ESD-TR-66-673

ELECTRONIC SYSTEMS DIVISION

AIR FORCE ADP EXPERIENCE HANDBOOK (PILOT VERSION)

December 1966

TACTICAL PLANNING DIVISION
DIRECTORATE OF PLANNING AND TECHNOLOGY
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

LEGAL NOTICE

OTHER NOTICES

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FOREWORD

This handbook was prepared by the Information Systems Division of Planning Research Corporation, Los Angeles, California, under contract number AF 19(628)-5988, project number 7990. The Air Force Project Officer was Major George H. Montague, Electronic Systems Division, ESLT. Work on the project was performed under the direction of Alan J. Gradwohl, PRC Project Manager, from 16 February 1966 to 15 December 1966, with George S. Beckwith in charge of producing this handbook. Other contributors providing significant assistance include the following PRC staff members:

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ABSTRACT

This handbook of Air Force automatic data processing experience is a pilot version of one to be produced in the next phase of the project. The ADP experience data was collected by interview on 18 Air Force ADP systems; the handbook produced during the next phase of the project will be updated from experience periodically reported to Headquarters, USAF, from some 200 ADP systems. The purpose of the pilot version is to acquaint Air Force personnel with the concept of using highly organized, summarized, and retrievable ADP experience in judging proposals for new automation. The pilot version of the handbook contains data collected after the fact from only 18 ADP systems, and hence the handbook has limited usefulness for actual evaluation of ADPS proposals. It does, however, contain cost estimation equations and narrative experience that will be useful until the 200 system handbook can be produced in Phase III.

Experience relevant to a proposed ADPS is retrieved from the handbook via information extracted from the proposal. The extracted information consists of quantitative workload descriptors of the proposed ADPS (e.g., number of input data fields and number of output formats) and certain qualitative descriptors (e.g., centralized or decentralized operations and presence or absence of direct access storage). The quantitative workload descriptors are used with cost estimation iso-graphs in the handbook to predict costs, so that proposed cost factors (e.g., man-months of development effort and dollars per month of hardware cost for application production) may be compared with Air Force experience. Both quantitative and qualitative descriptors are used to retrieve relevant information from the 18 system descriptions found in the handbook. The retrieved experience will be used to check consistency and to uncover potential problems of the proposed ADPS that may be encountered during system development and operation.

A primer on the use of this handbook applied to a hypothetical ADPS proposal is published separately as ESD-TR-66-672. A final report covering activities and conclusions of the project is also published separately as ESD-TR-66-671.

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I. USE OF EXPERIENCE HANDBOOK

The Experience Handbook is used to evaluate a proposed ADPS in two major steps. The first step involves the comparison of proposed cost factors such as man-months of development effort with estimated cost factors obtained through use of cost estimation iso-graphs. These iso-graphs are graphical representations of cost estimation equations derived from sampled data on 18 Air Force ADP systems. Subsection I.A. describes the use of these iso-graphs.

The second step for use of the handbook involves reviewing the proposed hardware, software, development plan, file conversion plan, etc., in light of experience gained by the Air Force in the development and operation of 18 ADP systems. The experience information is retrieved from 18 system descriptions through the use of 12 indexes. Subsection I.B. describes the use of these indexes for retrieval of experience information, while subsection I.C. describes the format and content of the experience information in the system descriptions.

A. Cost Estimation

1. Description of Iso-Graphs

Five sets of iso-graphs representing the five cost estimation equations and their respective intervals are available for cost estimation. These sets of iso-graphs are identical in structure and are contained in Section II. Each set is used for determining three expected values for a cost factor. Cost factors that may be estimated are as follows:

Development Cost

- Man-months of development effort

Operations Cost

- Number of program maintenance personnel
- Number of operations personnel
- Dollars per month of hardware cost for application production
- Dollars per month of hardware cost for program maintenance

The workload descriptors from the ADPS proposal are used for determining cost from the iso-graphs. The workload descriptors required for using all five sets of iso-graphs are as follows:

Input Variables

- Characters per month of input volume
- Number of input data fields

Output Variables

- Characters per month of output volume
- Number of output formats

Data Base Variable

- Characters in data base

See Figure 1 for an example of a set of iso-graphs. The set contains three charts, each to be entered in identical fashion. The horizontal scale of the example marks off the number of input data fields, while the vertical scale marks off the number of output formats.

2. Obtaining the Cost Estimates

Follow the procedure of steps a through g to obtain the three values of a cost factor.

a. Find the workload descriptor value for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.

b. Draw a vertical line through all three iso-graphs at the value established in step a.

