NAME OF SYSTEM:

Aircraft Accident Analysis

ORIGINATOR:

Bureau of Safety
Civil Aeronautics Board (CAB)
Washington, D.C. 20428

OBJECTIVE. To establish a data or fact information retrieval system that will enable the Bureau of Safety to promptly answer questions and conduct analyses on aircraft accidents. Further, to use this wealth of stored information in studies aimed at reducing civil aircraft accidents.

BACKGROUND. The Bureau of Flight Safety is responsible for promoting safety in civil aviation. The Civil Aeronautics Board (CAB) investigates accidents involving civil aircraft and holds public hearings to help determine the cause of accidents. It also conducts special studies and investigations to reduce the rate of aircraft accidents.

The growing size of the civil aviation fleet has made it necessary for the CAB to design an information system with a much wider range of storage and retrieval capabilities than former methods. More specifically, the new system had to be able to compile, store, manipulate, and update large amounts of data concerning the more than 5,000 civilian aircraft accidents occurring annually. The system also had to possess the capability for periodically producing reports and statistics on these accidents. Additionally, on individual accidents, it had to render complex accident analyses and provide precise data on demand.

The CAB study group found that the only functional category of methods and equipment that could meet these needs was a complete data or fact retrieval system. The class of equipment selected was an electronic computer using magnetic tape.

THE NEW METHOD. The source information—about 100 aircraft accident reports weekly—is received at CAB headquarters from the field investigators of the Federal Aviation Agency and the Civil Aeronautics Board. These typed unpublished accident reports range from 10 to 50 pages, depending upon the nature of the accident. Individual reports may be indexed under as many as 50 terms, such as registration of aircraft, owner of aircraft, date of accident, plus a series of terms to describe specific accident characteristics.

The Analysis Division, Bureau of Safety, converts the report information into codes representing the accident characteristics. A dictionary of approximately 3,400 terms is used jointly with the term code book as indexing tools. The codes selected to describe accident report information are keypunched into punched cards that are subsequently batched, converted to magnetic tape, and merged with the master tape record of aircraft accidents.

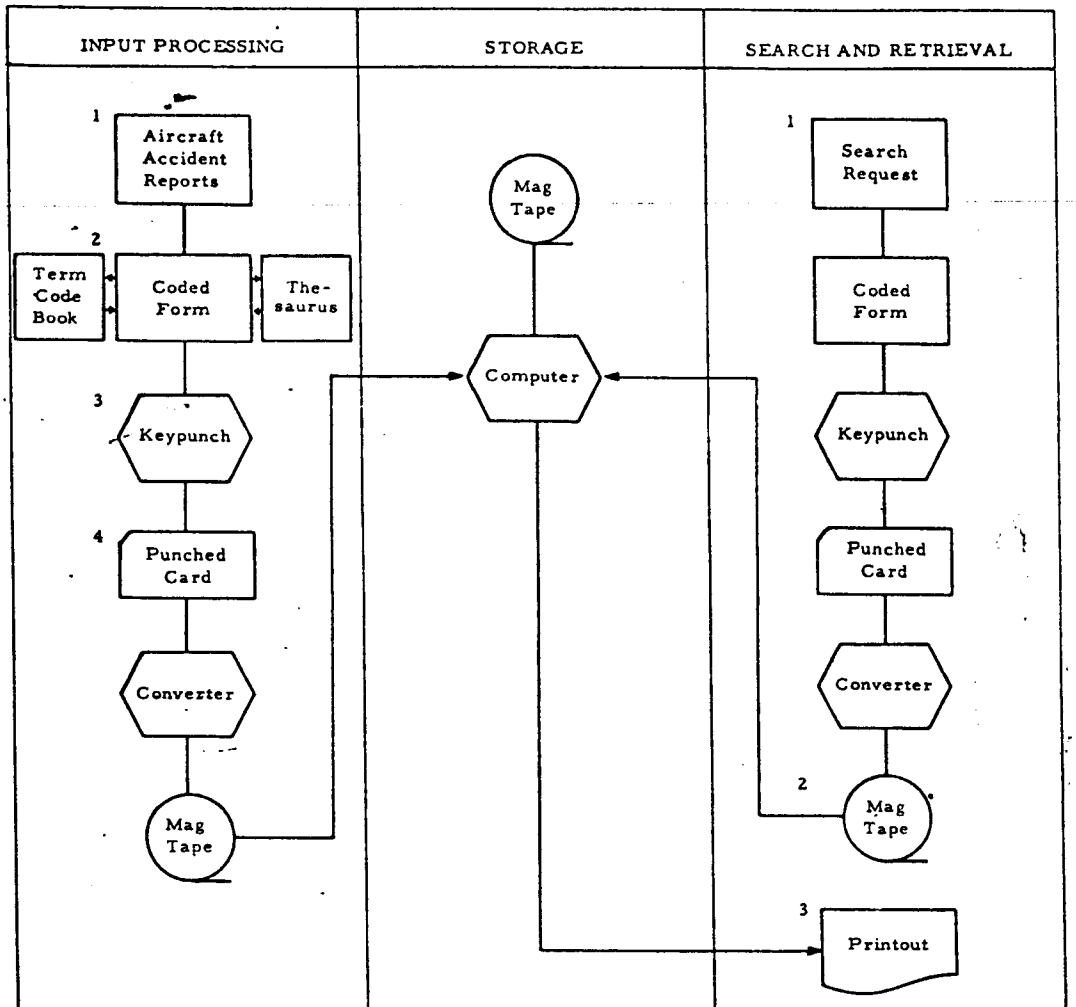
Search actions are usually prompted by inquiries received by mail or interoffice memorandum. Special reports are normally generated by the Board, the Federal Aviation Agency, the National Aeronautics and Space Administration, and other organizations associated with the problem of aviation safety. To conduct a search, each request for accident information is converted to magnetic tape in the same sequence and manner as the original accident data entered onto the master tape record file.

In the actual data retrieval process, the magnetic tape containing the search questions is "read" into the computer for matching against the master tape record according to the program instructions, with the retrieval of the requested information presented in printout form.

REMARKS. The initial input conversion costs of this system are relatively high when compared to noncomputer retrieval methods, due to the complex details associated with planning, programing, and refinement activities. However, once the system is in full operation both processing and storage costs recede to a marked degree.

One of the system's greatest benefits is its ability to retain a broad base of subject matter and its program flexibility, which enables it to handle a variety of search needs. The system can answer up to 100 search questions on one programed tape run. A typical report might cover a listing of all air taxi service accidents occurring in 1969 by type of aircraft, kind of flying weather, phase of flying when accident occurred, plus many other pertinent details. These features thus free Bureau of Safety personnel to handle and evaluate a broader spectrum of current information than would be possible under manual retrieval systems.

AIRCRAFT ACCIDENT ANALYSIS



1. Reports from Field Offices flow to Washington, D.C. at an average of 100 per week.

2. Analysis division clerk converts codes reflecting accident characteristics.

3. Keypunch operator transformis coded information to machine readable language.

4. Punched card information converted to magnetic tape.

All accident report information stored on magnetic tape unit of computer system. Updating of information performed periodically.

1. Requests initiated by Bureau of Safety and other interested air safety organizations (parallel processing routine as described by items 2 thru 4 in col. 1)

2. Search questions on magnetic tape read into computer.

3. Appropriate computer program produces answers in printout format.

NAME OF SYSTEM:

The FOSDIC SS

ORIGINATOR:

Bureau of the Census

Suitland, Maryland 20233

OBJECTIVE. To develop the techniques and to operate an advanced information handling and processing system that will result in greater efficiency and economy in the processing of the 1970 census.

BACKGROUND. The Census Bureau "provides basic statistics about the people and the economy of the Nation in order to assist the Congress, the executive branch, and the public generally." The best known task performed by the Census Bureau is the "census of the population and housing taken every ten years."

The art of census taking has changed greatly since the original hand tallies that began in 1790 and continued through the 1880 count. However, by 1890 the challenges of improving the manner of recording the results of the decennial census were becoming apparent. In that year the Bureau experimented with the punched card and had a degree of success. In 1951 it installed UNIVAC I, which greatly assisted in reducing the large backlog of punched cards resulting from the 1950 tally. In that census it took over 3,000 keypunch operators to process the millions of cards of census information.

For the 1960 census the Bureau designed a new system in conjunction with the National Bureau of Standards. The key to that system was called FOSDIC, which stood for Film-Optical Scanning Device for Input to Computers. This original FOSDIC application reduced the input information handling time from 200,000 man hours for the 1950 census to 28,000 man hours for the 1960 census. In total, the FOSDIC capabilities are estimated to have saved $6 million in input costs over the 1950 system performance.

Still not fully satisfied with the 1960 results, this year's information handling procedures will again depend on new innovations and technological advancements, largely developed by the Census Bureau's Engineering Development Laboratory.

THE NEW METHOD. The 1970 population census input consists of two types of forms—a so-called 100 percent short version uncoded form to be filled out by all households, and a pamphlet-type sampling form to be completed additionally by about 1/5th of all the households. In total about 65 million of the shorter version forms will be processed and about 14 million of the pamphlet type.

The actual fully automated processing of the completed form questionnaires will be accomplished through the integration of two specially designed systems. The first, Camera 3, developed by the Engineering Development Laboratory, will include 40 separate microfilm units. The other system encompasses the FOSDIS SS model, redesigned for the 1970 census in the Engineering Research Branch. It basically consists of a computer scan unit, a console, and two servos. Six such FOSDIC units will be used to meet the tight processing schedule. The final equipment in the series of automated actions are UNIVAC computers, three of which will be used—two model 1108's and one model 1107.

The processing program calls for the uncoded type form to be fully processed prior to the pamphlet-type household form, which needs some manual coding prior to being machine processed. The 100 percent use form will require about 130 million microfilm frames (images) for the total program, which means a daily production of about 1.1 million frames.

The input sequence of the 100 percent form starts with the Camera 3 processes. First the forms are placed face up on the special vacuum feed belt that brings the document into position for microfilming. A photocell technique insures proper positioning for the camera exposure of about 100 frames per

minute. The film is then developed in negative film form, as this method allows the questionnaire form's marks and filled-in circles to show as clear spots on the film.

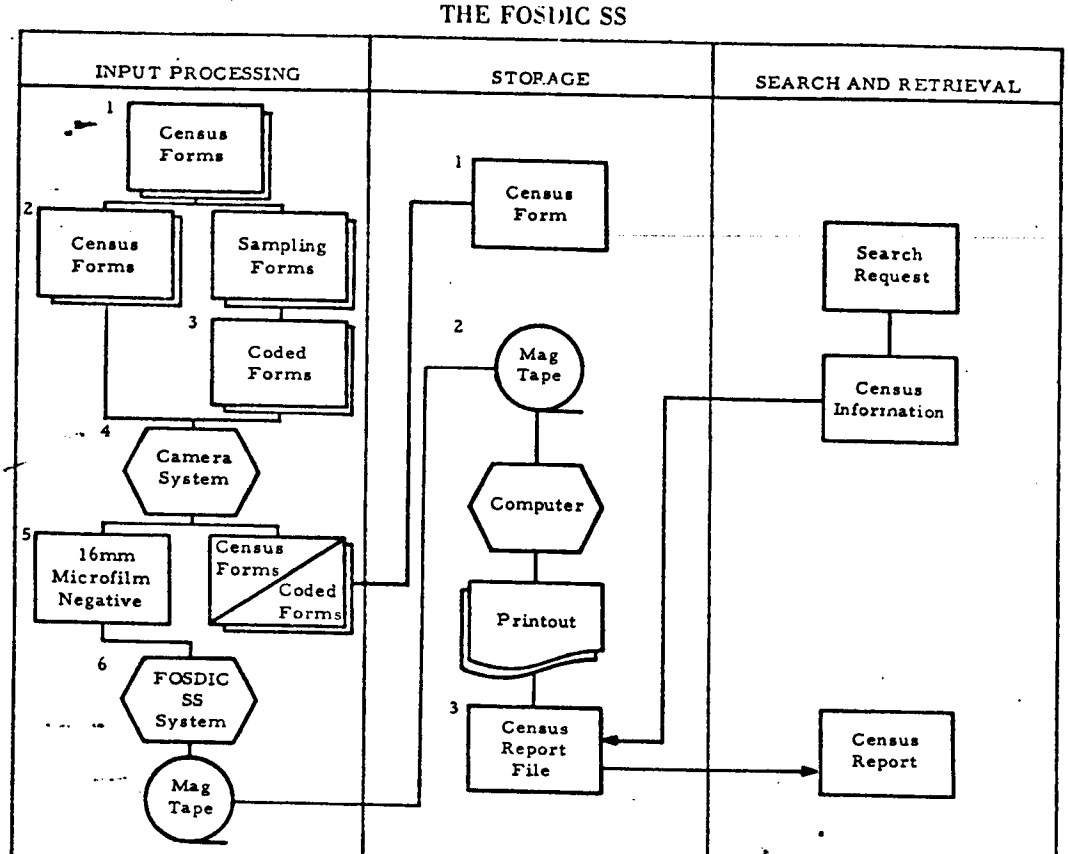
The developed film then moves to the FOSDIC operation where it is converted to magnetic tape. The film is first carried through an aperture where a "flying spot scanner" records the relative film shadings of dark, gray, and clear, including the marked answers on the questionnaire. These resultant electrical impulses are transferred to the FOSDIC computer section where they are converted to binary-coded, input magnetic tape. In the final step the computers convert the compatible magnetic tape information into human-readable form. The output product is a statistical summary printout of the questionnaire answers.

The magnetic tape records are then indexed and filed in an appropriate arrangement. The printout information is converted into statistical summaries for use by the Census Bureau and other Government agencies. After proper analysis and interpretation, the results will be disseminated to the nation through a variety of Government publications and other communication media.

REMARKS. This FOSDIC SS, CIM (computer input microfilm) System is a prime example of the technological breakthroughs in automated, information processing capabilities that have occurred since the taking of the last census. In 1960, for example, the system transferred the equivalent of 8 hours of punched card data into magnetic tape in 1 minute. The 1970 system performs this same function in 12 seconds. In addition to the reduced processing time, the automatic features of document handling and information extraction insure error-free printouts of census results.

The sophistication, costs, and processing capabilities of this unique system may now be beyond the requirements of most information handling activities. However, as beneficial innovations reach the market place these CIM characteristics and automated document handling features will become more feasible for use on less demanding applications.

THE FOSDIC SS



1. Input is 144 million census form questionnaires.

2. One hundred and thirty million filled out by all households. One-fifth of these households also completed sampling form.

3. Sampling forms are manually coded and held for further processing until uncoded forms have been processed.

4. Forms automatically belt-fed and positioned for Kodak C-2 camera processing and developing.

5. Original forms sent to storage; microfilm enters the FOSDIC system.

6. System scans microfilm and converts information to binary-coded magnetic tape.

1. Original report forms are held for future disposal.

2. Univac computers convert the magnetic tape information into human-readable form and printout summaries of questionnaire information.

3. Summary information compiled into report file package at conclusion of all processing.

Users of information are interested Government officials, private sector institutions, and the general public who desire census report information for studies, evaluations, trends, plans, and other reasons.

NAME OF SYSTEM:

Census Age Search

ORIGINATOR:

Public Information Center
Bureau of Census
Pittsburg, Kansas 66762

OBJECTIVE. To accelerate the conversion of the geographically-oriented census records to an alphabetic name file to improve search efficiency in order to process increased volumes of inquiries received from the public.

BACKGROUND. The Public Information Center provides the public with legal proof of age, citizenship status, and family relationships through searches of microfilm files. The Center has a major problem in searching the microfilm records of these original census of population documents, since the listings are geographically oriented, while the searches are name oriented. A search under such conditions has always been time consuming, frustrating, and occasionally fruitless. To correct this situation, the Census Bureau, over a period of years and within its limited budget outlay, has been cross-referencing the geographically oriented State files to a surname-coded reference system. Because of the enormity of each State's file of census participants, the soundex code system of surname identification was adopted. This system uses a combination of four alpha-numeric characters to represent the last name; that is, the first letter of the surname followed by three numerical codes representing the three or less consonant sounds contained in the remaining letters of the name. With literally millions of names to be processed, progress in converting the file was relatively slow.

