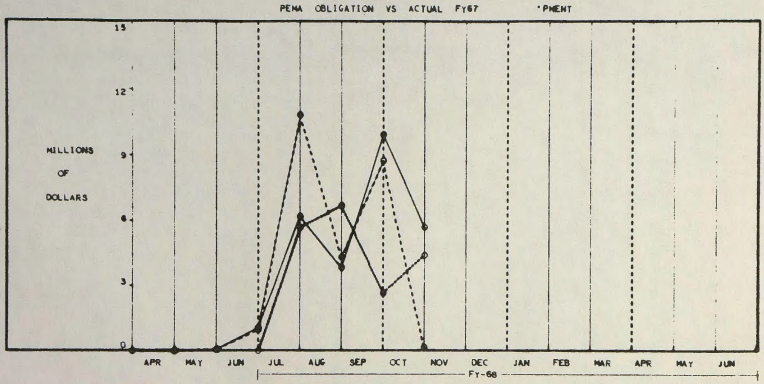

U S ARMY MISSILE COMMAND
FY 68 ADMINISTRATIVE OPERATIONS PROGRAM
PERSONNEL COMPENSATION + BENEFITS
TOTAL ANNUAL PLAN
INITIATIONS $90.1 OBLIGATIONS $89.8
STATUS AS OF 10/31/67
PERCENT
100
90
80
70
60
50
40
30
20
10
0
33.3
33.6
49.9
33.4
33.5
TIME ELAPSED FY 68
$30.3
PLANNED INITIATIONS
$45.0
PROGRAM AUTHORITY
$30.1
ACTUAL INITIATIONS
$30.1
ACTUAL OBLIGATIONS
1. SUB-ALLOTMENTS RECEIVED ARE NOT INCLUDED
2. DOLLARS IN MILLIONS
4. FISCAL YEAR FOR INITIATIONS BEGINS ON APRIL 1 AND ENDS MARCH 31 EXCEPT IN THOSE CASES WHICH THE CENTER IS PROHIBITED BY LAW FROM MAKING INITIATIONS IN ADVANCE

Figure 16

U S ARMY MISSILE COMMAND
FY 68 RESEARCH AND DEVELOPMENT PROGRAM

ARMY TEST APPLICATIONS PROGRAM



INITIATION BACKLOG	0.0	0.1	1.1	6.3	3.9	10.1	5.8							
INITIATION RATE	0.0	0.1	1.0	11.0	4.4	8.9	0.2							
OBLIGATION RATE	0.0	0.0	0.0	5.8	6.8	2.7	4.5							

1. SUB-ALLOTMENTS RECEIVED ARE NOT INCLUDED
4. FISCAL YEAR FOR INITIATIONS BEGINS ON APRIL 1 AND ENDS MARCH 31 EXCEPT IN THOSE CASES WHICH THE CENTER IS PROHIBITED BY LAW FROM MAKING INITIATIONS IN ADVANCE

ER-8-4-AAP-00-10-15

Figure 17

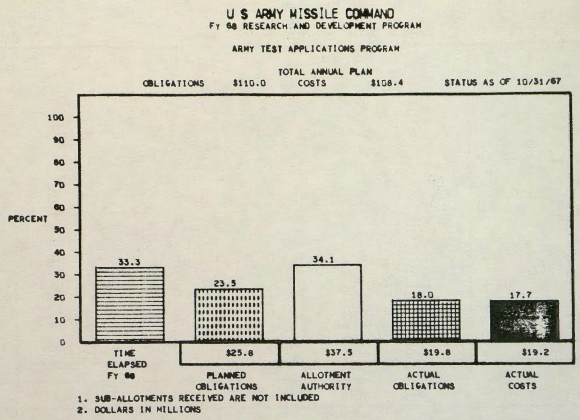

U S ARMY MISSILE COMMAND
FY 68 RESEARCH AND DEVELOPMENT PROGRAM
ARMY TEST APPLICATIONS PROGRAM
TOTAL ANNUAL PLAN
OBLIGATIONS $110.0
COSTS $108.4
STATUS AS OF 10/31/67
PERCENT
100
90
80
70
60
50
40
30
20
10
0
33.3
23.5
34.1
18.0
17.7
TIME ELAPSED FY 68
$25.8
$37.5
$19.8
$19.2
PLANNED OBLIGATIONS
ALLOTMENT AUTHORITY
ACTUAL OBLIGATIONS
ACTUAL COSTS
1. SUB-ALLOTMENTS RECEIVED ARE NOT INCLUDED
2. DOLLARS IN MILLIONS