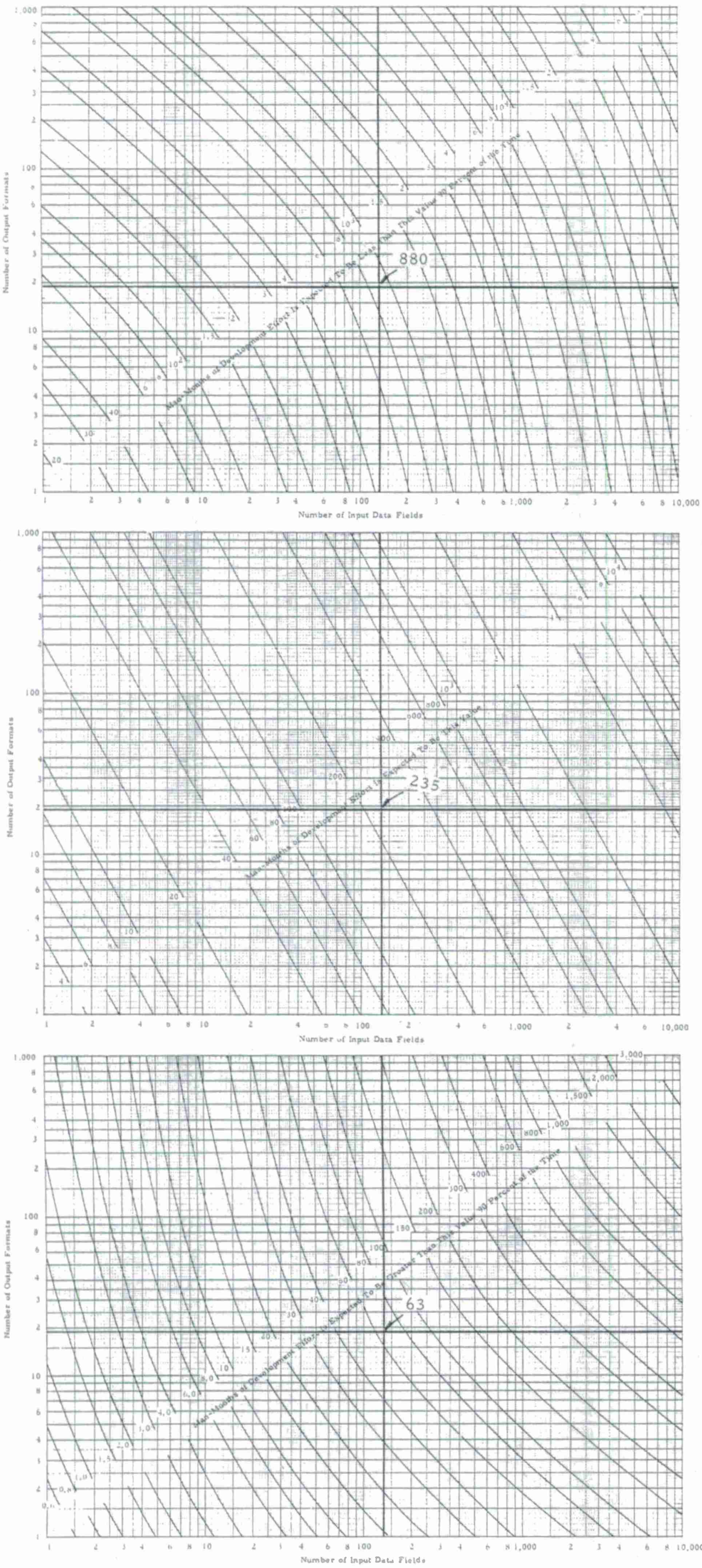
c. Find the workload descriptor value for the proposed ADPS on the vertical scale of each of the three iso-graphs.

d. Draw a horizontal line on all three iso-graphs through the values established in step c.

e. On the top iso-graph, determine the value that the cost estimate is expected to be less than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step b) and horizontal (step d) lines between adjacent iso-lines.

f. On the center iso-graph, determine the value that the cost estimate is expected to be, by logarithmically interpolating the intersection point of the vertical (step b) and horizontal (step d) lines between adjacent iso-lines.

g. On the bottom iso-graph, determine the value that the cost estimate is expected to be greater than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step b) and horizontal (step d) lines between adjacent iso-lines.



Cost Estimating Procedure for Man-Months of Development Effort

1. Find the value of Number of Input Data Fields for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in step 3.
5. On the top iso-graph, determine the value that Man-Months of Development Effort is expected to be less than 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Man-Months of Development Effort is expected to be, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Man-Months of Development Effort is expected to be greater than 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.

FIGURE 1 - COST ESTIMATING ISO-GRAPH FOR MAN-MONTHS OF DEVELOPMENT EFFORT

3. Interpreting the Results

The results taken from the three iso-graphs have the following meaning:

Top Iso-Graph Iso-lines of this chart give the value the estimated cost factor is expected to be less than, 90 percent of the time.

Center Iso-Graph Iso-lines of this chart give the value the cost factor is expected to be (50 percent of the time it will be greater and 50 percent of the time it will be smaller).

Bottom Iso-Graph Iso-lines of this chart give the value the cost factor is expected to be greater than, 90 percent of the time.

4. Using Estimated Costs and Relevant Experience

The proposed costs are compared with estimated costs from the top and bottom iso-graphs to determine whether the proposed costs fall within their respective prediction intervals.[1] If any of the proposed costs are outside their respective prediction intervals, these costs are highly suspect of error and should be carefully examined using relevant experience data retrieved from system descriptions in the handbook. If the proposed costs are within their predicted intervals, relevant experience data are retrieved from the system descriptions to verify the reasonableness of the proposed costs.

B. Retrieval of Relevant Experience

Twelve indexes are available for retrieving information from the 18 system descriptions. The system descriptions appear in Section III and indexes in Section V. Two of the indexes use workload descriptors for retrieval of experience, while the other 10 use other system attributes such as functional area. The 12 indexes do not exhaust all attributes for indexing, but provide convenient tools for retrieving the bulk of experience data in the system descriptions relevant to a proposed system. This section describes the manual procedures for retrieving information relevant to a proposed ADPS using each of the 12 indexes.

1. Development Experience Index

The Development Experience Index uses a Development Experience Index Worksheet (see Section V) in conjunction with a plastic index card. The index card is also used with the Operations Experience Index. Figure 2 illustrates the parts of the index card.

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[1] The prediction intervals for the cost estimation equations in this pilot version of the Experience Handbook are rather wide. These wide intervals are largely due to the small sample size used in development of these equations.