With the passage of the Medicare Act by the Congress in 1965, the resultant deluge from the public for confirmation of age caused a greatly accelerated emphasis on conversion of the State files.

THE NEW METHOD. The conversion of the 1910 census records to soundex-coded surnames is being done on a State-by-State basis. The input for this accelerated conversion effort initially covers the keypunching of the name, age, references, and other identifying data on punched cards. These punched cards are then converted to magnetic tape, and through use of a special computer program each surname is assigned the proper soundex code. An additional computer program provides for a complete sequential sort by soundex code of all names within a given State. The sequence following the surname includes the first name, middle initial, and lastly the county of residence.

When all listings have been sequentially placed on the magnetic tape, the file is ready for conversion to microfilm. This action is made possible through use of COM (computer output microfilm) equipment that is capable of automatically entering photo-optical binary codes on microfilm. Each 16-mm. microfilm frame consists of the entries for five families, with identifying photo-optical binary-coded data covering only the fifth or last family shown in the frame.

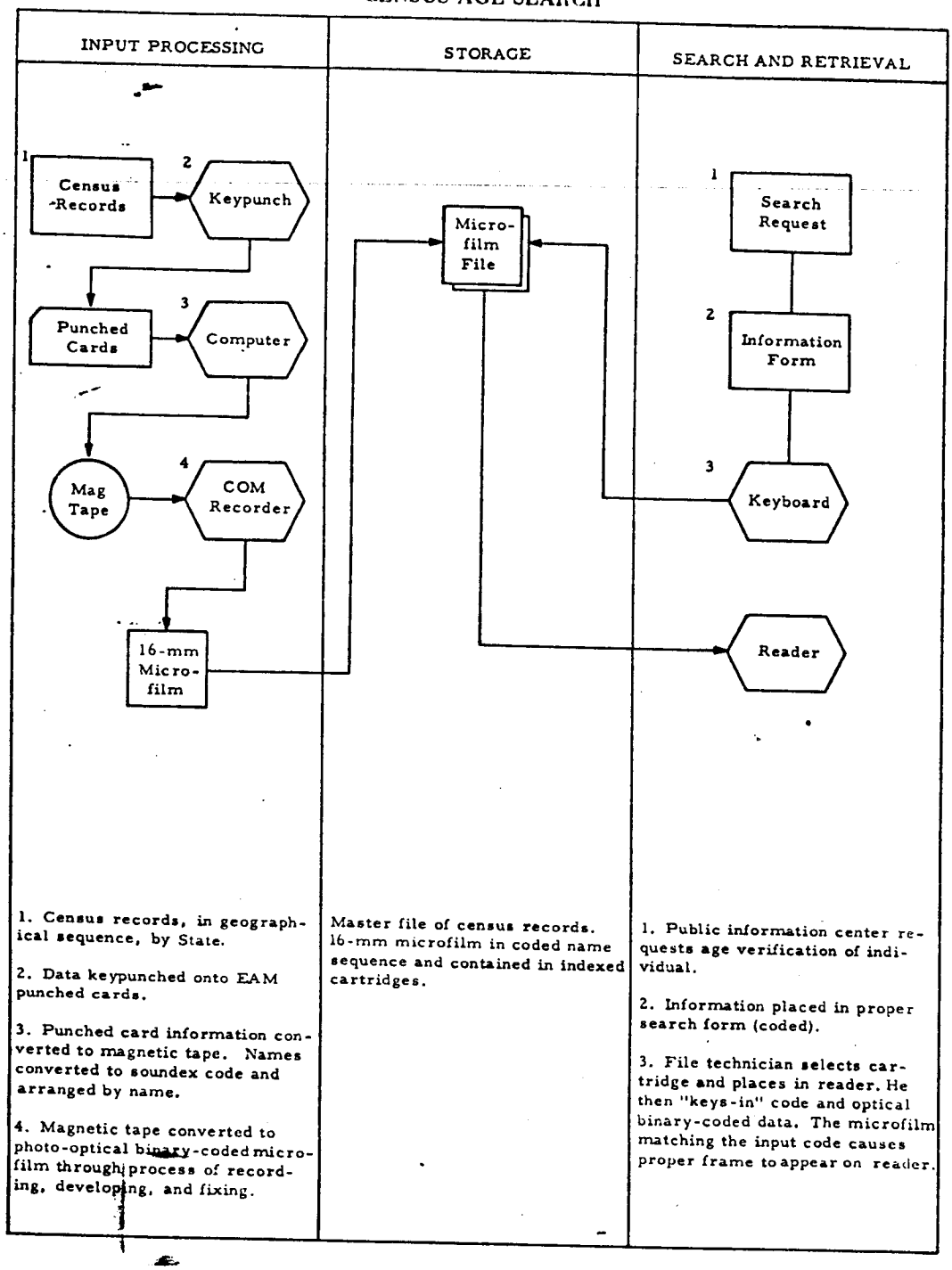
A typical State's soundex-arranged population file contains about 150 100-foot cartridges. Within the cartridge the data on each listing is arranged first by the first letter and three digits of the soundex code, then by the first four letters of the given name, and finally by the county of residence. A typical search station consists of three interrelated components. In sequence of use they are the film cartridge rack, which can hold over 200 film cartridges within easy reach of the search station operator; the electrically-operated microfilm reader, a standard Lodestar Recordak model with a capability of moving film at the rate of 10 feet a second; and the key device for this photo-optical, binary-coded microfilm system, the automated retrieval keyboard.

To conduct a search, the operator selects the appropriate microfilm cartridge, places it in the reader, and "keys in" the appropriate soundex code representing the name being looked up, followed by the given name and county code. With all information placed in the microfilm reader, the operator turns on

the start button. When all the keyed-in data matches the binary coding on a particular film frame, the reader will display the next image, which should be the film frame containing the requested information. If the individual's residence location was not known initially, a slightly wider search of the film might be necessary, especially if the surname were fairly common.

REMARKS. This roll microfilm system with optical binary code and computer-like image-finding capability lends itself to precise selection of desired documents. For example, this updated system has enabled searchers to find the desired name 50 percent of the time in the first viewing of the microfilm. In contrast, the older manual reader search through geographically arranged files was successful in only 15 percent of the first searching attempts.

CENSUS AGE SEARCH



NAME OF SYSTEM:

National Weather Records Center (FOSDIC IV)

ORIGINATOR:

Weather Bureau

Environmental Science Services Administration

Department of Commerce

6010 Executive Blvd.,

Rockville, Maryland 20852

OBJECTIVE. To establish a practical system for gathering, processing, and storing large masses of Weather Bureau observation data. Further, to store this data in a format suitable for high-speed machine searching in connection with weather research programs.

BACKGROUND. The Regional Weather Records Processing Centers are responsible for routine processing of domestic United States Weather Bureau surface observations. The National Weather Records Center routinely processes upper-air data, marine data, and data gathered outside the country. Punched cards and computer processes are used in all stages of the various weather observation tasks. Upon completion of routine processing, the punched cards and other source records become part of the permanent record collection maintained at the National Weather Records Center, Asheville, N.C.

The succesful employment of data processing equipment for the preparation of climatological statistics began in 1936 when punched cards were used for summarizing more than five million marine observations. Since then the use of punched cards has accelerated constantly, and by 1961 the Asheville facility contained over 400 million cards.

With the knowledge that punched cards are not the best medium for permanent storage of this historical data, the Weather Bureau turned to the microfilming of these records. To more effectively perform this task, a special camera was designed which microfilms punched cards at the rate of 840 cards a minute. This capability allows for a placement of 12,000 card images on each 100 foot roll of 16-mm. microfilm and reduces the data space needs by a ratio of 180 to 1. The original microfilm is retained in the master file and a positive film is produced for the working copy on which the punched holes appear as transparent square spots.

In the late 1950's, to make the microfilm punch card images practical as a machine processing medium, a high-speed electronic optical film reader called FOSDIC II (Film Optical Sensing Device for Input to Computer) was designed and built by the National Bureau of Standards and placed into operation at the National Weather Records Center. This equipment had the capability of searching any 10 columns of card images, based on plugboard programing, at a rate 5 times faster than that of punched card input.

THE NEW METHOD. A new Model IV FOSDIC developed by the National Bureau of Standards was recently integrated into the Weather Bureau's Asheville, N.C., data processing activity. This model FOSDIC IV is especially designed for rapid scanning and selection of data and can read the punched card data contained on microfilm 4 times as fast as the FOSDIC model II. This processing rate corresponds to a column-by-column examination of 2,000 full cards per minute.

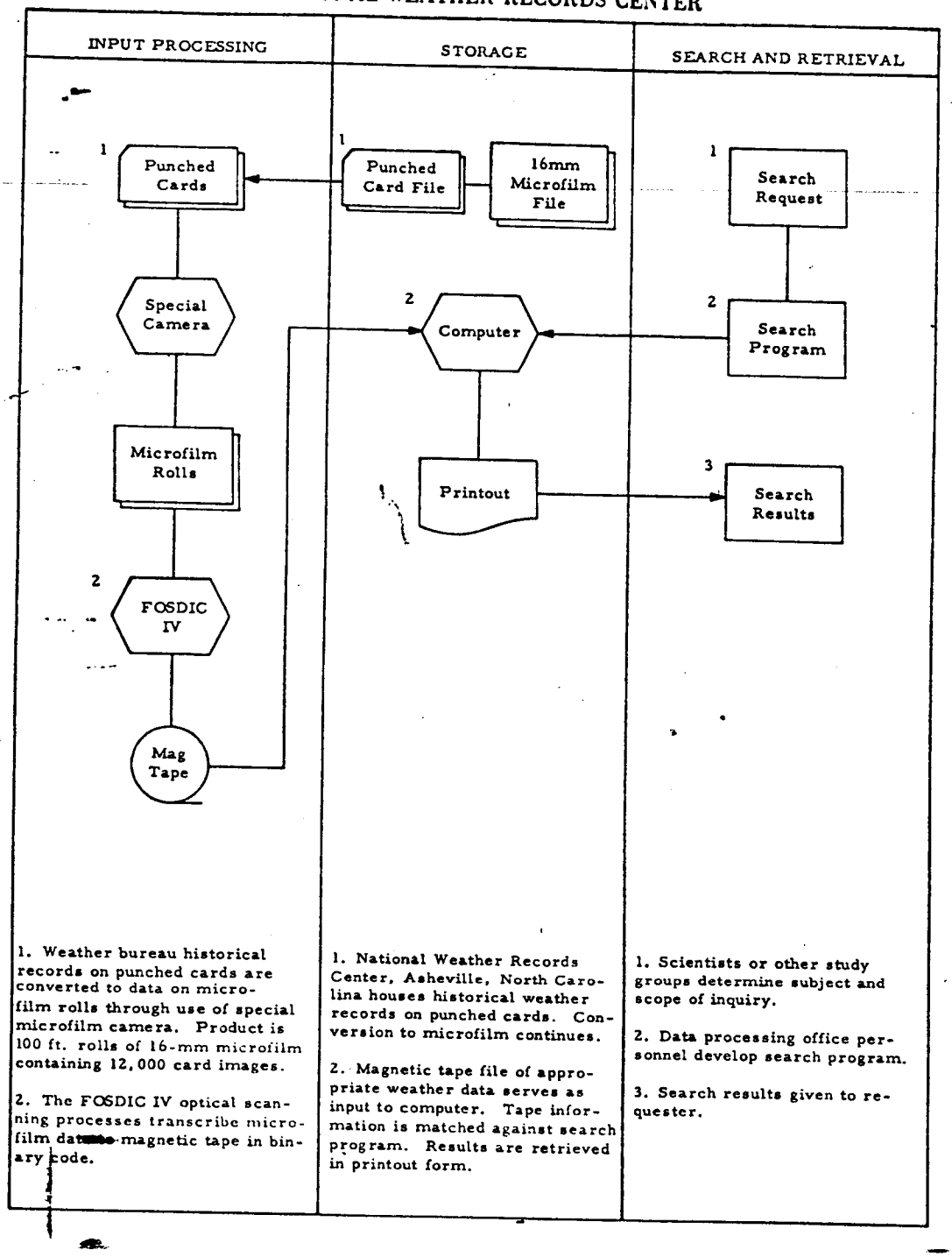
Using a plugboard program, an electronic optical scanning device reads the spots on the microfilm created by the holes in the punched cards and converts the spots to binary-coded information on magnetic tape. The data on the magnetic tape can then be used as input to normal computer processing.

To better understand the full processing cycle of historical weather data available for study, let us assume that a group of meteorologists wish to study the winter season, West Coast entry point of storm tracks arriving from the Pacific Ocean. The group feels that the scope of research should include all records of the area accumulated since 1960. Further, let us assume that these 400,000 records, representing the weather data for the period, are still in punched card form at the Weather

Bureau's National Records Center. Initially, these cards become the input to the microfilming processing sequence and conversion to microfilm. The FOSDIC IV operation next transcribes the microfilm data into binary-coded magnetic tape. Finally, based on somewhat sophisticated computer programs, the magnetic tape is processed through the computer with a resultant printout of the requested data.

REMARKS. The Weather Bureau initially turned to microfilm as a permanent storage method because it insures file integrity and lasting record life. It is also reproducible at a relatively low cost. The punched card means of permanent storage has such limitations as bulk, a tendency to deteriorate over a period of time, and the possibility of loss or mutilation. Additionally, microfilm is far faster as input to computers.

NATIONAL WEATHER RECORDS CENTER



1. Weather bureau historical records on punched cards are converted to data on microfilm rolls through use of special microfilm camera. Product is 100 ft. rolls of 16-mm microfilm containing 12,000 card images.

2. The FOSDIC IV optical scanning processes transcribe microfilm data to magnetic tape in binary code.

1. National Weather Records Center, Asheville, North Carolina houses historical weather records on punched cards. Conversion to microfilm continues.

2. Magnetic tape file of appropriate weather data serves as input to computer. Tape information is matched against search program. Results are retrieved in printout form.

1. Scientists or other study groups determine subject and scope of inquiry.

2. Data processing office personnel develop search program.

3. Search results given to requester.

NAME OF SYSTEM:

Information Storage and Retrieval for Patents

ORIGINATOR:

Electrical Examining Operation

Patent Office

Department of Commerce

Washington, D.C. 20230

OBJECTIVE. To design and evaluate a completely mechanized document storage and retrieval system that would accelerate the retrieval of patent information for review by examiners. Additionally, to provide the capability for the identity and retrieval of a broader selection of relevant patent information.

BACKGROUND. The Patent Office maintains a central records file containing more than 3¼ million approved patents classified into more than 300 classes and 57,000 subclasses. Government regulations specify that the approval of any new patent application must be based on "novel or original features." Compliance with this policy thus demands a high degree of search accuracy and recall capability. For example, patent examiners must review all approved patents that seem related to or have the same features as new patent applications.

For years the Patent Office had been investigating new approaches to the problems inherent in the conventionally maintained hierarchical subject classification file of patents. As the file size increased, searching speeds and file accessibility became a critical problem. As one possible solution to the information problem, a Patent Office study group selected 6,000 patents for initial conversion to an experimental mechanized storage and retrieval system.

THE NEW METHOD. This experimental system uses three types of information retrieval equipment and processes in support of this effort. They are a 1401 IBM computer, a plastic microfilm jacket, and mechanical card-selecting equipment.

The computer serves as the storage medium for the patent reference index. It maintains the important descriptive data necessary to the identification of patents having relevance to new patent applications. The main reason for the success of the document retrieval function is the seven digit patent serial number. In patent searches, the computer selects and prints a list of pertinent patent numbers in accordance with the search index terms used.

For the document storage function, the study group selected a 4 x 6 inch plastic microfilm jacket coupled with a Randomatic mechanical card selector device. These media were chosen because of the relatively low cost of jacket preparation and the fast retrieval features of the mechanical selector device. In converting to the microfilm jacket system, the initial action involved the computer-assisted identification and selection of the 6,000 patent documents from the conventional file. A standard 16-mm. camera was then used to microfilm the selected patent documents. After film development, the roll film was cut into 12-image strips and manually inserted into the jacket pockets. The final step before filing of the jackets was the placing of the code notches on the bottom edge of each jacket through use of a special punch. The notches represent the seven digit patent serial number and are the means by which the mechanical selector device identifies individual film jackets.