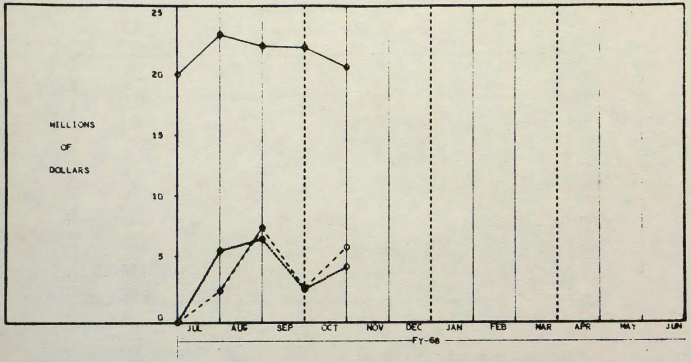
Figure 18

U S ARMY MISSILE COMMAND
FY 68 RESEARCH AND DEVELOPMENT PROGRAM

ARMY TEST APPLICATIONS PROGRAM

UNCOSTED OBLIGATIONS IN THE PROCUREMENT CYCLE

STATUS AS OF 1C JI: 67



UNCOSTED OBLIGATIONS	20.0	23.2	22.3	22.2	20.6						
OBLIGATION RATE	NA	5.8	6.8	2.7	4.5						
COST RATE	NA	2.6	7.7	2.8	6.1						

1. SUB-ALLOTMENTS RECEIVED ARE NOT INCLUDED

Figure 19

ER-8-4-AAP-00-3E 10

General Specifications and Procedures for Film Processing Area

1. The facility should be enclosed in an ample area (about 250 sq feet) with floor to ceiling walls.

2. If possible, provide positive air pressure in the room to keep dust from entering when doors are open.

3. All incoming air supply to the room should be filtered.

4. A small, closet type, dark room should be placed in one corner of the room to accommodate loading of the recorder's magazines and serve as a film storage area.

5. Formica counter tops should be provided for film inspection tables, reproduction, splicing and other work surfaces. All work surfaces should be cleaned daily.

6. Provide cabinet and storage facilities for a work stock of supplies to be used for current production needs.

7. Paint walls with hard surface that can be wiped clean periodically.

8. Floors should be cleaned and waxed frequently and every attempt should be made to provide dust-free operation.

9. Traffic in the processing and duplication area should be held to a minimum, unauthorized personnel and smoking should be prohibited in any area where film is handled.

10. Air conditioning should be provided to comfortable working temperature (approximately 72 degrees).

Appendix A

COMPUTER AND MICROFILM
COST FACTORS

1. The following speeds and cost factors are based on actual operating experience at USAMC microfilm installations and are the basis for the cost computations used in the Comparative Cost Analysis-Computer Printout vs Microfilm Output Worksheet, figure 6.

a. SC 4400 processes 200 frames per minute.

b. Kalvar duplicator processes 650 frames per minute.

c. Cartridge loading 600 frames per minute.

d. Silver film: $.02613 per foot.

e. Duplicate or copy film: $.0206 per foot.

f. Kalvar copier plus labor: $.15/100 ft.

g. SC 4400, tape drive and labor: $23.00/hr. or ($4.60/100 ft.)

h. Film development, chemicals and labor: $.62/100 ft.

i. Cartridge loading: $.27/100 ft.

j. Microfilm readers monthly rental rate $45.00.

k. Computer rental rate and labor $43.00 per hour.

l. IBM 1401 Computer effective printing speed 900 pages/Hr.

m. Average cost of standard forms per page based on 1000 page sets.