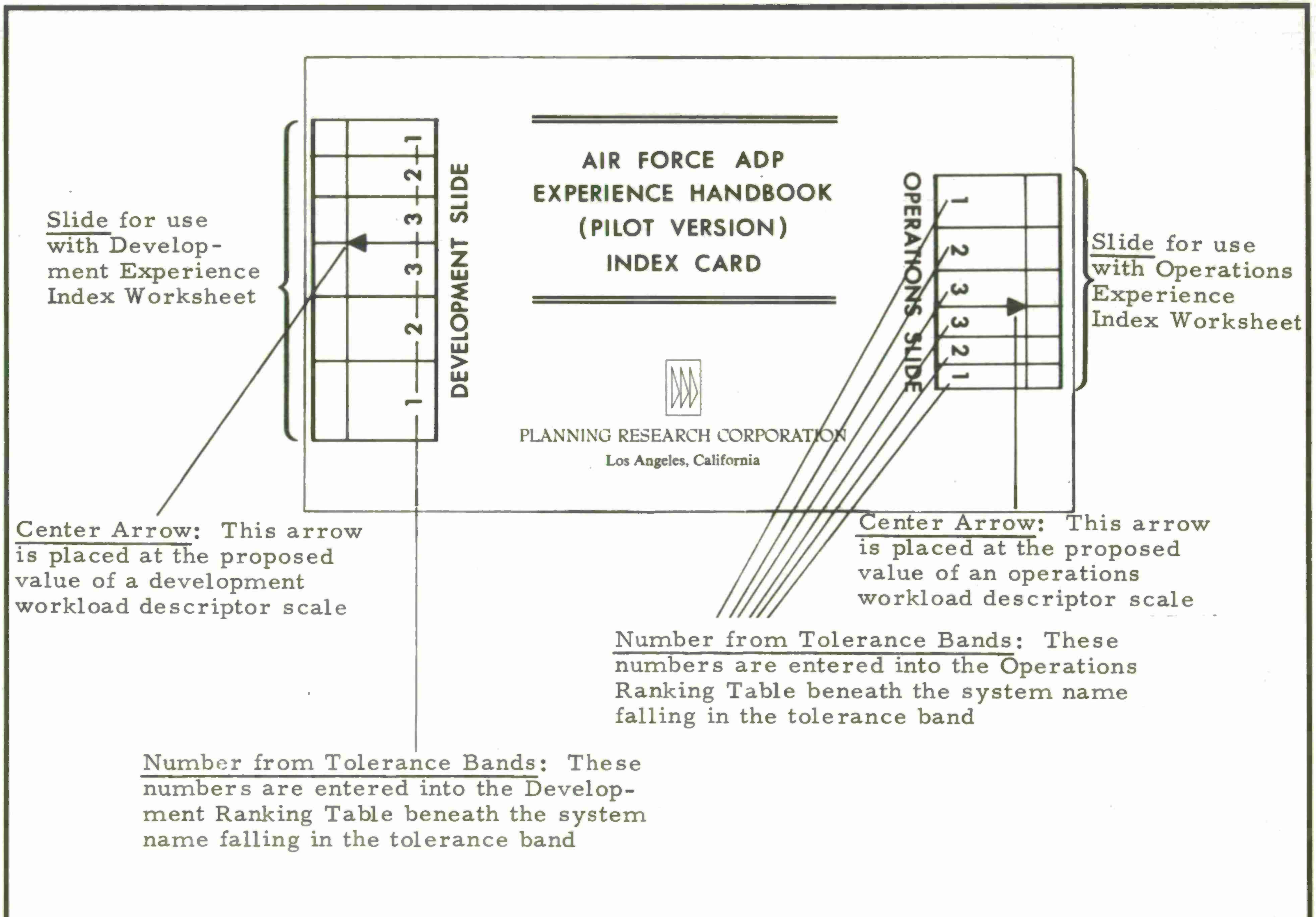


FIGURE 2 - PARTS OF THE INDEX CARD

To determine systems which have relevant development experience, fill out a Development Experience Index Worksheet according to the following procedures (also included on the worksheet):

a. Enter the proposed values for No. of Input Transaction Types, No. of Input Data Fields, No. of Output Formats, and No. of Data Base Record Types in box below the corresponding scale.

b. Remove the index card from the pocket and position the center arrow of the Development Slide at the proposed value on the No. of Input Transaction Types scale.

c. For all systems bounded by the Development Slide, enter the number from the tolerance band in the No. of Input Transaction Types row of the Ranking Table beneath the corresponding system name.

d. Repeat steps b and c for No. of Input Data Fields and No. of Output Formats.

e. Repeat steps b and c for No. of Data Base Record Types if the proposed value is not zero. If the proposed No. of Data Base Record Types is zero, enter the number 3 in the Data Base row of the Ranking Table beneath ADOBE, MISSIM, and ORBIT.

f. Enter the Total Rank in the bottom row of the Ranking Table. Total Rank is computed by adding the numeric entries in each column of the Ranking Table.

g. The system with the largest Total Rank is the most relevant system in developmental aspects to the proposed system. Relevancy of other systems is in order of Total Rank. Systems with Total Rank equal to or greater than 7 are highly relevant to the proposed automation. Systems with Total Rank less than 7 but greater than 3 have less relevance, but may still be used, while developmental experience data from systems with Total Rank less than or equal to 3 should not be used.

2. <u>Operations Experience Index</u>

The Operations Experience Index uses an Operation Experience Index Worksheet (Section V) in conjunction with the same plastic index card used for the Development Experience Index. See Figure 2 for definition of index card parts.

To determine systems that have relevant operations experience, fill out an Operations Experience Index Worksheet according to the following procedures (also included on the worksheet):

a. Enter the proposed values for Char./Mo. of Input Volume, Char./Mo. of Output Volume, and Char. in Data Base in the box below the corresponding scale.

b. Remove the index card from the pocket and position the center arrow of the Operations Slide at the proposed value of the Char./Mo. of Input Volume scale.

c. For all systems bounded by the Operations Slide, enter the number from the tolerance band in the Char./Mo. of Input Volume row of the Ranking Table beneath the corresponding system name.

d. Repeat steps b and c for Char./Mo. of Output Volume.

e. Repeat steps b and c for Char. in Data Base, if the proposed value is not zero. If the proposed Char. in Data Base is zero, enter the number 3 in the Data Base row of the Ranking Table beneath ADOBE, MISSIM, and ORBIT.

f. Enter the Total Rank in the bottom row of the Ranking Table. Total Rank is computed by adding the numeric entries in each column of the Ranking Table.

g. The system with the largest Total Rank is the most relevant system in operational aspects to the proposed system. Relevancy of other systems is in order of Total Rank. Systems with Total Rank equal to or greater than 5 are highly relevant to the proposed system. Systems with Total Rank less than 5 but greater than 2 have less relevance, but may still be used, while operational experience data from systems with Total Rank less than or equal to 2 should not be used.