The storage file environment includes an integrated keyboard, jacket selector device, and film jacket container. Because of characteristics of the coding and retrieval routine, microfilm jackets may be filed in random sequence.

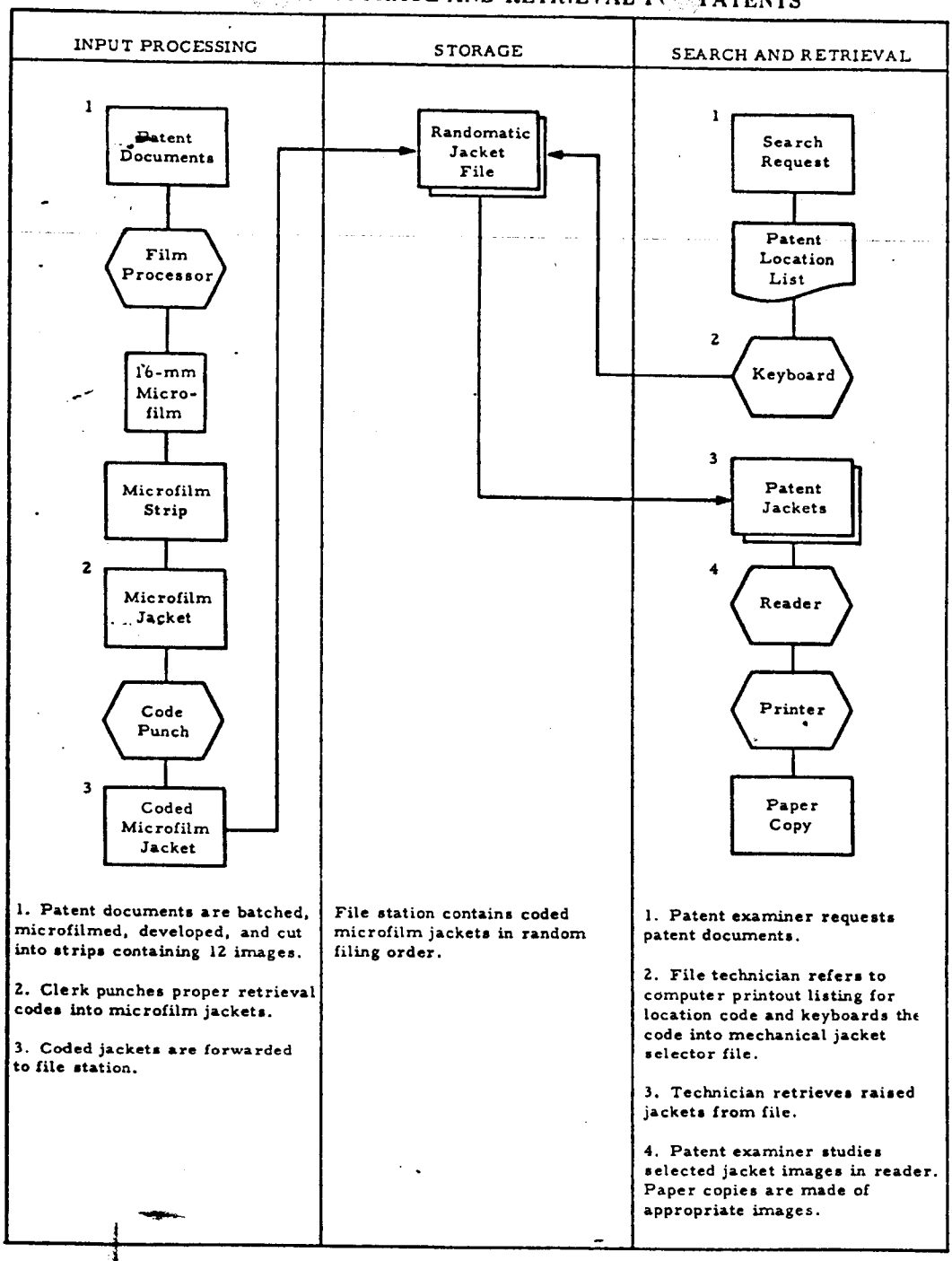
To retrieve a jacket, the file technician first refers to a computer printout listing of patents and identifying numbers coinciding with the patent examiner's request. Using the integrated keyboard, the clerk keys in the patent numbers. A mechanical actuating unit then causes the identified patent jackets

within the file to raise slightly above the others. Retrieval then consists of picking the raised jackets out of the file container. These selected jackets are given to the patent examiner for preliminary study on the nearby search reader-printer. Should the examiner desire a more detailed study of the patent, the technician can quickly make a film-to-film reproduction of the full jacket, which can be used by the examiner in his work area for reading purposes or for making selective paper copies.

REMARKS. This mechanized microfilm jacket retrieval system has the capability for fast selection and retrieval of needed documents on a continuing basis. Its features that permit random refiling of returned jackets also save considerable time. The plastic film covering of jackets affords maximum protection to the microfilm strips.

The nature of patent examination work often requires detailed study of patent documents. Thus, the patent information needs to be close to the work area. While the acquisition and maintenance costs are rather high for such a system, there is always the possibility that it might be fully justified through improved program effectiveness.

INFORMATION STORAGE AND RETRIEVAL FOR PATENTS



NAME OF SYST[illegible]:

JCS Records Retrieval

ORIGINATOR:

Documents Division, Joint Secretariat
Office, The Joint Chiefs of Staff (JCS)
Washington, D.C. 20301

OBJECTIVE. To develop and operate a nonconventional document identification and retrieval system that will provide key Joint Secretariat officials and "action officers" with desired information in a more responsive and efficient manner.

BACKGROUND. The Joint Secretariat of the JCS primarily supports the Chairman in his duties as chief military advisor to the President, the National Security Council, and the Secretary of Defense. In performing these duties the Staff prepares strategic plans and provides for the strategic direction of the Armed Forces. The documentary support of these often critical responsibilities is the Records and Information Retrieval Branch, Documents Division, which is the focal point for document management. The former conventional methods of performing document classification, storage, and retrieval activities could not cope with the increased workload resulting from unsettled world conditions.

Due to the relatively slow reaction time to document requests, officers and other researchers were spending considerable manhours in attempting to correlate and retrieve information. As a result of this steady deterioration in document response, responsible authorities recommended that a feasibility study be conducted with a view toward improving the document management activity. Numerous mechanical and automated indexing and retrieval methods and systems were evaluated in terms of the office's requirements. The study resulted in the selection of an optical coincidence coordinate indexing system as being the most practical method for improving the system.

THE NE[illegible] METHOD. The Termatrex optical coincidence system was chosen as the best for their particular needs. The key feature of this system is a 9 x 9 inch opaque plastic index card. This card contains 100 vertical code positions and 100 horizontal positions for punching holes, a total of 10,000 positions. All hole or code positions radiate up and across from the lower left-hand corner. To identify these positions, a four digit numbering method is used. The first two digits represent the vertical positions and the last two digits, the horizontal positions. For example, position number 2256 would represent a hole location 22 positions up from the card's left-hand corner and 56 positions to the right. All like hole positions represent the same number on each card.

Each optical coincidence card represents a particular term that has been authorized for inclusion in the "Joint Glossary for JCS Records." This glossary consists of keywords and terms derived from technical, scientific and military terminology, and the natural language. The glossary's primary purpose is to aid and control selection of keywords and terms and to keep the number of term cards to a practical minimum. New terms are added as they become necessary in the identification process. Currently there are about 2,500 terms listed in the glossary. Aside from the coincidence cards, the Termatrex system also consists of a hole drilling machine and a simple, backlighted card viewing device (light box).

The input processing sequence begins with the receipt of new documents in the Records and Information Retrieval Branch. Indexing specialists assign document accession numbers both to the document and to a worksheet form. Additional descriptive bibliographic data is also placed on the worksheet together with the key terms describing the content of the document. The document is then released for staff action, and the worksheet passes to the file technician, who pulls the appropriate optical coincidence term cards from the reference file. All term cards representing the processed document are then superimposed in the Termatrex drilling machine. The operator sets the drilling position

for the accession number a[illegible]ned and drills a hole simultaneously throug[illegible] each term card. The cards are then returned to their proper places in the reference file.

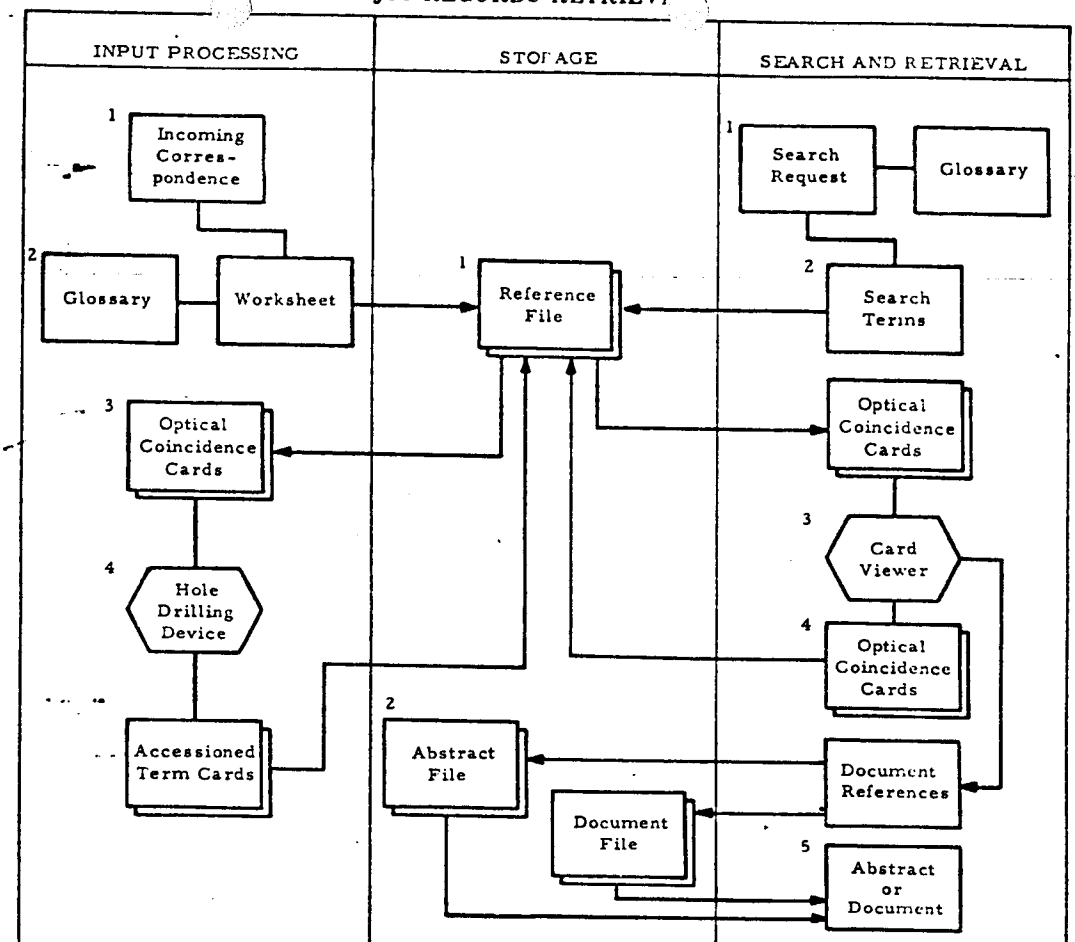
In a search situation, the user must first identify the basic terms that apply to the search request, perhaps with the aid of a file specialist and the glossary. The term cards are then withdrawn from the reference file and superimposed on top of the card viewer. Dots of light show through the coincident holes and thus indicate the documents that were indexed under the search terms. The identity of the accession numbers is then revealed by means of the viewer scale. In cases where the researcher feels that too many references are indicated, he may refine the search question by employing additional terms, which merely requires the selection of the optical coincidence cards and adding them to the stack on the viewer. Once he is satisfied with the search results he has the choice of obtaining either an abstract of the documents or the original pape[illegible] The total search routine, including doc[illegible]ent retrieval, can be accomplished in just a few minutes.

REMARKS. This system was able to meet initial study objectives at a very reasonable cost. Its relative ease of conversion to mechanized applications was also a factor in the original recommendation.

Aside from its low cost and simplicity of operation, a great advantage of this system is its excellent manipulative qualities. By adept term card selecting and shifting of cards, a user may often obtain faster search satisfaction than had the search been performed by more sophisticated methods.

While the system is excellent for identifying pertinent documents, one must always refer to a second source, either an abstract or the document itself, to determine the contents of the document.

JCS RECORDS RETRIEVAL



1. Records and Retrieval Branch specialist assigns accession numbers to both documents and worksheets.

2. Specialist lists key terms with aid of glossary.

3. With worksheet information specialist withdraws appropriate term cards from file.

4. Holes are drilled in grid positions reflecting document's accession number. When completed, cards are returned to file.

1. The Optical Coincidence Term Card File is maintained in alphabetical order and consists of about 2,500 authorized terms.

2. Both the abstract and document file are located in close proximity to the reference file.

1. Research and action officers, with aid of specialist, settle on search terms.

2. Specialist withdraws proper cards and places them over light source.

3. Light showing through holes identifies documents with coincident terms.

4. Document accession numbers are noted and cards are returned to file.

5. The searcher requests file specialist to withdraw cited abstract or basic document.

NAME OF SYSTEM:

Automated Engineering Data Retrieval and Reproduction

ORIGINATOR:

Engineering Support Division
Procurement and Production Directorate
Army Electronics Command
Fort Monmouth, New Jersey 07703

OBJECTIVE. To establish and operate an image storage and retrieval system that will automatically locate engineering drawings and reproduce aperture cards for use in procurement actions.

BACKGROUND. The Army Electronics Command is responsible for managing the electronic-communication "commodity" for the Army. This encompasses not only the research and development activities, but also the procurement, production, and maintenance of each developed item. The Procurement and Production Directorate translates material planning and requirements (specifications) into the acquisition of specific hardware items.

Before an item can be acquired, a series of preparatory procurement actions must be taken. One of these actions is gathering the pertinent documentation making up the technical data package that is given to the prospective bidders. Accompanying each of these data packages is a set of engineering drawings and associated lists that describe in detail the item(s) to be procured. As the size of bid packages increased due to the complexities of procurement items, it became increasingly difficult to meet deadlines for distribution of the technical data package to prospective bidders. After many studies of the growing problem, the Army Electronics Command adopted a highly automated image search and retrieval system to solve the problem.

THE NEW METHOD. The Documentation Automated Retrieval Equipment (DARE) is the heart of the new system. It is used for the automatic storage and retrieval of film chip copies of coded aperture card reproductions of engineering drawings. These chips measure 35-mm. by 3 inches and contain both binary-coded identification information and the image of the engineering drawing. The film chips are stored in a special automated file container, which currently contains about 490,000 images of active engineering drawings.