1 part - .0031	4 part - .0052
2 part - .0049	5 part - .0050
3 part - .0047	6 part - .0053

2. The cost per cartridge (100 ft of film) was computed using 2000 frames (pages) per cartridge. Based on the above cost factors, fixed production costs for the original film are as follows:

a. Silver Film	$2.61
Development - Labor	.62
SC 4400 - Labor	4.60
Original Production Costs	$7.83

Appendix B

b. Based on cost factors in paragraph 1, the production costs for 100 ft of copy film per cartridge (2000 frames) are as follows:

Kalvar Copy Film	$2.06
Duplicating 100 ft Film - Labor	.15
Cartridge Loading - Labor	.27
Total Cost Per Cartridge	$2.48

c. An example of a 10,000 page report on microfilm distributed to five sites would be computed as follows:

Original film production 5 reels @ $7.83 ea.	=	$39.15
Copy film production 25 cartridges @ $2.48 ea.	=	$60.40
Total Production Costs		$99.55

Copies Made	Frames Made	Total Cost	Cost Per Frame
1	2,000	$10.31	.00515
2	4,000	12.79	.00314
3	6,000	15.27	.00254
4	8,000	17.75	.00221
5	10,000	20.23	.00202
6	12,000	22.71	.00188

3. Example of conventional printing cost. Cost for a typical 10,000 page report on 5 part paper at .0050 cents per page.

a. Material

50,000 pages @ .0050 per page	$250.00

b. Computer costs

10.5 hours 1460 @ 43.00/hr	$851.50

c. Labor (Deleave and Bind)

10,000 sets @ 1.57 M	31.40
Total Cost of Conventional Printing	$1132.90

Appendix B

List of Equipment and Supplies Required
for Implementation of a Micromation System

EQUIPMENT

Basic S-C 4360 (6,000 LPM) GSA Contract GS-00S-67236	$1,850.00
Basic S-C 4400 (15,000) GSA Contract GS-00S-67236	$3,000.00
Edit Option	54.00
Reread Option (Model F-111, 7 times reread)	200.00
Polaroid Camera Option (Removable Camera)	125.00
Polaroid Camera Option (Separate Optical Path)	300.00
Kalvar Film Duplicator K 92 (Formerly MMR 401) GSA Contract GS-00S-68660	225.00
Film Processor Eastman Viscomat	600.00
Tape Drive Switching Unit	50.00

FILM

Recommend Silver original product #1563 manufactured by Recordak. This film incorporates the best qualities of all Blue sensitive microfilm. It can be processed negative or reversal and when processed reversal, needs no fixes or hardner.

16MM unperforated 1000 @ .02613/ft. $26.13

KALVAR COPY FILM

Recommend 4 mil base film be used. This film processes the durable quality necessary to withstand the wide range of conditions it will be subject to in world wide use. Type 16 Kalvar is a high contrast film for projection viewing.

Type 16 16MM 4 mil base 1000 @ .02062/ft. $20.62

FILM CARTRIDGES

Film cartridges of the three major producers of roll film readers are not interchangeable. They vary in price as well as features. The Recordak and 3-M cartridge loading time is about 1 minute each, Bell & Howell, due to disassembly, requires about 3 minutes each. Prices of each type are as follows:

MANUFACTURER	QUANTITIES	PRICE
3M	100 to 1000	$1.08 ea
Recordak Mod 2A	over 150	.94 ea
Bell & Howell	100 to 499	2.43 ea

CHEMICALS

Chemicals to process original film. 1 gallon container processes 3600 ft of film:

Recordak Developer	Type 5	$4.69 gal.
Recordak Fixer	Type 1	$3.65 gal.

GENERAL SUPPLIES

Illuminator Transparency (Film Inspection)			
Kodak Delux #2	25.00 ea	3 ea	75.00
Lens 40 MM for S-C 4400	196.00 ea	1 ea	196.00
Lens 50 MM for S-C 4400	196.00 ea	1 ea	196.00
Cartridge Loading Station Kodak	62.50	2 ea	125.00
Split reels 16 MM 600 ft.	5.26 ea	6 ea	31.56
Big Inch Tape Sorter	41.00	1 ea	41.00
Goggles, Welders (Worn while operating K 92)	3.75 ea	2 ea	7.50
Press tape Splicers (Purchased in quantities of 1000)	.01 ea	12,500	125.00
Polyester Splice Tape Scotch Brand #850	10.00 Roll	1 ea	10.00
Blades Recordak Splice	1.20 Dz	2 Dz	2.40
Reels 16MM 100 ft.	.09 ea	10 ea	.90
Gloves (lint free) Film Handling	2.78 Dz	8 Dz	22.24
Kalvar Heat Drum MMR 401	25.00 ea	2 ea	50.00
Lamp Recordak Reader	1.10 ea	5 ea	5.50
Kalvar Glass Exposure Drum MMR 401	35.00 ea	1 ea	35.00
Rewinds Pro Craig	14.23 Pr.	2 Pr.	28.46
Rewinds Craig	9.95 Pr.	3 Pr.	29.85
Rewinds Newmade Dynamic	48.60 Pr.	1 Pr.	48.60