3. Functional Area Index

The Functional Area Index is used to retrieve systems with the same functional area as the proposed ADPS. All sampled ADP systems fall into one of the following functional areas:

- Operations Supporting
- Research and Development
- Materiel Management
- Personnel Manpower

- Financial and Accounting
- Weather
- Transportation Management
- Miscellaneous

To use this index, find the row of the Functional Area Index Table (Section V) with the same functional area as the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the same functional area.

4. Decentralized Operations Index

Decentralized operations imply that an ADPS has a centralized development with a number of decentralized operations dependent on the centralized development for system maintenance and support as well as delivery of the initial system capability. The Decentralized Operations Index is used to retrieve systems with the number of operational installations in the same range as the number of operational installations of the proposed system. Sampled ADP systems are divided into groups according to the following criteria:

- Single Operational Installations
- From 2 to 7 Operational Installations
- From 8 to 100 Operational Installations
- More than 100 Operational Installations

To use this index, find the row of the Decentralized Operations Index Table (Section V) corresponding to the number of operational installations for the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the number of operational installations in the same range.

5. Multiple Application Index

"Multiple applications" refers to the operation of more than one ADPS at a given computer installation. The Multiple Applications Index is used to retrieve systems with the number of applications on an installation in the same range as the number of applications of the proposed system. Sampled ADP Systems are divided into groups according to the following criteria:

- Single Application at an Installation
- From 2 to 10 Applications at an Installation
- More than 10 Applications at an Installation

To use this index, find the row of the Multiple Application Index Table (Section V) corresponding to the number of applications at an installation for the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the number of applications in the same range.

6. Programming Language Index

Programming languages include procedure-oriented languages, assembly languages, and the lack of any language usage (machine language). The Programming Language Index is used to retrieve systems using the same type of programming language in their development as the proposed ADPS.

To use this index, find the row of the Programming Language Index Table (Section V) with the same programming language specified for the proposed ADPS. An "X" will appear in this row under each sampled ADPS using the same programming language as the proposed system. Since more than one programming language may be used in a system development, the same procedure may be repeated to retrieve systems using all programming languages planned for use in the proposed ADPS.

7. Processing Type Index

The Processing Type Index is used to retrieve systems with the same type of processing control specified for the proposed system. The processing types are defined by the following criteria.

- Real-time data collection
- On-line inquiry processing
- Batched processing under executive control
- Batched processing with no executive control

To use this index, find the row of the Processing Type Index Table (Section V) corresponding to the processing type of the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the same processing type.

8. File Conversion Index

The File Conversion Index is used to retrieve systems with types of file conversion similar to the proposed system. Types of file conversion are defined by the following criteria:

- No file conversion
- Conversion from manual to ADP system
- Conversion from PCAM to ADP system
- Conversion from ADP to ADP system

To use this index, find the row of the File Conversion Index Table (Section V) corresponding to the type of file conversion for the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the same type of file conversion.

9. Direct Access Storage Index

The Direct Access Storage Index is used to retrieve systems with an amount of direct access storage in the same range as the direct access storage for the proposed system. Sampled ADP Systems are divided into groups according to the following criteria:

- o No direct access storage
- o Less than 10 million characters
- o From 10 million to 50 million characters
- o Greater than 50 million characters

To use this index, find the row of the Direct Access Storage Index Table (Section V) corresponding to the amount of direct access storage for the proposed ADPS. An "X" will appear in this row under each sampled ADPS with amount of direct access storage in the same range.

10. Computer Cost Index

This index is used to retrieve systems with computers of approximately the same basic monthly rental cost as the proposed ADPS. If a proposed value for basic monthly rental (for all applications) is available, systems with approximately the same cost may be located by searching for rows with the closest value of basic monthly rental. An "X" will appear under each sampled ADPS with the same value of basic rental cost.

11. Computer Index

The Computer Index is used to retrieve systems using the same computer as the proposed ADPS. In the event that a proposed system does not specify the computer to be used, this index will not be applicable.

To use this index, find the row of the Computer Index Table (Section V) with the proposed computer. An "X" will appear in this row under each sampled ADPS using the same computer. If the proposed ADPS has more than one computer model, such as a base computer and peripheral computer, each computer must be looked up individually in the Computer Index Table. Systems using both the proposed base and the peripheral computers should be used in preference to systems using the base or peripheral computers individually.

12. Security Index

The Security Index is used to retrieve systems with the same security classification as the proposed system. Security classifications may apply to any one or all of the following system aspects:

- o Inputs
- o Data base
- o Output

- o System design and programs
- o Hardware

Sampled ADP systems are divided into four groups according to the following criteria:

- o No aspect of system is classified
- o Some aspect of system is Confidential
- o Some aspect of system is Secret
- o Some aspect of system is Top Secret

To use this index, find the row of the Security Index Table with the highest classification of data to be found in the proposed ADPS. An "X" will appear in this row under each sampled ADPS with the same level of security classification.