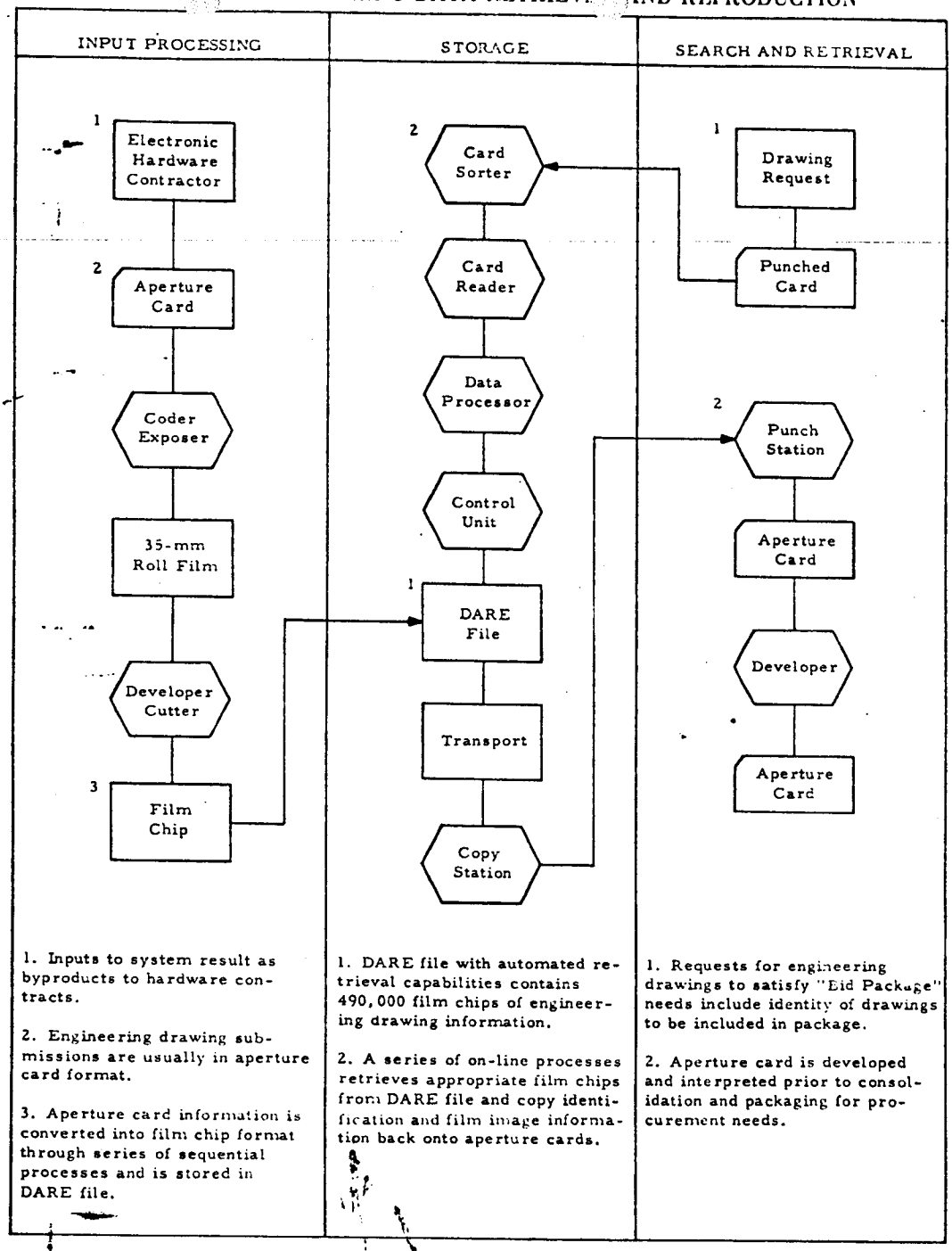
As specific groups of drawings are needed to support procurement package requirements, previously sorted punched cards containing appropriate engineering drawing data are placed in a punched card reader. The information interpreted by the reader is passed to the central processing unit that transmits the information to the control unit. The electronic impulses from this unit command the transport unit's mechanism to retrieve the proper film chip from the storage container. (The actual identification of the chip is performed by an optical reader that scans its binary-coded information for image selection purposes.) The chip image is then copied onto an output aperture card, and the binary-coded information is keypunched into the output card. Subsequent film development and interpretation (printing) at the top of the punched card are performed on-line.

The system can also be programed to automatically make multiple copies of the same drawing. Output controls allow for the proper batching of aperture cards intended for individual bid packages. As many as 4,000 engineering drawings can be selected and processed per day for forwarding to prospective bidders.

REMARKS. The DARE system is especially effective when applied to large and active files of document information that must be conveyed to users on short deadlines and in reduced size for handling and transmission purposes.

The system can store up to 855,000 engineering drawings or similar information displays, and through use of a modular concept it can double that capacity. In addition to the automatic retrieval and copying capabilities, it can also accept and purge 2,000 documents per day.

AUTOMATED ENGINEERING DATA RETRIEVAL AND REPRODUCTION



1. Inputs to system result as byproducts to hardware contracts.

2. Engineering drawing submissions are usually in aperture card format.

3. Aperture card information is converted into film chip format through series of sequential processes and is stored in DARE file.

1. DARE file with automated retrieval capabilities contains 490,000 film chips of engineering drawing information.

2. A series of on-line processes retrieves appropriate film chips from DARE file and copy identification and film image information back onto aperture cards.

1. Requests for engineering drawings to satisfy "Eid Package" needs include identity of drawings to be included in package.

2. Aperture card is developed and interpreted prior to consolidation and packaging for procurement needs.

NAME OF SYSTEM:

Building Space Information

ORIGINATOR:

U.S. Army Information and Data Systems Command

Department of the Army

Washington, D.C. 20314

OBJECTIVE. To provide management current information on the status of building space used by Army organizations in the National Capital Region.

BACKGROUND. The administrative building space reporting system was developed to better respond to property management requirements in the National Capital Region. The former manual methods of collecting and compiling building space data became impractical as new information requirements were added. Additionally, the closing of many temporary buildings under Army jurisdiction necessitated modern methods for managing the program. As a result of these factors an automated system was established in 1967 to better respond to the new requirements. Since then the system has been modified several times to comply with Office of Management and Budget and General Services Administration policies.

THE NEW METHOD. Under current policy the system requires tabular data to be reported under four specifications. These are building specifications; organization specifications; administrative space reporting master file, with update transactions and edit specifications; and administrative space master file conversion specifications.

In order to meet these requirements three magnetic tape files are maintained, which collectively are affected by 16 different computer programs. Eleven card sorts are also required to establish, maintain and produce the needed outputs. The three master files are as follows:

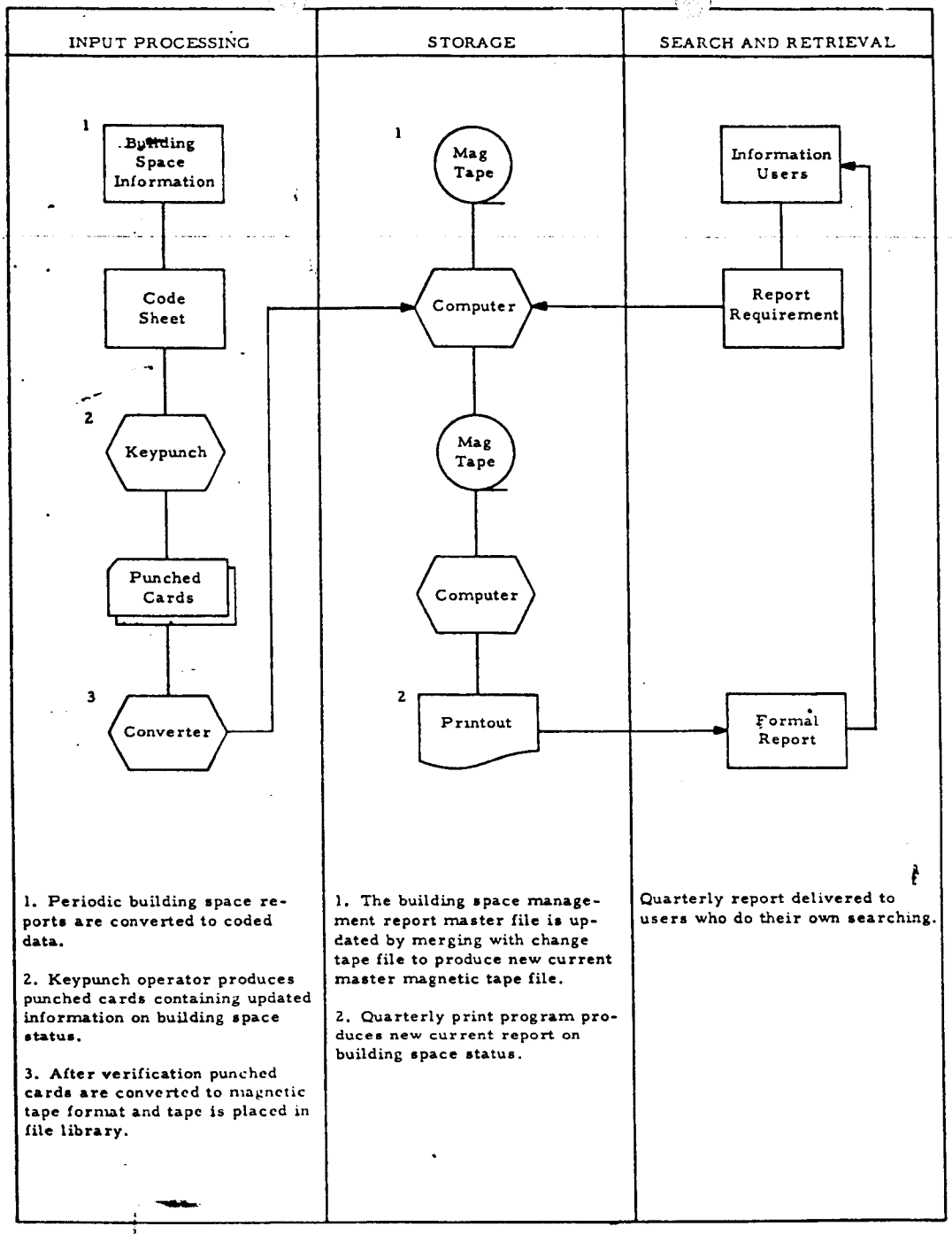
1. The *Space Management Master File* wherein each record contains 16 data elements that identify applicable buildings, organization, transaction data, record creation data, date of space assignment, plus individual totals of office, storage, and special-type space. In addition, each record includes the total bulding space managed during the previous quarter; personnel occupancy space on other than a prime shift; plus several other data elements. Each of the above element breakouts are maintained for each building and each organization occupying any portion of the building.
2. The *Building and Organization Table Master File* includes data elements that identify the type of file (building or organization), transaction date and code, and the Department of Defense (DOD) building code or organization code, as applicable. The building records contain location code ownership, condition code, State code, and building name and location. The organization records comprise Office of the Secretary of Defense (OSD) component code, total code, activity code, and organization name and address.
3. The *OSD Valid Transactions File* contains transaction data relative to building or organization changes.

System files are updated quarterly from administrative space reports. The processing is accomplished in initial, intermediate, and final cycles. This is to insure that all data and information contained in the initial reports are correct or are corrected as shown by intermediate cycle reports (reruns of initial cycle), and that final cycle reports accurately reflect building space status.

REMARKS. This system consists of several basic information categories with numerous reporting elements therein. Many status changes occur between reporting periods that require posting to the file record. While this information could be rendered manually, it would take considerable manpower and "lead-time" to meet reporting schedules. However,

conversion of source data to machine-readable language, coupled with sequential updating programs, make the meeting of these requirements a routine task for the computer. Additionally, the fast processing speed can give more currency to the data contained in the report. The system not only automatically produces information in a format that permits the users to conduct their own searches, but in addition has the potential for conducting an endless variety of data manipulation and retrieval actions on demand.

BUILDING SPACE INFORMATION



NAME OF SYSTEM:

Deficiency Identification

ORIGINATOR:

Army Information and
Data Systems Command
Department of the Army
Washington, D.C. 20314

OBJECTIVE. To establish an automated data and information dissemination, storage and retrieval system which will allow Army operating agencies to better evaluate and manage inspection and audit reports of deficiencies in the manpower and monetary functional areas.

BACKGROUND. For many years, inspection and audit reports listing deficiencies in procedural compliance were reviewed and corrected at the lowest management level having jurisdiction over the matter. It became evident that the same types of deficiencies might also be occurring at those management levels where the review was being made. Consequently, it was concluded that if there was awareness of such a trend at a higher level of review, the repetition of the deficiency might be avoided through early corrective action.

In order to solve this growing need for an earlier awareness of any unsatisfactory trends at higher reviewing levels, the Army established a Deficiency Identification System within the Army Information and Data Systems Command.

THE NEW METHOD. The Deficiency Identification System's data is compiled at the management level where the inspection and audit occurs. Short extract reports concerning deficiencies are made out in accordance with standard procedures. They are then forwarded to the Army Information and Data Systems Command in Washington, D.C., for coding and classifying prior to entry into the computer's data bank.

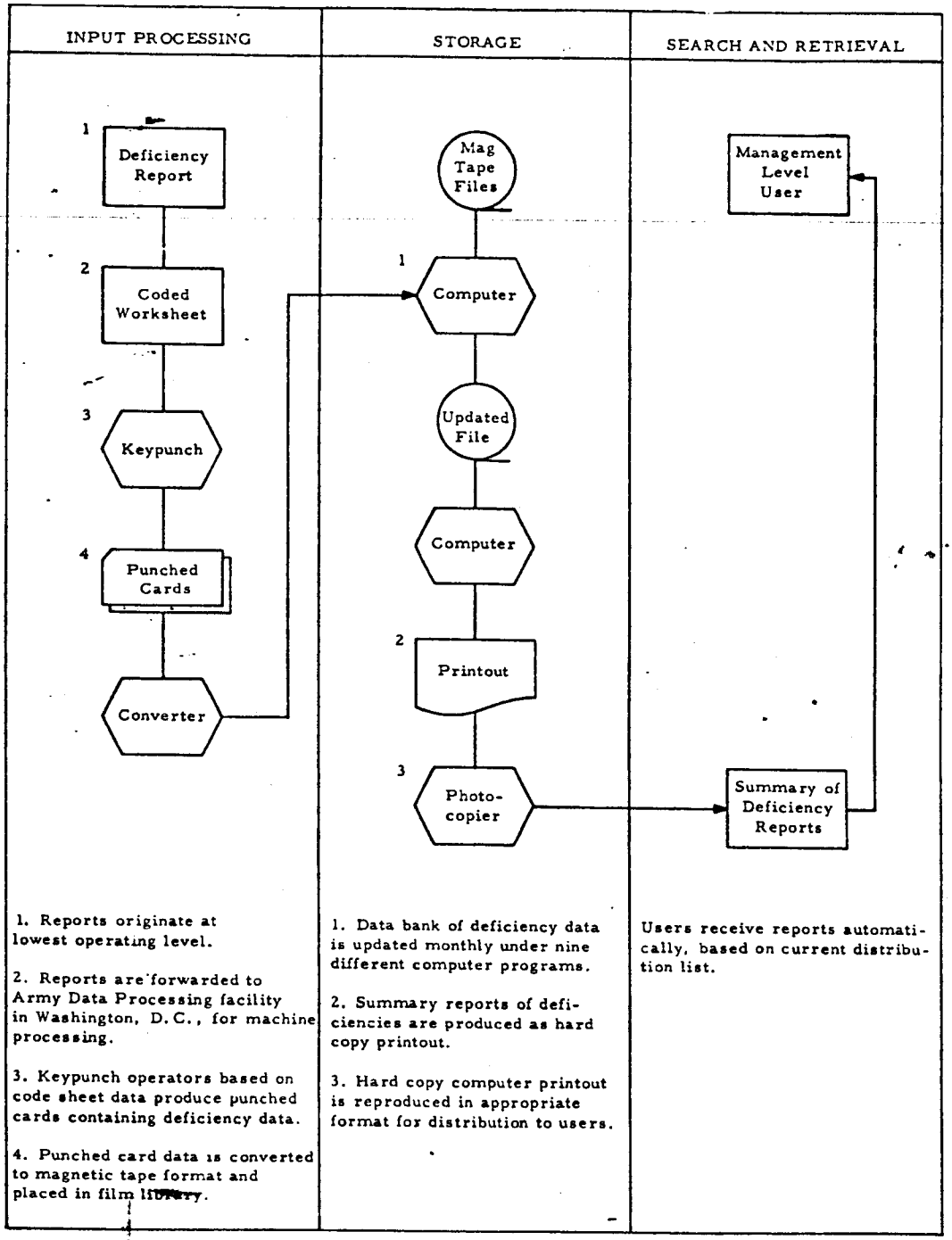
The system consists of a Master Table File and a Master Deficiency Identification File. The former file provides functional classification codes and a 65-character deficiency description for each of 165 functional or subfunctional classifications. The Master Deficiency Identification File contains specific information pertaining to 36,000 deficiency records. Based on these files, two documents are prepared and forwarded to agency operating officials. The first is a "Dictionary of Deficiencies" that contains a listing of all current deficiencies, including appropriate classification codes. The second is a "Current Cluster Report" containing a summary of all deficiency transactions, showing totals by functional classification and by major command.