Appendix C

FILM HANDLING PROCEDURES PERTAINING TO INSPECTION AND MAGAZINE LOADING

Film Inspection

After the original film is processed it must be inspected to ascertain that it meets established standards of quality. The film inspector visually looks for defects that indicate machine malfunction and/or operator errors. The opacity of the image is read on a densitometer and physical characteristics checked with the aid of a loupe or a microscope. After passing inspection, the original film (positive, black print on transparent background) becomes input to the Kalvar reproduction process.

The film inspector's basic tools are:

1. A good quality "light box."
2. A set of Neumade Baby Rewinds (usually one geared end on the right and one dummy end on the left side of the light box).
3. A 10X jewelers loupe with a rubber covering.
4. White lintless film inspection gloves.
5. A clean working area.

The roll of film to be inspected is placed onto the dummy end of the rewinds. The film is passed over the illuminator and wound onto a lightweight return reel on the right hand (geared) rewind. As the inspector slowly winds the film across the light box he visually scans the film. Every ten to fifteen feet he stops and closely examines the film with the loupe.

All defects must be reported to the supervisor so that immediate corrective action can be taken.

To examine the film with the loupe, pick up the film with the left hand (use glove) with the base (shiny side) up. Place the wide part of the loupe directly on the surface of the film. Look through the loupe at the film image. The distance from the eye to the loupe will be approximately one inch, but will vary depending on the individual, when the image comes into sharp focus.

With the loupe the inspector looks for:

1. Sharpness of the image.

Appendix D

2. Continuity of the lines-(no broken characters that can be contributed to the recording process.

3. Visual image contrast-(general appearance of the image).

4. Clean background-(no dust, smudges, or fingerprints on the film).

5. Completeness of the image-(image not cut off or misaligned due to equipment malfunctioning).

6. Processing defects-(scratches, under-or-overdevelopment, emulsion digs, etc).

When handling microfilm certain ground rules must be observed. Always handle microfilm with lint free gloved hands to avoid fingerprints on the film. Fingerprints can be removed from the base (shiny side of the film) but not from the emulsion. Handle film only by the edges. To avoid scratching the film when it is wound from one reel to another it must not be allowed to rub against any surface. When it is necessary to clean film, use a soft absorbent cloth or chamois dampened with film cleaner. Never tighten the film on a spool by successively pulling on the film, while holding the reel stationery, and then winding up the slack. This practice will cause "cinch marks" on the film. Cinch marks are very small scratches caused by dust specks trapped in the convolutions of the film.

Magazine Loading

The tools needed to load magazines are contained in Appendix B. The "How to Use" instructions accompany the tools which are normally furnished as a kit.

If the copy (Kalvar) film is to be used in a Recordak magazine, it is recommended that the edges of the film be lightly waxed. Caution must be exercised to insure that the copy film is tightly wound and edges are in a smooth plane. When waxing use the following procedure:

Apply a wax impregnated cloth or chamois to the edges of the film. Both edges of the film should be waxed. Extreme care should be taken to apply a minimum amount of wax to the film edge. Barely enough wax to slightly discolor the film edge should be applied. Using a clean, dry cloth, wipe any excess wax from the film edges. No light colored specs of wax should appear on the film. Too much wax is liable to work into the image area of the film, obscuring some of the print. ONLY SIMONIZE PASTE WAX FOR FLOORS SHOULD BE USED.

Splicing Procedure

It is necessary to inspect the film leader and the plastic button on each magazine to see that the end of the leader is neither bent nor

broken; if it is, the leader must be discarded. Any splices which change the continuity of the edges may cause film jams and, consequently, reader malfunction. When using Presstape Splicer use the following procedure:

1. All corners of the Presstape adhere to the film.

2. There are no air bubbles or foreign particles under the Presstapes when making the splice. If there are, they will reduce the strength and increase the thickness at that point.