C. Evaluation of Relevant Experience

After the names of relevant systems have been determined through indexing, as described in subsection I. B, the next step is to examine the system descriptions for relevant experience information. Table 1 enables one to quickly determine which sections of a system description will contain experience information for a given index. An index may select a large number of systems on a specific attribute, such as the use of COBOL. To reduce the number of systems examined, exclude systems first on the basis of different functional areas and then on the basis of a low ranking of the Development and Operations Experience Indexes. Subsections I. C. 1 through I. C. 21 describe the format and content of sections in the order in which they appear in the system description, and also specify their use in evaluation of experience data.

1. System

This section of a system description identifies the ADPS by its title, the computer designation(s), and the acronym used for reference throughout the handbook. The acronym is repeated at the top of each page of the system description.

2. Data System Designator

This section of a system description identifies the ADPS by the USAF Data Systems Automation Program (DSAP) code.

3. Data Collection Date

This section of a system description identifies the month and year in which the data collection occurred for the ADPS.

4. Location

This section of a system description identifies the office and address to contact for more detailed information on the ADPS. This

TABLE 1 - RELEVANT SYSTEM DESCRIPTION SECTIONS RETRIEVED BY INDEXES

Name of Index \ Sections of System Description	Location	Function	Organization	History	Schedule	Description	Workload	Hardware	Software	Application Program Development	File Conversion	Documentation	Personnel	Operations	Application Program Maintenance	Benefits	Cost Factors	Future Plans
Development Experience			R	R	H	R			R	H	R	R	R		H	R	R	
Operations Experience			R			R		H	R		R	R	R	H		R	R	
Functional Area		H				H				R	R		R		R	R		
Decentralized Operations	H		R	H	H	R		R		H		R	R		H	R	R	
Multiple Application			R						R					H				
Programming Language						R		R	H	H			R		H	R		
Processing Type						H	R	H	H	R				R			R	
File Conversion				R	R		R	R			H						R	
Direct Access Storage						R		H	R	R				R	R			
Computer Cost				R	R		R	H	R					H			R	
Computer				R	R		R	H	R	R	R			H	R		R	
Security			H	R		R		R		R	R	R		H				

Notes: H indicates a highly relevant section.
R indicates a relevant section.

section also identifies the location of development, location of maintenance, location of pilot installation, location of first operational installation, and the number of operational installations.

5. Function

This section of a system description identifies the primary user(s) and briefly describes the AF mission being supported by the ADPS and the functions performed by the system in support of the mission.

6. Organization Chart

This section of a system description identifies the ADPS organizational designator(s), developer(s), user(s), and operator(s) and the relationships between them. Whenever possible, the general organizational framework shown in Figure 3 has been adhered to.

A brief commentary follows the chart, when appropriate, in an attempt to explain special actions taken in organizing the effort and the ramifications of these actions on system development and operation.

7. History

This section of a system description briefly describes any systems related to the ADPS that may have contributed to its development. Proposals and/or directives effecting the system development of the ADPS and significant milestones are identified.

8. Schedule

This section of a system description displays a schedule showing all known proposed and actual dates that may be significant to the development and operation of the ADPS. The schedule identifies the actual development and operational phases of the ADPS.

9. Description

This section of a system description identifies and describes the processing functions performed by the ADPS. The orientation is toward the functional characteristics of the system rather than the data processing characteristics. The section begins with a narrative description of the system, including descriptions of any unusual communication capabilities used to get input to the system and output to the user. The above is accompanied by the system flow chart(s) for the ADPS. The system flow chart(s) contain several or all major processes of the system at a macro level.