Two other reports are issued. One is a summary of all deficiency reports for the year to date of report, and a second lists deficiencies by operating agencies and major command. All reports are updated and disseminated to appropriate Army management levels on a monthly basis for evaluation and appropriate corrective action.

Thus, the system assists in improved response to audit and inspection data and thereby facilitates the elimination of deficiencies before critical problems arise.

REMARKS. This system utilizes the capabilities of the computer to manipulate and maintain large collections of data. With proper indexing and instructional programs, the computer produces a more meaningful, concise representation of the deficiency items than is possible when conventional methods are used.

DEFICIENCY IDENTIFICATION



NAME OF SYSTEM:

Engineering Drawings Storage and Reproduction (with Color Overlays)

ORIGINATOR:

U.S. Army Engineer District, Savannah

Corps of Engineers

Savannah, Georgia 31402

OBJECTIVE. To develop and operate a microfilm and half-size construction drawing system that will effectively serve the internal needs of the Corps of Engineers and be acceptable to the engineering-construction community.

BACKGROUND. The Army Corps of Engineers is the largest and most diversified engineering organization in the world. As the primary agency for engineering and construction, the Corps builds structures for the space program and national defense, as well as nationwide systems of civil works for flood protection, harbor development, and hundreds of other essential purposes.

The Savannah Engineer District is principally responsible for the maintenance and improvement of harbors, waterways, and civil works construction within its area of jurisdiction. The major work in support of these varied construction activities is that of engineering design. Responsibility for the district's reproduction of drawings and specifications rests with the Reproduction Branch of the Office of Administrative Services. This activity reproduces original drawings in both paper format and microform. Typically some 70–100 construction projects are supported each year, with each requiring about 80 architectural drawings and hundreds of pages of specifications.

The Reproduction Branch workload has doubled over the last 5 years. Because of this trend, coupled with new and improved capabilities offered in paper reproductions and microform methods, the district has been converting many of the old procedures to improved methods of information handling. Previously, a typical standard engineering drawing was produced on linen or paper and reproduced full-size on a blueprint, whiteprint, or diazo-type machine and distributed as required.

THE NEW METHOD. The system that is gradually being installed utilizes new techniques and equipment to better satisfy economic, operational, and user requirements.

The basic input to the system is construction drawings originated internally or by contract. These drawings facilitate prospective contract documentation by displaying the plan in a graphic form. Prospective contractors are given early notice of planned new construction, and those interested are sent "bid packages" for study and possible bid action.

In support of these contractor requirements, the original drawings are directly reproduced as full-sized or half-sized copies through use of an Itek platemaker and an offset press. The copy reproduction system has the added capability of duplicating the original engineering drawings for use as multicolor, line drawing overlays. For example, a construction drawing can show existing features in black; aboveground new construction in green; and belowground work in red. Thus, in a brief glance, a technician or engineer can readily distinguish between existing facilities and the new work to be accomplished.

After a construction contract has been awarded, the contractor has the choice of receiving one set of drawings in full-size format and an appropriate number of copies in half-size with color overlays.

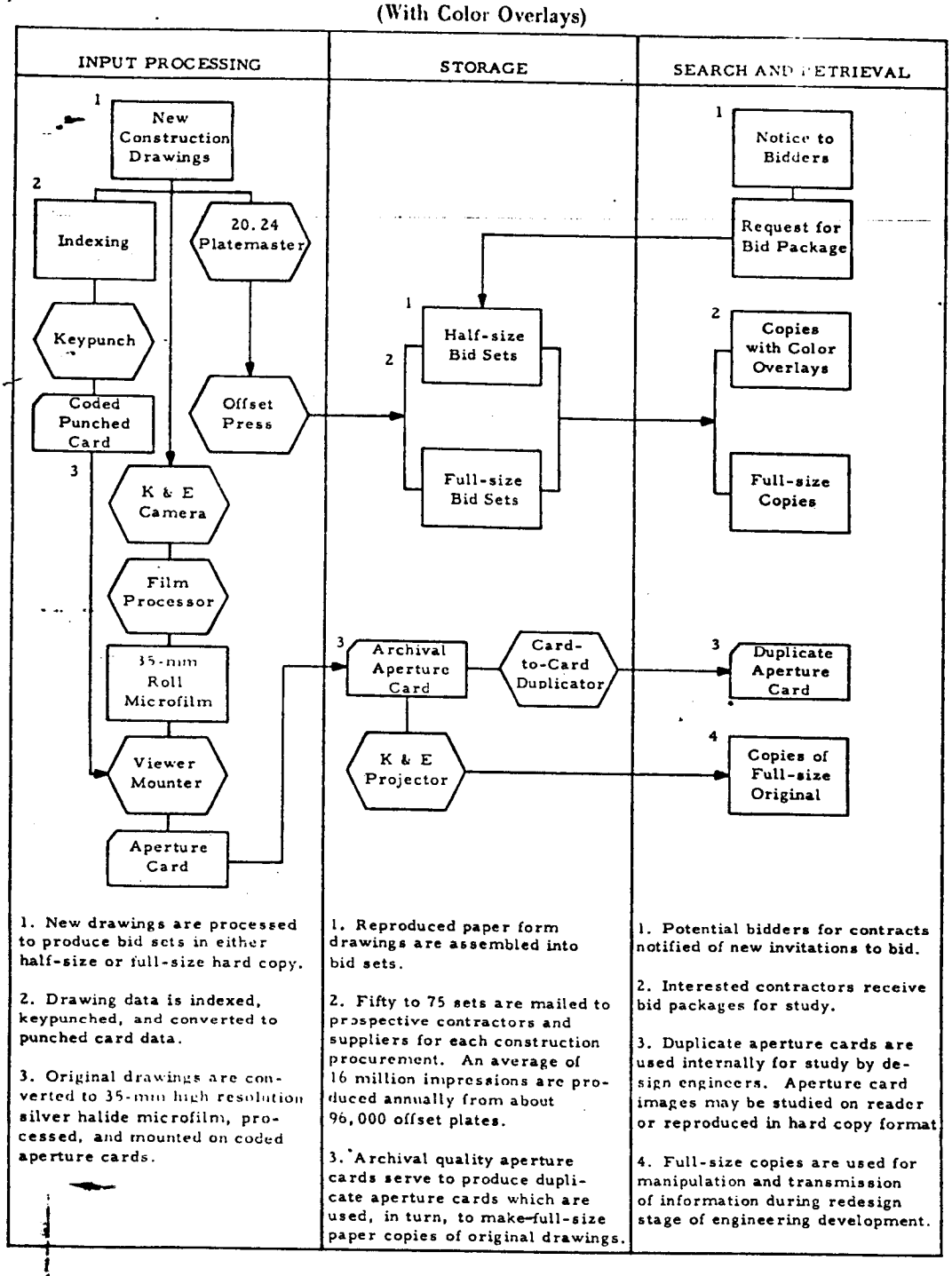
The original drawings are also used to produce archival-quality, 35-mm. silver halide, black-and-white microfilm for mounting on index-coded standard aperture cards. These aperture cards are then used to create duplicate aperture cards using a card-to-card duplicator device. These new sets of cards are used

internally to make full-sized, hard-copy, black-and-white engineering drawing images for manipulation and transmission of information during any redesign phase of existing engineering specifications.

REMARKS. The use of the Itek platemaker for satisfying contractor "bid set" requirements permits reduction of a drawing to half-size paper plates costing about 60 percent less than the full-size prints. This savings is especially significant in terms of a year's production under the half-size format. Some contractors still desire full-size copies, but their number is diminishing as they realize the greater adaptability, legibility, and multicolor advantages of the half-size format.

The use of microform for the reproducing of original engineering drawings is just beginning to be realized. For example, the camera used in such a system, when equipped with a projection or "blow-back" head, will project the archival-quality film image back onto a piece of sensitized drafting plastic and in so doing will reproduce the original drawing in full size. With eradicating fluids and ink, changes can be made on the reproduced drawings to create new originals. Thus this technique can be used to modify existing drawings, rather than having to prepare new ones.

ENGINEERING DRAWINGS STORAGE AND REPRODUCTION
(With Color Overlays)



1. New drawings are processed to produce bid sets in either half-size or full-size hard copy.

2. Drawing data is indexed, keypunched, and converted to punched card data.

3. Original drawings are converted to 35-mm high resolution silver halide microfilm, processed, and mounted on coded aperture cards.

1. Reproduced paper form drawings are assembled into bid sets.

2. Fifty to 75 sets are mailed to prospective contractors and suppliers for each construction procurement. An average of 16 million impressions are produced annually from about 96,000 offset plates.

3. Archival quality aperture cards serve to produce duplicate aperture cards which are used, in turn, to make full-size paper copies of original drawings.

1. Potential bidders for contracts notified of new invitations to bid.

2. Interested contractors receive bid packages for study.

3. Duplicate aperture cards are used internally for study by design engineers. Aperture card images may be studied on reader or reproduced in hard copy format.

4. Full-size copies are used for manipulation and transmission of information during redesign stage of engineering development.

NAME OF SYSTEM:

Correspondence Retrieval

ORIGINATOR:

Naval Ship Systems Command
Department of the Navy
Washington, D.C. 20360

OBJECTIVE. To develop and operate a large volume subject correspondence retrieval system through integration of the document reference search, storage, and retrieval functions into a single unified retrieval system, thus providing a more responsive information service.

BACKGROUND. The Ship Systems Command is responsible for ships, other watercraft, and most nonordnance shipboard material support of the Navy. In performing these duties, the headquarters each day receives about 8,000 pieces of correspondence. About 75 percent of these items are screened and forwarded to other offices for controlled handling. The remaining 2,000 pieces have record and possibly reference value, and thus must be identified as to subject matter and responsibility of action. About 100 inquiries are received each day that require referring to earlier correspondence. Since the information requested could form the basis for making some decision, Central Records must promptly respond to these inquiries.

In support of the above responsibilities, both a manual conventional subject file and a source file were maintained. The source file contained half-size copies of processed microfilm and was filed by the originator of the paper and date. The original document, after being routed and acted upon, was returned to Central Files and either replaced the microfilm in the source file or was filed by assigned subject code. Persons requesting a document had to know its originator and date or its basic subject. Several files were often searched before the document was found. The basic problems of this large filing system were the misfilings, lost documents, and limitations on the types of searches that could be performed.

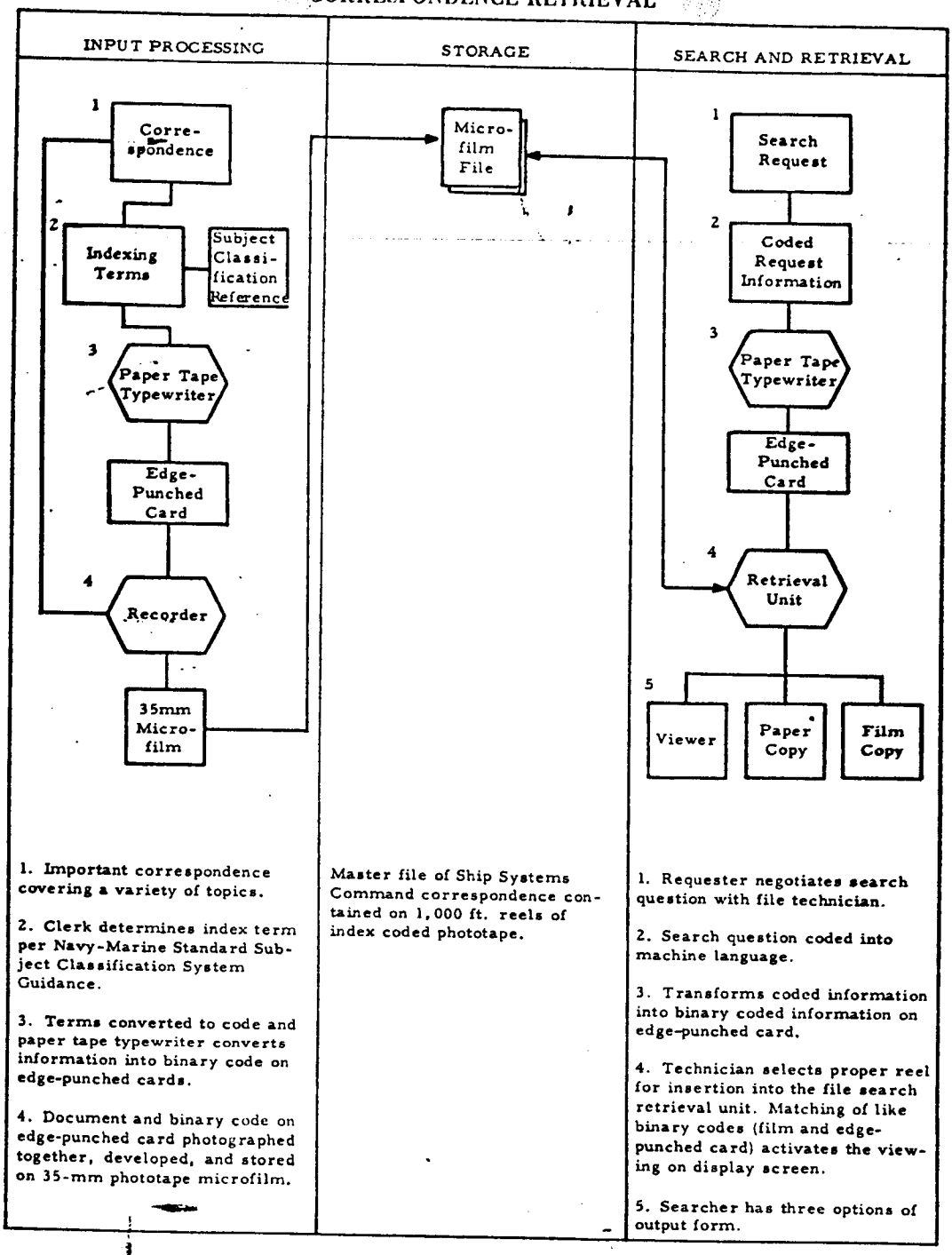
THE NEW METHOD. Incoming documents selected for entry into the File-Search System are first indexed by file station personnel in accordance with an amplified Navy-Marine Corps Standard Subject Classification System. This guidance material permits the documents to be indexed by such identifiers as date, name, addressee, addressor, contract number, type of ship, an a wide range of subject topics. Once the various indexing terms have been determined, a code clerk enters the pertinent indexing information in coded form onto a code sheet. This information is then converted through use of a paper tape typewriter into a machine-language binary code on an edge-punched card. The holes on the edge-punched card thus represent the same data as shown on the coded sheet. The edge-punched card, together with the document it describes, are then placed upon the recording table of a special microfilm camera, and the coded index card is inserted into a slot on the control panel. The insertion of the card automatically triggers a camera recording device that simultaneously produces a photographic image of the binary-coded index data and the document. After development, the resultant roll of microfilm contains both the document and the photo-optical binary-coded index data. The information concerning documents and related index codes is stored on 1,000-foot reels of 35-mm. microfilm that hold 33,000 image pages each.

The processing of requests begins with receipt and "negotiation" of the search question. Once the search question is framed the processing procedures parallel those of the input sequence. First, the search question is coded in machine language. Then, through use of the paper tape typewriter, the resultant edge-punched card is ready for insertion into the File-Search Retrieval Unit. Next, the appropriate reel of coded microfilm is inserted into the Retrieval Unit. Then, with the proper placement of the edge-notched card, the Retrieval Unit will search automatically for documents answering the coded input infor-

mation. Once the match is found, the machine will stop automatically at the selected document image. At this point, three options are available to the requester: he can read the document directly as it is displayed on the viewing screen; he can obtain a hard copy of the image; or he can obtain a film copy of the selected frame through use of an auxiliary copy camera attachment.

REMARKS: This new Correspondence Retrieval System has improved both the breadth and responsiveness of the file search. The system also includes a capability for computer-like manipulation of information due to the programed circuitry of the File-Search Retrieval Unit. Additionally, the file structure may be expanded or modified to meet changing patterns of requests.