3. The edges of the film at the splice are aligned as illustrated on the following sketches. Figure 20

In the case of reusing both the leader and trailer, it is particularly important that they be handled just as though it were a new splice, i.e., either the leader or trailer and the film to which they are being spliced are cut at the same time, and the Presstape applied in the prescribed manner.

When continuous reuse of leaders and trailers is made, the minimum length of the leader must not be less than 5½ inches. The minimum length of the trailer from the drive roller opening to its end must not be less than 6 inches.

Appendix D

SUPPLY CATALOG

PRODUCTION AND PUBLICATION COSTS

		UNIT	COST QUARTERLY	COST ANNUALLY
A.	Cost of Complete Hard Copy Supply Catalog Publication Duplicate	$177.10		
B.	Cost of Hard Copy Duplicate Per Page	$ 0.001		
C.	Cost of Total Army Requirement 177,101 pages; 6,000 cys	$1,062,606		
D.	Library Maintenance		1,250	5,000
E.	Workable Storage & Utilization Space Required: 20 X 30 ft @ $7.00 per sq ft	600 sq ft	12,600	50,400
F.	Cost of Army Changes: 17,000 page changes qtrly	6,000 cys	102,000	408,000
	DSA Changes: 25,000 page changes qtrly	6,000 cys	150,000	600,000
G.	Distribution Costs: Packaging, Handling, Addressing: Changes	84 Volumes 6,000 cys $109.26 per cy	655,560	2,622,240
H.	Freight Costs: 84 Vol per cy, 2 lbs per Vol.	$ 0.88 Vol	332,640	1,330,560
	4,500 Copies CONUS	$ 1.68 Vol	211,680	846,720
I.	Lead Time Effective Date	90 Days		
J.	Revisions: 5% of TOTAL Per Qtr, 8,855 Pages, Printing $ 53,130 Freight $131,640 Distr $140,400	6,000 cys	325,170	1,300,680
	TOTAL COST		$1,790.900	$7,163,600

NOTE: Data herein are prelininary estimates developed by AMCCDO relative to the application of microfilm techniques in the Catalog Area. Dollar savings indicated have not been audited. Microfilm distribution requirements are being developed.

Appendix E

MICROFILM

PRODUCTION AND PUBLICATION COSTS

	UNIT	COST QUARTERLY	COST ANNUALLY	RECURRED ANNUAL SAVINGS
A. Cost of Complete Microfilm Supply Catalog Publication	$106.26			
B. Cost of Microfilm Duplicate Per Frame	$ 0.0006			
*C. Cost of Total Army Requirement 177,101 Frames; 6,000 cys	$637,563.60			
D. Library Maintenance		0.00	0.00	5,000
E. Workable Storage and Utilization Space Required; w/viewer: 10 X 10 ft	100 sq ft	2,100	8,400	42,000
F. Cost of New Tape Including All Changes in Microfilm	6,000 cys	637,563	2,550,254	241,572
G. Distr Costs; Packaging, Handling, Addressing	90 Cartridges 6,000 cys $39.00 per cy	234,000		1,086,240
H. Freight Costs: 90 Cartridges				
4,500 cys CONUS	$0.10	40,500	162,000	1,168,560
1,500 cys O/S	$1.00	135,000	540,000	306,720
I. Lead Time Eff. Date	Upon receipt			
J. Cost of Viewer (rent $47.50, with copier $1,895; std $1,325; port $450)	$800 avg			
6,000 ea @ 800	$4,800,000			
TOTAL COST		$1,049,163	$4,196,652	$2,966,948

*Microfilm distribution requirements are being developed.

Appendix F

FINANCIAL STATEMENT

INITIAL CONVERSION TO MICROFILM IN LIEU OF HARD COPY..	$ 425,043	
FIRST YEAR SAVINGS.....	$2,966,948	
TOTAL FIRST YEAR SAVINGS.....		$3,391,991
INITIAL COST OF 6000 VIEWERS @ $800 EA.....	$4,800,000	
FIRST YEAR DEFICIT.....		$1,408,009-
SECOND YEAR SAVINGS.....	$2,966,948	
SECOND YEAR SAVINGS REALIZED		$1,558,939
THIRD YEAR SAVINGS REALIZED		$2,966,948
FOURTH YEAR SAVINGS REALIZED		$2,966,948
FIFTH YEAR SAVINGS REALIZED		$2,966,948

Appendix G