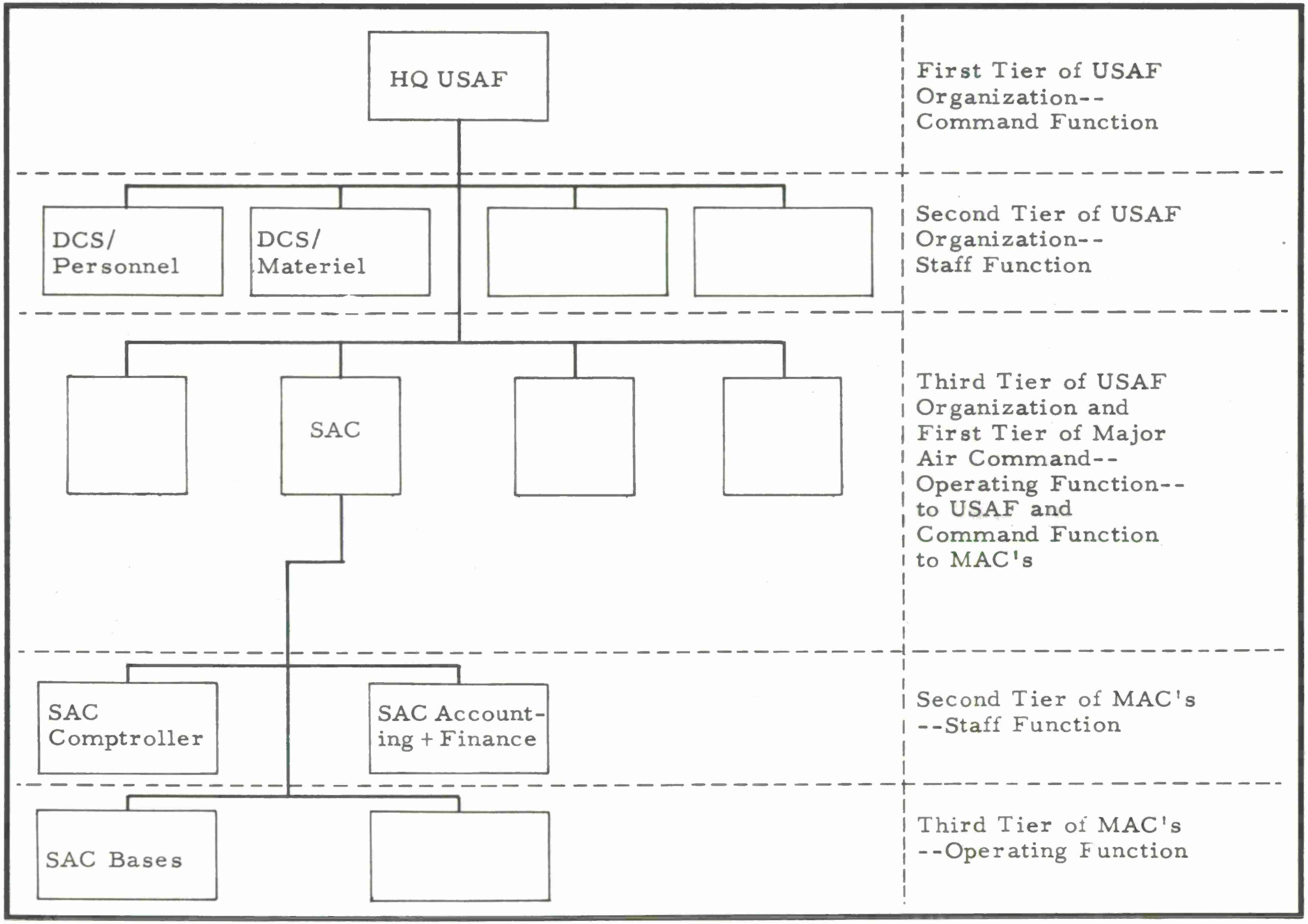


FIGURE 3 - LEVELS OF ORGANIZATION

10. Workload

This section of a system description identifies the magnitude of the ADPS workload through an information flow diagram. The diagram is composed of four major areas: (1) inputs, (2) data base, (3) processing functions, and (4) outputs. These areas are broken down as follows:

a. Inputs

(1) Characters per month of input volume
(2) Number of input transaction types
(3) Number of input data fields
(4) Percent of input rejects

b. Data Base

(1) Characters in data base
(2) Percent of characters on direct access (D/A) storage
(3) Milliseconds of access time for D/A
(4) Number of data base record types
(5) Number of data base records
(6) Percent growth rate per month
(7) Characters per month of update input

c. Processing Functions

(1) A vertical bar graph is used to display the percentage breakdown of source instructions and hours of application production by the following processing categories:

(a) Input edit
(b) File maintenance
(c) Query
(d) Sort
(e) Merge
(f) Compute
(g) Report generation
(h) Control

(2) The following quantities are shown both for the base computer(s) and for the peripheral computer(s):

(a) Source instructions
(b) Object instructions
(c) Hours per month of application production

d. Outputs

(1) Characters per month of output volume
(2) Number of output formats
(3) Response time (seconds), if on-line system

11. Hardware

This section of a system description identifies and describes the hardware used by the ADPS. The section is composed of two major areas: (1) a hardware configuration chart and (2) a hardware specifications table.

a. The configuration chart indicates model numbers and hardware interconnection of components for all computers in the system by charts such as that shown in Figure 4.

b. The specifications table is not a rigid format; it only includes specifications for hardware present in the system. Whenever required, the table includes the following:

(1) Computer model number
(2) First delivery date (month/year)
(3) Word or character machine
(4) Add time (in microseconds)
(5) Internal storage

(a) Effective cycle time (in microseconds)
(b) Word or character size
(c) Storage capacity in words or characters

(6) External storage

(a) Magnetic tapes

- Model number
- Transfer rate

(b) Disk

- Model number
- Transfer rate
- Capacity (in characters)
- Access time (in milliseconds)

(c) Drum

- Model number
- Transfer rate
- Capacity (in characters)
- Access time (in milliseconds)

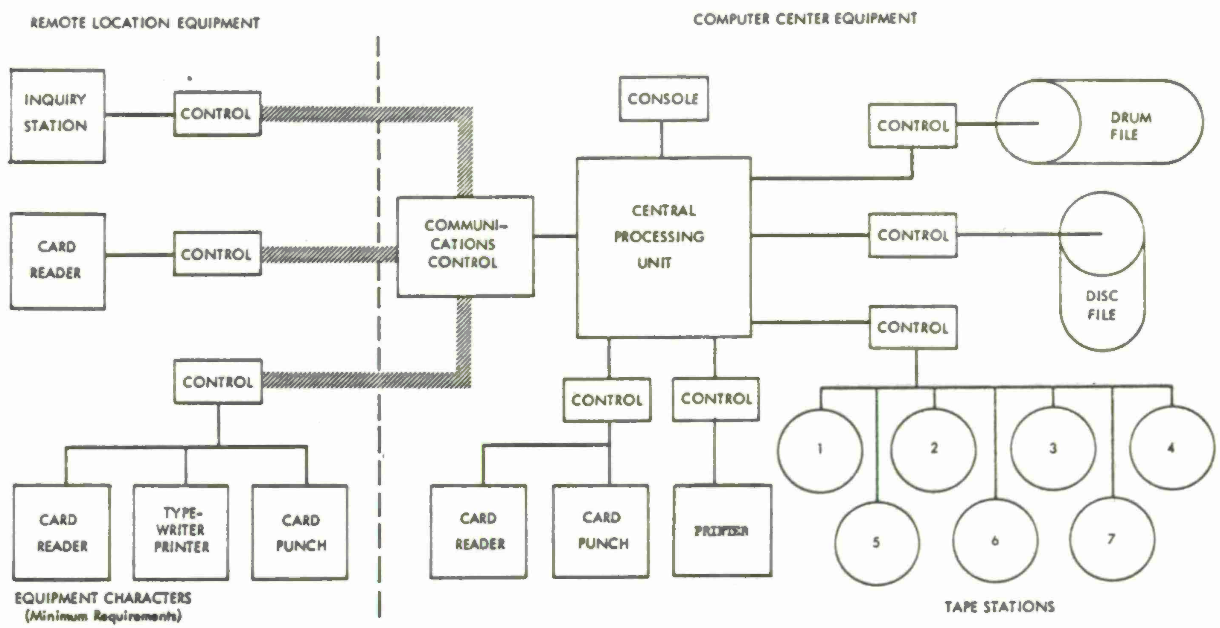


FIGURE 4 - SAMPLE CONFIGURATION

(7) Peripheral devices

(a) Card Reader

- o Model number
- o Speed (in full 80 char. cards per minute)