CORRESPONDENCE RETRIEVAL



NAME OF SYSTEM:

Failure Rate Data Dissemination (FARADA)

ORIGINATOR:

Fleet Missile Systems Analysis and Evaluation Group

Naval Ordnance System Command

Corona Naval Weapons Center

Corona, California 91720

OBJECTIVE. To operate a technical information storage and dissemination system that will assist in improving the reliability of military hardware.

BACKGROUND. The Naval Ordnance Systems Command, acting for the Naval Material Command, is responsible for material support aspects, including the production of hardware for the entire range of military and space equipment. A specific duty relating to these responsibilities is the monitoring of the reliability engineering aspects in these many space systems.

For many years, hardware reliability reporting was handled on a decentralized basis by various Navy Bureaus. As a natural outgrowth of emerging improvements in methods for gathering, processing, and transmitting information, the Navy several years ago assigned this responsibility to the Data Management Division of the Fleet Missile Systems Analysis and Evaluation Group. Since then the FARADA system has become so meaningful that the Army, the Air Force, and the National Aeronautical and Space Administration (NASA) have been cosponsoring and funding the program.

THE NEW METHOD. The FARADA system collects and disseminates information on the failure rate and failure mode of the various materials manufactured for military and space use. The report breaks down the material into such categories as part, component, module, and assembly. The source data handled within the system emanates from the operational users throughout the military service and NASA. Guidance information for participants includes appropriate forms covering each category of part or mode failure.

Completed forms showing failure rate data are forwarded on a scheduled basis to the Data Management Division, where data is converted to machine language and stored on magnetic tape for processing on a UNIVAC computer. Every 90 days an updated report is produced and sent to users.

The system collection of data comprises one FARADA *Standard Operating Procedure* handbook and five *Failure Rate Data* handbooks. The latter contains more than 38,000 line entries of tabulated failure rate data and 2,000 line entries of failure mode data. Information tables are also kept current on 400 different failure stress curves. Background information is also maintained that describes the more specific aspects of the data displayed, such as location, use, quantities, type of maintenance, and failure criteria. The present growth rate of published and distributed data is about 20 percent per year.

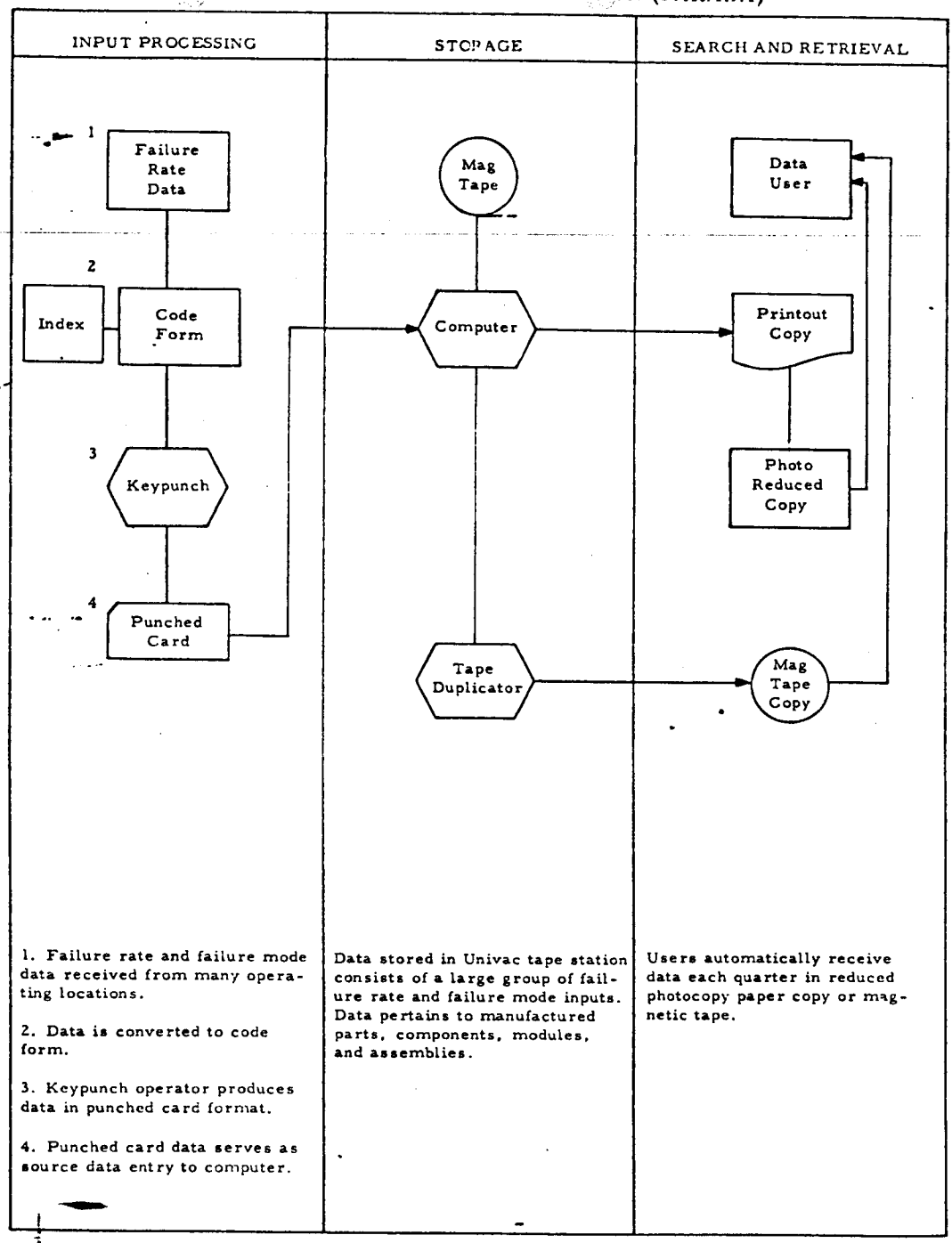
The system's output consists of photo-reduced handbook pages derived from computer printout and systems background information pages for insertion into the set of five handbook binders. In addition to paper output format, the entire tabulated data output is available to program participants in the form of computer tapes.

The primary users of the FARADA Program are approximately 250 prime and major subcontractors engaged in either military or NASA efforts. In addition, about 80 Government activities and 15 educational institutions participate in the program as secondary users. The information and data is used by design engineers and reliability engineers in making reliability predictions. Surveys show that 99 percent of the primary participants use the FARADA data in the intended or designed manner.

REMARKS. The compu[illegible] with its large memory capacity and its data manipulating ability, is used to good advantage in the FARADA System. The output data needs only to be reduced in size before transmission to the hundreds of users. The ability to provide selected users with magnetic tape copies of data reports eli[illegible]ates multicopy packaging and the problem of slow mail delivery.

The computer's capabilities greatly aid in improving the reliability of operating systems and equipment, improving logistics planning, and reducing technical data research time.

FAILURE RATE DATA DISSEMINATION (FARADA)



1. Failure rate and failure mode data received from many operating locations.

2. Data is converted to code form.

3. Keypunch operator produces data in punched card format.

4. Punched card data serves as source data entry to computer.

Data stored in Univac tape station consists of a large group of failure rate and failure mode inputs. Data pertains to manufactured parts, components, modules, and assemblies.

Users automatically receive data each quarter in reduced photocopy paper copy or magnetic tape.

NAME OF SYSTEM:

Miniaturized Navy Catalog Data

ORIGINATOR:

Naval Supply Systems Command
Department of the Navy
Washington, D.C. 20350

OBJECTIVE. To explore and develop new and improved methods and procedures for use in disseminating Navy catalog data and to reduce costs and increase the effectiveness of this supply management function.

BACKGROUND. Since 1949, the Navy has disseminated descriptive and management data in the form of printed publications. These publications are distributed to military personnel (requisitioners) located in all parts of the world, as well as to forces afloat, and provide the information needed to effectively manage logistics tasks. Currently, there are 15 separate classes of catalog publications distributed in time cycles ranging from monthly to annually. To illustrate the magnitude of this endeavor, for fiscal year 1971 it is estimated that the printing budget for catalog data alone will total about $1.3 million.

Because of the rising printing and other costs and anticipated increases in the size and number of publications to be managed, the Navy conducted a comprehensive study of the problem. As a result, an in-depth test was conducted to evaluate the feasibility of miniaturizing the catalog data. It was found that most users of the data would prefer a microform system for information storage and dissemination. Accordingly, the Navy has initiated a long-range program that eventually should convert most of the present printed paper catalog publications to microform. As a first step, the Navy has established a microfiche system for designation of selected descriptive management data.

THE NEW METHOD. Among the several catalog classes selected for the initial conversion to microform format is the Navy Management Data List (NMDL). It comprises about 10,000 pages contained in 20 volumes, each about 1-inch thick. About 8,000 NMDL catalog sets are produced. Updating of the NMDL in the past was accomplished by the periodic publication of cumulative bimonthly change bulletins and page revisions, both of which required extensive manual maintenance. When the volume of cumulative changes totaled about 25 percent of the original catalog, or when two years had elapsed, a new updated addition would be printed. Thus, the many changes made it necessary for a searcher to frequently make a double look-up.

The transformation of the NMDL catalog information to microfilm is a relatively simple task under present computer capabilities. Since catalog data is already maintained on magnetic tape, the tape acts as conversion input to the COM (computer output microfilm) microfilm recorder. The COM recorder changes binary-coded information on magnetic tape to readable page images on 16-mm. roll microfilm. The film is cut into strips, and through a series of photographic processing steps, is transformed into a negative microfiche master. The National Microfilm Association (NMA) microfiche format is used. Each microfiche contains 100 page images of catalog information. A microfiche duplicator produces sufficient microfiche copies for distribution to participating ships and stations and shore stations of the Naval Material Command.

The search routine consists of finding the Federal Stock Number (FSN) pertaining to a known NMDL number, which identifies a particular supply item. The searcher first scans the full-size index tabs labeling the approximately 100 microfiche to identify those within the numerical range. Selected microfiche are positioned in the glass carrier of the reader and viewed on the display screen. A scan of the NMDL listings reveals the matching FSN needed to fulfill the search requirement.

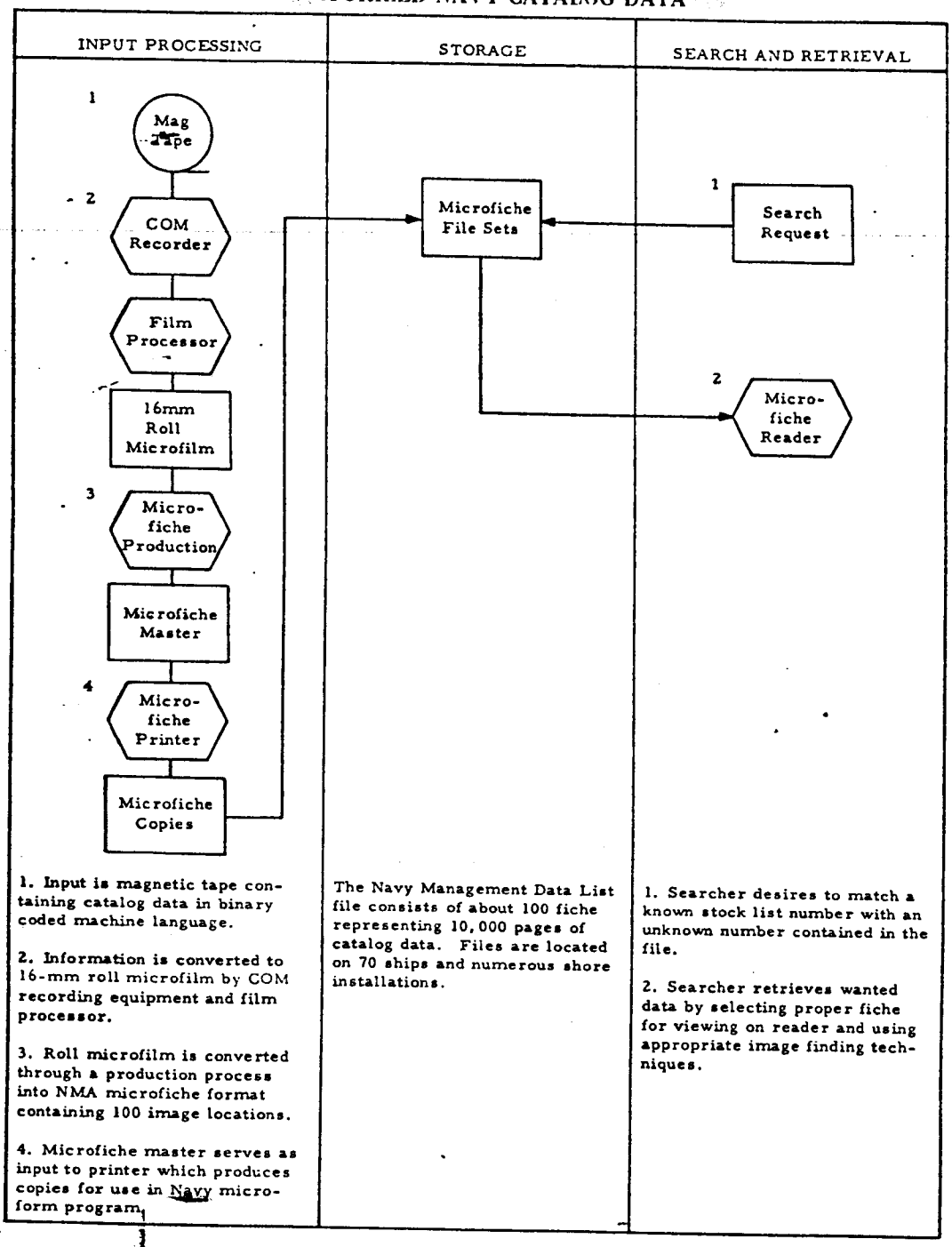
REMARKS. Because the COM microfilm recorder eliminates the computer output bot-

tleneck, it also results in a major cost savings. Recent studies in the data processing service industry have shown that reductions as high as 40 percent in monthly service costs can be realized by using COM in place of computer printout.

Catalog data in microform can be produced in a much shorter time span, and the material is distributed quickly by airmail or first-class mail, whereas bulky catalogs by necessity are usually transported by parcel post. This transmission feature thus narrows the gap between the information accumulation cut-off date and the users receipt of the data.

From the standpoint of user acceptance of this microform system, a comprehensive field test and analysis conducted by the Naval Ship Systems Command showed that over 90 percent of 200 users preferred microform over standard hard copy catalogs for searching.

MI ATURIZED NAVY CATALOG DATA



NAME OF SYST

Public Works Drawings Retrieval

ORIGINATOR:

Public Works Department
Puget Sound Naval Shipyard
Department of the Navy
Bremerton, Washington 98314

OBJECTIVE. To design and operate a document storage and retrieval system that will insure the integrity of the original information and still permit fast access and normal use of the stored information.

BACKGROUND. The Public Works Department of the Puget Sound Naval Shipyard is responsible for the activities associated with changes and modification of buildings, structures, and utilities located on the installation. In support of these matters, the Design Division of the Public Works Department prepares the necessary engineering drawings and insures their safekeeping.

The engineering documents for the smaller shipyard construction requirements are prepared in-house, while those pertinent to larger construction activities are developed either by higher Navy levels or by commercial contract. Developed drawings come under the control and custodianship of the Design Division. Because these large and detailed drawings are often used at some distance from their storage site and are frequently subjected to hard usage at work locations, a better method for control and use of the drawings was needed. An aperture card system was adopted as the best way for preserving the integrity of drawing information.

THE NEW METHOD. The collection of about 53,000 engineering drawings identifies specific elements or features of the shipyard facilities. The reference system is based on local classification features. The main categories include such data elements as assigned facility number, originator's branch code, physical location, and type of work to be performed.

The in[illegible]l conversion to the standard aperture card format began with the sorting of the engineering drawings into compatible sizes for more effective productivity during the microfilming and image inserting process. The reference information was then placed on a log sheet that governed subsequent processing actions. A copy of the log sheet was used as a basis for data input to the aperture card and assured proper matching of card and microfilm image during the image mounting process.

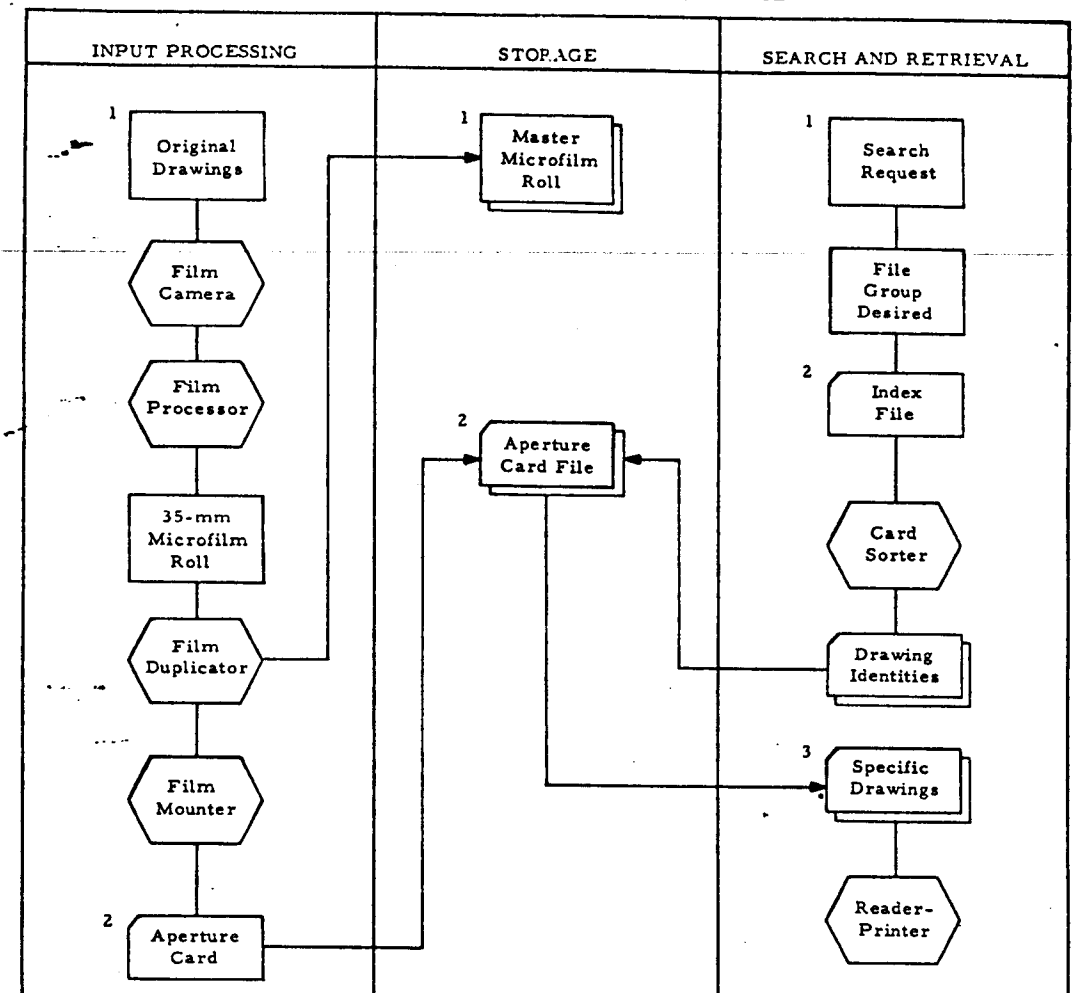
New engineering drawings now entering the system are assigned a facility group or category by the originator, based on the structure's name or identity number. Selected identifying data is keypunched into the punched cards and interpreted (printed) across the top of the card. When more than one facility is involved in a work project, duplicate locator cards are prepared for cross-indexing purposes. These duplicate cards, which do not contain film images, are maintained for machine processing purposes and are commonly referred to as "slave decks." They are filed primarily by facility or group category, followed by the organizational branch to which the facility is assigned.

Engineering drawings are photographed on 35-mm. negative roll microfilm. A microfilm roll duplicate copy is produced for aperture card purposes, and the original microfilm is retained for archival purposes. The aperture cards are filed by drawing number in the Design Division.

Searches for drawings originate primarily within the Division and are handled by an assigned engineering technician. Searching is accomplished by machine sorting of the locator "slave deck" cards and facility grouping. The first sort run will isolate the designated subclass, and where volume warrants additional runs may be made to facilitate the numerical identity of the desired drawings. The appropriate aperture card reproductions of the original tracings are then retrieved from the aperture card file. Users can read the information or produce enlarged paper copies by using the aperture card reader-printer.

REMARKS. This syste atisfies the Design Division's objectives of assuring file integrity, and, additionally, the master roll is always available to recreate the original drawing in appropriate size should the aperture card become lost. e system's mechanical sorting capability improves the search process by quickly identifying desired drawings and reducing the possibility that any pertinent drawings are overlooked.

PUBLIC WORKS DRAWINGS RETRIEVAL



1. Original engineering drawings are converted to aperture card format through a sequence of filming, film processing, film duplicating, and film cutting.

2. Image frames are mounted on index coded aperture cards.

1. Master microfilm roll retained for security and archival purposes.

2. The Design Division's aperture card file contains about 53,000 drawings, with 4,000 additions annually. File is structured numerically by drawing identification.

1. Search requests are usually initiated by division personnel desiring drawings within a specific facility group.

2. Machine sort isolates specific drawing identities.

3. Appropriate aperture cards are withdrawn from file. Users select either paper copy or visual display for satisfying search need.

NAME OF SYSTEM:

Allotment Disbursement Record

ORIGINATOR:

Air Force Accounting and Finance Center

Department of the Air Force

3800 York Street,

Denver, Colorado 80205

OBJECTIVE. To establish an improved off-line system for storing, maintaining, searching and retrieving personnel pay and disbursement data.

BACKGROUND. The Air Force Accounting and Finance Center provides technical supervision, advice, and guidance to the accounting and finance functional elements of the Air Force and performs centralized accounting and allotment disbursement functions. In the allotment disbursement activity, more than $1 billion is paid out annually in connection with 14.5 million individual pay transactions. As an example of the enormity of this operation, in 1968 it took 1.8 million pages of 14 x 11 inch special computer printout paper to record payment data. These listings were subsequently decollated and bound in volumes holding 500 pages, with a yearly total of 3,500 volumes.

Inquiries pertaining to allotment matters are received from within the Government as well as by the principals involved. The allotment inquiries are generally concerned with nonreceipt, incorrect amount, wrong name, or loss. An evaluation of the time spent in fulfilling a search request revealed an average of about 2.5 minutes per search, with about 300 Center personnel having access to the voucher records. In the case of many daily telephone inquiries, only 44 percent of the calls could be answered without a followup call.

With the introduction of a second-generation computer system to handle a variety of automated finance systems, not including the check disbursement function, a problem arose relative to the voucher record printouts from the computer. The problem mainly concerned the need to convert digital data quickly and economically into readable form that would be compatible with the computer's other capabilities. The evaluation of various options recommended that a COM (computer output to microfilm) system was the best answer.

THE NEW METHOD. Magnetic tape reels containing the allotment disbursement information are placed on a magnetic tape drive and the data is fed directly into an S. D. 4400 Document Recorder. Through an internal computerized program this equipment converts the magnetic tape impulses into readable characters that are recorded on 16-mm. microfilm. This conversion is performed at the rate of 62,500 characters a second which is equivalent to four computer printout pages of information. The microfilm, after developing, is used to make several negative duplicate copies for use in the Central Inquiry Office. The original copy, after proper treatment, becomes the archival master copy of the allotment disbursement activity. The working copies of microfilm are then cut into 100-foot lengths, placed in the FILMAC 400 system's film cartridges, and taken to the Central Inquiry Office files.

The Inquiry Office operation may be compared to the operation of a data bank. The office contains three sets of microfilmed disbursement records that are housed in rotary, vertical containers. Each of the three search stations is manned by three to four inquiry clerks and contains one file set and two FILMAC 400 reader-printers, plus three or four telephone outlets. The files contain the current three months data, which is updated monthly. Individual cartridges hold about 2,000 pages of information, with 50 individual records per film image. Thus, each cartridge may hold as many as 100,000 records.

All records are arranged numerically by the last two digits of an individual's Social Security number. Cartridges are positioned within the container to visibly show its range of record numbers. The image finding is

performed by the odometer method. Each searcher, having knowledge of both the cartridge's range of numbers and the number and name being searched, is able to estimate the linear position of the record within a few frames. The system is relatively simple and allows most searches to be completed within 15 seconds.

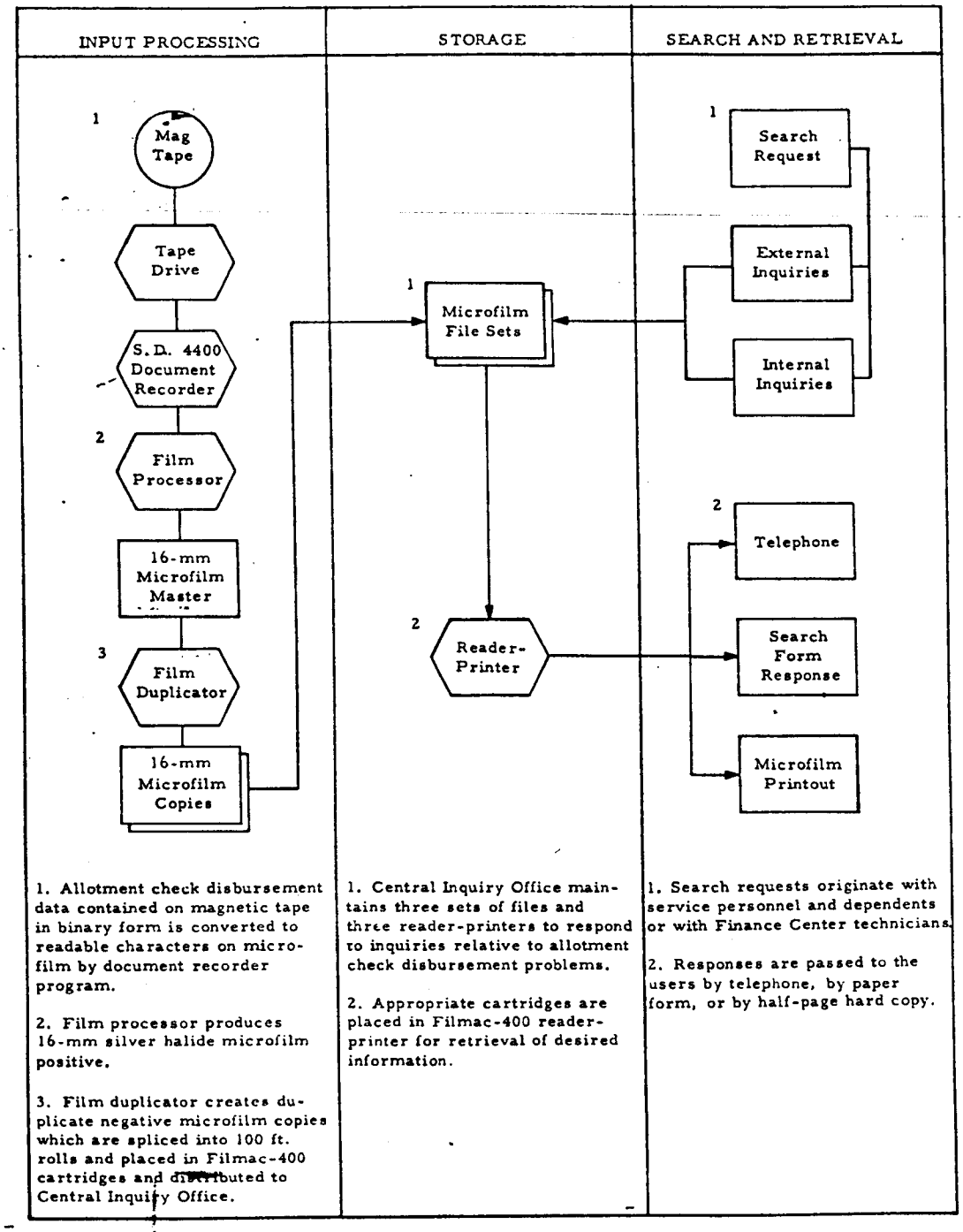
Search actions are generated from external as well as internal sources. The external requests are received by letter or by telephone. All incoming phone calls at the Finance Center's main switchboard are immediately referred to one of the open lines to the Inquiry Office. About 5,000 such calls are received each month. Internal search requests are received via a search request form and are usually acted upon in a matter of minutes.

Once a record is located and placed on the reader-printer, the searcher has three methods of responding to the requester. If requested by phone, the response may be read directly from the reader screen; if requested internally, the answer may be transcribed on a search request form; and if requested by letter, either a form answer or a "half page" hard copy printout of the record may be mailed to the researcher. The hard copy feature of the [illegible]nter is the most practical since the record requested is only one of 50 contained on each film frame. Usually, all of the search actions can be handled at the search clerk's normal work location.

REMARKS. The principal advantage of this system over the former search methods, in terms of the Accounting and Finance Center's mission, is the much faster response to service member inquiries. Additionally, the following benefits have also accrued as a result of adopting this COM technique:

1. Because of the much faster computer output resulting from this new system, about 500 additional computer hours are now available annually for other applications.
2. Since the system's inception, requirements for more than one million sets of multiple-part, tab paper have been eliminated.
3. The present storage space for active and inactive disbursement records amounts to 1,944 cubic feet. Once the microfilm system completely eliminates the paper records, the space reduction ratio will be 50 to 1.

ALLOTMENT DISBURSEMENT RECORD



NAME OF SYSTEM:

Legal Information Through Electronics (LITE)

ORIGINATOR:

Air Force Accounting and Finance Center

3800 York Street,

Denver, Colorado 80205

OBJECTIVE. To permit rapid yet exhaustive searching and retrieval of information contained in the Comptroller General Decisions and other large collections of legal and administrative documents.

BACKGROUND. The office of the Staff Judge Advocate, Air Force Accounting and Finance Center, Denver, Colorado, first proposed the development of Project LITE as early as 1961. The attorneys at the Denver agency had become aware of certain breakthroughs in automatic indexing and machine searching and believed such techniques would help solve their growing, legal precedent search problems.

Until the LITE system became fully operational in 1964, searches of legal precedent material, such as Comptroller General Decisions and the U.S. Code, were conducted manually. The searches took place at numerous locations throughout the Air Force financial community and involved a duplication of effort. Also, to compound the problem, the body of law and regulatory material was expanding at a rather alarming rate. It was thus obvious to those charged with researching material that emerging new computer capabilities should be investigated with a view toward developing a supplementary, automated data or fact retrieval system.

The system became operational in 1964 after several years of concept development. It included the latest in automated indexing and machine information retrieval techniques. The system is designed to assist procurement officers, attorneys, and other interested users in finding relevant precedent material upon which to bas .dministrative and legal decisions.

THE NEW METHOD. In simplest terms, the search and retrieval processes operate on the information stored in two files within a SPECTRA 70/45 computer, the text file and the vocabulary file. To develop the text file, each word from a document is transcribed to a machine-language mode, such as punched cards or paper tape. This is in turn converted and stored on computer magnetic tape.

With the text file stored on tape, the computer is then used to develop the vocabulary file. This file is basically a concordance or dictionary of all the text file words, with the exception of a standard list of 112 common words. The elimination of these common words from the dictionary reduces the volume of stored controlled text words by about 45 percent. By way of a programed process, each text word within the computer is assigned a text location code. As a result, each word, sentence, paragraph, and document is assigned a serial number.

Users of the system are generally given a short research indoctrination course covering the techniques of problem identification and search framing. The first phase concentrates more on the selection of search words and phrases, while the latter phase is more concerned with the mechanical functions of search. Once competent in using the System, the user has a choice of three output formats: a document citation to include the book volume, page number, scope line, and an abstract reflecting the question; a full page printout of the subject matter requested; or a Key-Word-In-Context (KWIC) printout reflecting the key or prime words appearing in the search request. Users normally submit their inquiries by mail, but they may make their requests by telephone or teletype when necessary.