(b) Card Punch

- o Model number
- o Speed (in full 80 char. cards per minute)

(c) Printer

- o Model number
- o Speed (in lines per minute)

(d) Paper Tape Reader

- o Model number
- o Speed (in characters per second)

(e) Paper Tape Punch

- o Model number
- o Speed (in characters per minute)

(f) Communications

- o Lines in multiplexer
- o Auto-dial
- o Number of consoles attached
- o Class of service

(g) Miscellaneous Devices

A commentary follows to indicate unusual hardware problems, conditions requiring hardware modification, redundancy or backup capability, and characteristics from the chart or table requiring explanation.

12. Software

This section of a system description identifies and describes the support software (i.e., compilers, assemblers, executives, etc.) used as tools in developing and operating the application programs of the ADPS.

A commentary follows, when appropriate, in an attempt to indicate slippages in delivery, problems encountered in software usage, special attributes that significantly assisted development and/or operation, and software maintenance support.

13. Application Program Development

This section of a system description describes the significant activities affecting development of the application programs for the ADPS. Included in the section are descriptions of logic definition, interaction between analysts and programmers, programming techniques, and type and extent of program and system testing.

A commentary follows, when appropriate, in an attempt to describe any conditions existing during the development phase of the ADPS that may have affected the development of the application programs.

14. File Conversion

This section of a system description describes the type and extent of file conversion activities required by the ADPS. Included in the section are descriptions of the format of data prior to conversion, the method of conversion, any special programs required for the conversion, quality control techniques employed in making the conversion, and hours of computer use required for conversion.

15. Documentation

This section of a system description lists all AFM's, AFR's, OI's, etc., documenting the ADPS. Included are descriptions of any other types of documentation and past, present, and future efforts to document the ADPS during development and operation. Comments are made regarding the completeness and usability of documentation when appropriate.

16. Personnel

This section of a system description describes the personnel involved with the ADPS through the use of a personnel table. The table indicates the following for managers, analysts, and programmers of the development phase, and for managers and operators of the operational ADPS:

a. Number of People

(1) Sampled
(2) Allocated to the system

b. Number of Years

(1) In ADP
(2) In functional area
(3) Of college

17. Operations

This section of a system description begins with a brief narrative description of the operation of the ADPS.

Pie chart representations of the computer utilizations are displayed for each different computer used by the ADPS. For multi-installation systems, computer utilization data is taken from one typical installation. The pie charts use the following classifications of time:

a. For the subject ADPS or application

   (1) Production time
   (2) Preparation time
   (3) Program development and maintenance

b. For all other applications

   (1) Production time
   (2) Preparation time
   (3) Program development and maintenance

c. Chargeable lost time (by application if possible)
d. Set Up time
e. Idle time
f. Unscheduled maintenance time
g. Machine error lost time
h. Scheduled maintenance time
i. Off time
j. Other time

Each pie chart uses 730 hours as the total available number of hours per month. This total number is exactly one twelfth of the number of hours in a 365-day year. The actual number of hours used during a 31-day (744-hour) or 30-day (720-hour) month was prorated to the 730-hour standard used in the pie charts.

The operations section ends with a brief commentary, when appropriate, in an attempt to clarify any apparent or hidden reasons for unusual utilization activity or lack of activity displayed in the pie charts. The commentary also notes any other unique operational characteristics of the computer installation as a whole.

18. Application Program Maintenance

This section of a system description describes the effort, techniques, and organization for all maintenance and continuing development activities to application programs after the system was declared operational. Included in the section, when available, are indications of relative efforts for program corrections as opposed to improvements or new development, and what portion of the program maintenance personnel was involved in the original system development.

19. System Benefits

This section of a system description identifies and describes the primary advantages offered by the ADPS. The section is divided into two paragraphs. The first paragraph discusses the proposed benefits on which the system was originally justified. The second paragraph discusses the benefits actually realized by system implementation. Broad categories of benefits that may be mentioned include cost savings, time savings, and new capabilities not available prior to implementation of this ADPS.

20. Cost Factors

This section of a system description displays eight developmental and operational cost factors in individual horizontal bar graphs showing the known proposed and actual values of each cost factor. The cost factors represent the subject ADPS and not the whole ADP installation. Hours/month of hardware use cost factors are all prorated to a standard month of 730 hours. The eight cost factors are defined as follows:

a. Man-Months of Development Effort

This is a developmental cost factor representing the number of man-months expended by manager, analysts, programmers, and operators to develop the ADPS during the development phase beginning with system design and ending when the system is declared operational. During this development phase, activities such as detailed system design, programming, checkout, and equipment installation are accomplished as required.

b. Months of Elapsed Development Time

This is a developmental factor representing the number of calendar months elapsed from the date system design for the ADPS is begun to the date the system is declared operational.

c. Dollars of Hardware Cost for Program Checkout

This is a developmental cost factor representing the hardware cost for computer hours used for program checkout during the development phase of the ADPS.

d. Hours/Month of Hardware Use for Application Production

This is an operational cost factor representing the monthly computer hours on the base computer(s), charged to the user of the ADPS for processing, that are classified as application production.

e. Hours/Month of Hardware Use for Program Maintenance

This is an operational cost factor representing the monthly computer hours used for application program maintenance of the operational ADPS on the base computer(s).