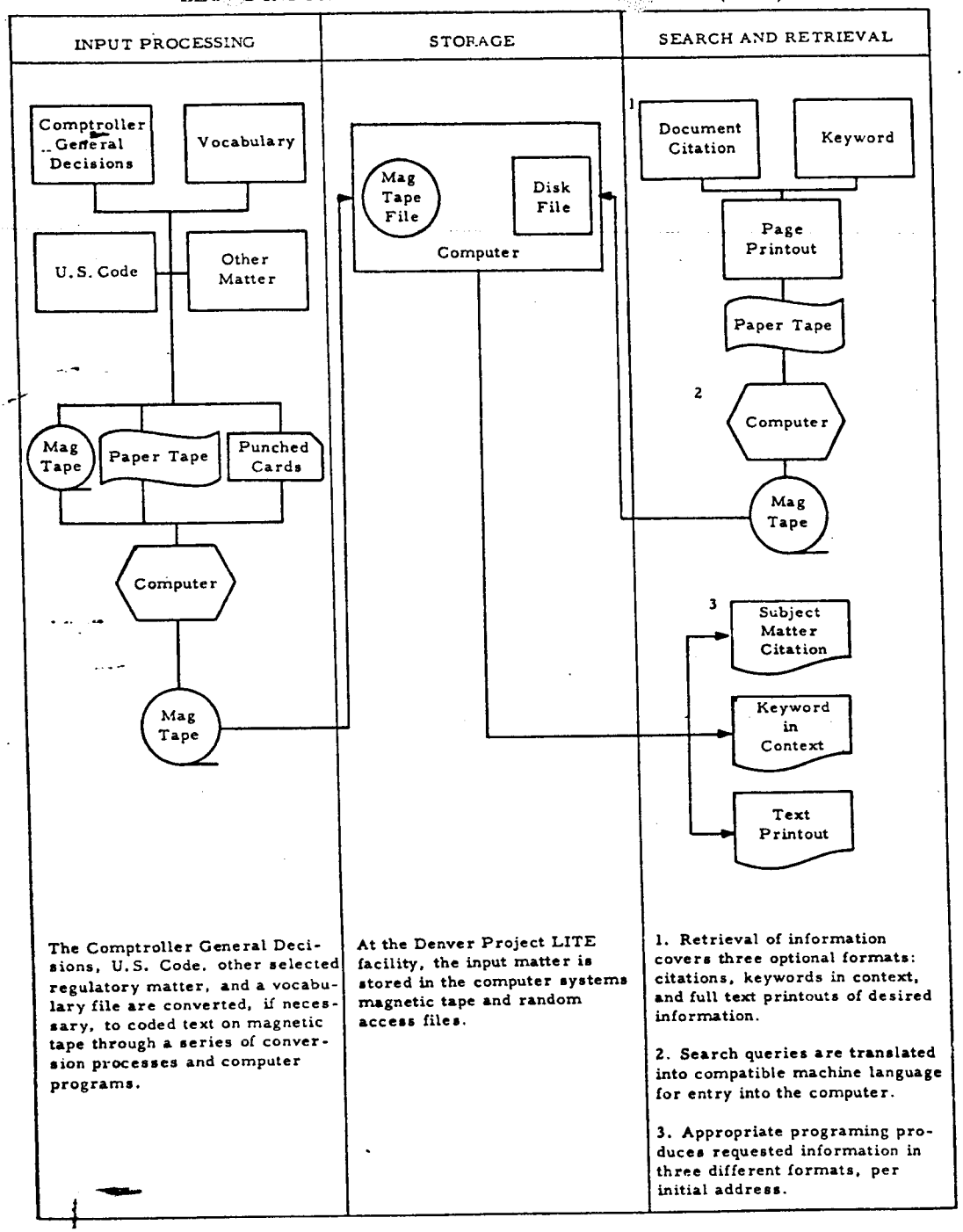
REMARKS. The data bank of the LITE System at Denver is currently categorized into four groups of information—*Statutes* (U.S. Code and Appropriation Acts); *Decisions* (Published Decisions of the Comptroller

General); *Regulations* (Armed Forces Procurement Regulations (ASPR) and Department of Defense Comptroller Directives and Instructions); and *Other,* which includes a wide variety of such documents as the Department of Defense International Law Agreements.

The system offers a wide range of flexibility in search strategy and is limited only by the imagination and ingenuity of those who use it. The initial costs of concept development and text vocabulary files conversion are often higher than costs of other data or fact retrieval processes. However, future costs for retrieval systems of this type should be greatly reduced by the knowledge and expertise acquired through the LITE System experience, by the availability of LITE computer programs for use by others, and by the future use of lower cost input methods, particularly optical character recognition. Further, as more and more installations such as the Comptroller General's Office use computerized composition techniques for preparation of their documents, the magnetic tape created for that purpose can also be used as the input for an automatic indexing and retrieval system.

It is therefore predictable that systems like LITE will play a steadily increasing role in solving the information retrieval problems of the future.

LEGAL INFORMATION THROUGH ELECTRONICS (LITE)



The Comptroller General Decisions, U.S. Code, other selected regulatory matter, and a vocabulary file are converted, if necessary, to coded text on magnetic tape through a series of conversion processes and computer programs.

At the Denver Project LITE facility, the input matter is stored in the computer systems magnetic tape and random access files.

1. Retrieval of information covers three optional formats: citations, keywords in context, and full text printouts of desired information.

2. Search queries are translated into compatible machine language for entry into the computer.

3. Appropriate programing produces requested information in three different formats, per initial address.

NAME OF SYSTEM:

Microform Personnel Record

ORIGINATOR:

Air Force Personnel Center
Department of the Air Force
Randolph Air Force Base,
Texas 28148

OBJECTIVE. To develop, test, and operate a more compact and efficient military personnel records system to meet the current and future demands for greater mobility, faster retrieval, improved controls, and reduction in maintenance costs.

BACKGROUND. The maintenance of the mass of documents required as source data in the Department's Master Personnel Records has become an increasingly serious problem since the Air Force was established as a separate military service.

The mobility of personnel and the need to move records from one file custodian to another and from one location to another have complicated the task of personnel records administration. Centralization of the Master Personnel Records activity has been an objective for many years. Since 1964, a series of long-range studies and analyses has been underway to develop system concepts, design, and hardware requirements. The concepts and basic requirements for a microform system have been completed, and the first stage of a long-range, two-stage program is now undergoing service tests at Randolph Air Force Base, Tex.

THE NEW METHOD. The overall system will eventually contain about 22 million microfiche images of paper records of active Air Force members. Images are appropriately indexed and stored in an image storage retrieval subsystem, with image recall based on automatic random-access techniques. User access to the file is by two-part query display terminals located throughout the Military Personnel Center.

The basic input for documents enter the system through 16-mm. planetary microfilm camera stations. Documents are photographed in a prescribed order on silver halide microfilm and processed by a commercial microfilm service company. The film roll goes to a production and titling station which, through a series of processes, produces silver halide COSATI (Committee on Scientific and Technical Information) quality master microfiche. Human-readable title data is added at the top of the microfiche by one of several processes. The master microfiche serves as input to a Kalvar microfiche printer where duplicate Kalvar microfiche are produced. The Kalvar duplicates are placed in the working file for use in servicing daily search requests.

The working file is housed in the computerized image storage and retrieval subsystem, which provides random access to designated images. This subsystem, at the direction of the searcher, also transports the desired images to TV cameras, hard-copy printers, or microfiche duplicating printers.

Index entries to the system may be produced in one of two ways. When documents are of a particular standard size they are scanned by an optical character reader (OCR) that records specific data fields on the document. Where documents do not meet size requirements the index entries are typed on bond paper for entry into the optical character reader. The OCR inputs of raw index data are converted to magnetic tape in the same serial order as the corresponding image frames on the roll film. The converted index data is then routed to the computer subsystem for processing and storing until needed to identify appropriate microfiche images.

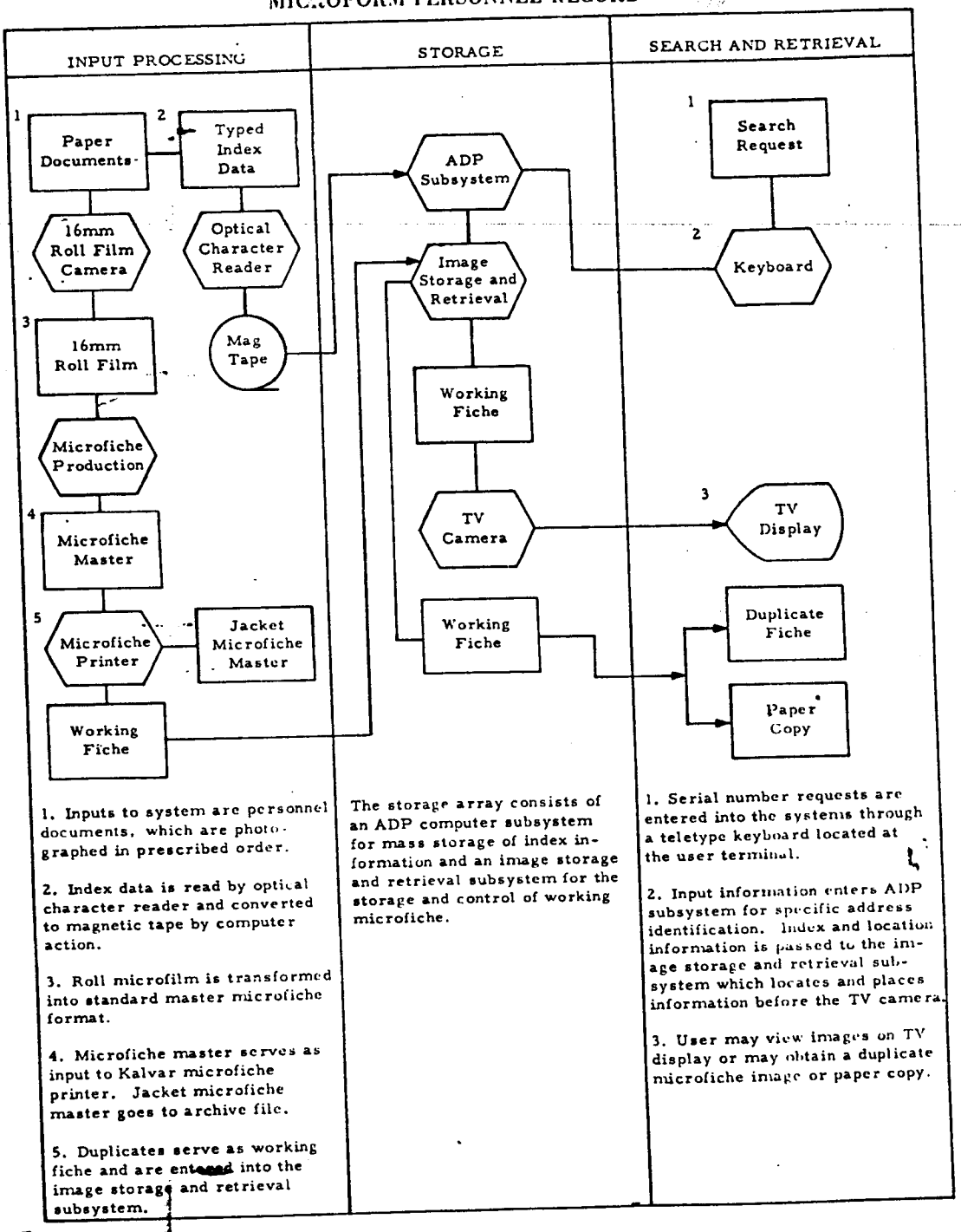
Retrieval of information from the storage file is accomplished through use of teletype keyboards located in user work areas. A user requests a record image microfiche by typing out the serial number of the individual and the subject matter index code in a formalized sequence. The keyboarded message is instantaneously translated by a computer that actuates the image storage and retrieval subsystem to retrieve and position the desired

images in front o[illegible] output port of the retrieval system. Assuming that the query results in an image to be displayed, a TV camera scans the image at the output port and transmits the image through the buffer to the TV monitor display location. Each display has an associated keyboard that controls the image selection from the buffer, in addition to display characteristics such as focus and contrast. Should the user desire a hard copy or duplicate microfiche, the image storage and retrieval subsystem routes the microfiche to a different output port where the images are reproduced by an electrostatic printer or where a duplicate microfiche is produced. The copies are then routed to the information user.

REMARK[illegible] This new microform personnel record system utilizes the latest advancements in computer and microform technology to a significant degree. While the system is most costly, the economic and morale benefits should more than pay for the developmental and initial procurement costs within a few years.

The system will greatly reduce the inherent delay in the completion of personnel actions. For example, it should yield valuable benefits in more detailed and responsive management of the individual member; consolidation of personnel records; increased file integrity; and significant reduction in the unit cost of personnel management transactions.

MICROFORM PERSONNEL RECORD



1. Inputs to system are personnel documents, which are photographed in prescribed order.

2. Index data is read by optical character reader and converted to magnetic tape by computer action.

3. Roll microfilm is transformed into standard master microfiche format.

4. Microfiche master serves as input to Kalvar microfiche printer. Jacket microfiche master goes to archive file.

5. Duplicates serve as working fiche and are entered into the image storage and retrieval subsystem.

The storage array consists of an ADP computer subsystem for mass storage of index information and an image storage and retrieval subsystem for the storage and control of working microfiche.

1. Serial number requests are entered into the systems through a teletype keyboard located at the user terminal.

2. Input information enters ADP subsystem for specific address identification. Index and location information is passed to the image storage and retrieval subsystem which locates and places information before the TV camera.

3. User may view images on TV display or may obtain a duplicate microfiche image or paper copy.

NAME OF SYSTEM:

Miniaturized Management Reports Distribution

ORIGINATOR:

Advanced Logistics System Center
Air Force Logistics Command (AFLC)
Wright-Patterson Air Force Base, Ohio 45433

OBJECTIVE. To improve current Command information system processes to allow for reduced cost for producing management information and at the same time to provide users with needed information in a more accessible format.

BACKGROUND. The Air Force Logistics Command (AFLC) provides worldwide logistics support to all Air Force organizations. These responsibilities include such complex and vitally sensitive activities as the procurement and maintenance of aircraft and related support systems and the movement and control of supporting material. In addition to the headquarters, five subordinate installations called Air Material Areas are responsible for performing the necessary activities in support of the overall mission. In the management of these multibillion dollar programs, AFLC for many years has been one of the larger users of automated information processing equipment and techniques. During this period, the Command has also been a leader in the exploration and use of appropriate technological advances.

As both the scope and number of computer-based management reports increased over the years, two output problems have become increasingly apparent. One has to do with the growing imbalance between actual machine processing speed and the rate of impact printer output in the form of master copy printout. The other concern involves the enormous increase in the volume of printed reports—over 32 million original pages were produced during the past year. An interim solution to the processing versus printout imbalance has been to employ IBM 1401 computer systems to relieve other computers—principally the IBM 7080—of massive print workloads. The bank of 1401 computers print output information based on magnetic tape input at the rate of 600 lines per minute on an around-the-clock schedule.

THE NEW METHOD. The new microfilm display system should become operational during fiscal year 1971, with similar equipment and procedures being used at each of the six locations. The new system will record output from the AFLC's computer processing equipment directly onto 16-mm. microfilm by means of COM (computer output microfilm) equipment. Peripheral equipment to support the new concept will be used for film processing, film duplicating, and for viewing the microfilm output.

Specifically, magnetic print tape will be the input to the off-line microfilm recorder. It will convert and record data information to human-readable images on 16-mm. microfilm, within the range of 7 to 15 thousand lines per minute. This conversion performance is in contrast to the current hard copy recording capability of 600 lines per minute. The film processor, normally working in direct line with the recorder, fixes the exposed film for permanent use. The first off-line process will entail the duplicating of the master microfilm copy in copies sufficient for distribution to the groups of users. After these duplicates are loaded into cartridges they will be forwarded to the several file stations where either readers or reader-printer equipment will be available for screen viewing or for the making of paper copies.

REMARKS. The system's cost over a five-year projection should annually average 14.2 percent less than current costs for labor, supplies, mailings, and both data processing and nondata processing equipment.

An analysis of paper information display versus microfilm image display revealed that the microfilm costs should range from 13 to 20 percent less than paper costs for the same number of information copies.