f. Number of Operations Personnel

This is an operational cost factor representing the number of personnel including operators, scheduling personnel, data edit personnel, magnetic tape librarians, report binders, managers, etc., allocated to the ADPS during the operations phase. Operations personnel all perform their functions within, and within the immediate vicinity of, the computer room.

g. Number of Program Maintenance Personnel

This is an operational cost factor representing the number of personnel including managers, analysts, and programmers allocated to perform the process of improving, changing, and correcting programs of the ADPS during the operations phase.

h. Dollars/Month of Hardware Cost

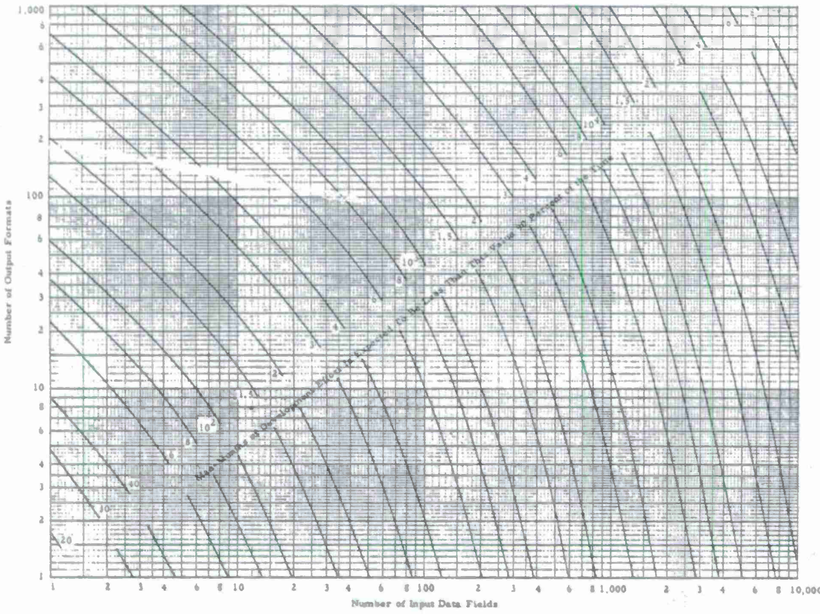
This is an operational cost factor representing the cost of monthly computer hours used for application production and program maintenance on the base computer(s) and peripheral computer(s).

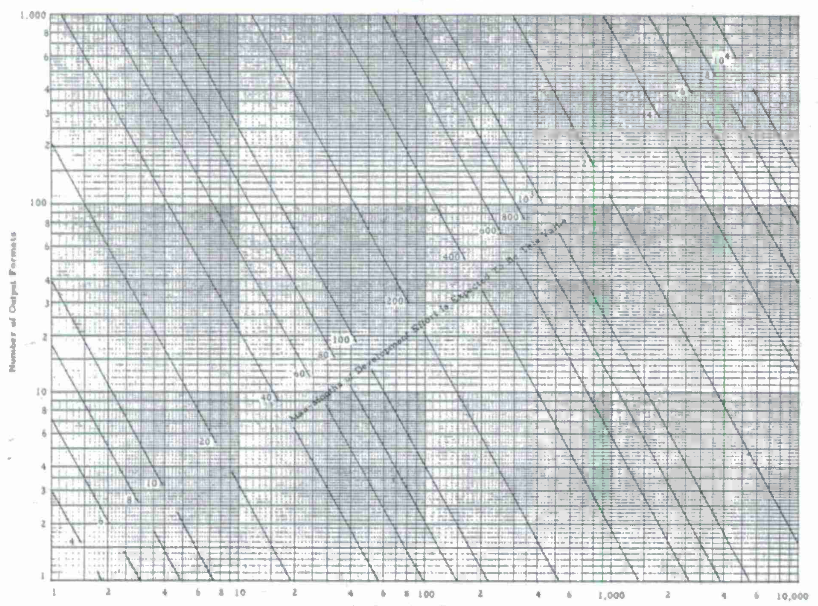
Each horizontal bar graph is followed by commentary to clarify the proposed and actual values of the cost factor and to explain any differences between these values.

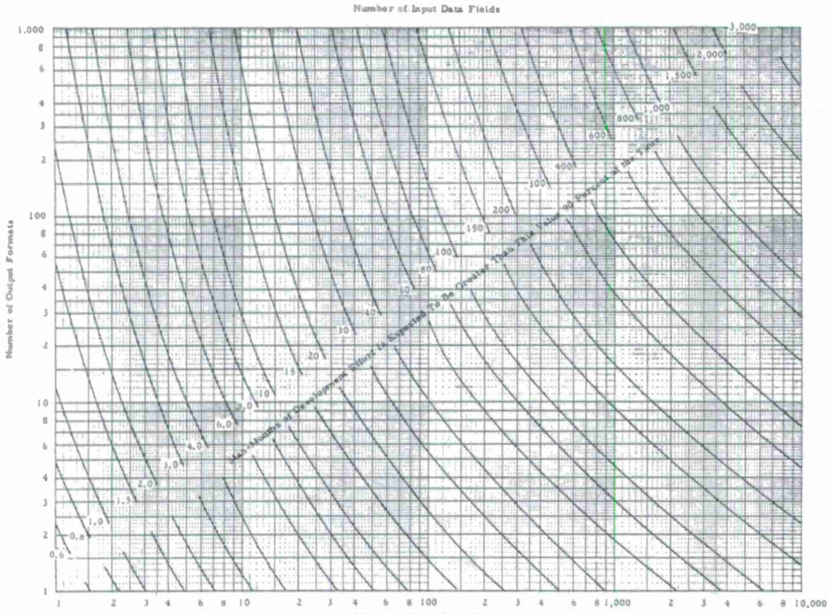
21. Future Plans

This section of a system description briefly describes any currently planned or contemplated changes or additions that may affect the ADPS.

II. COST ESTIMATION



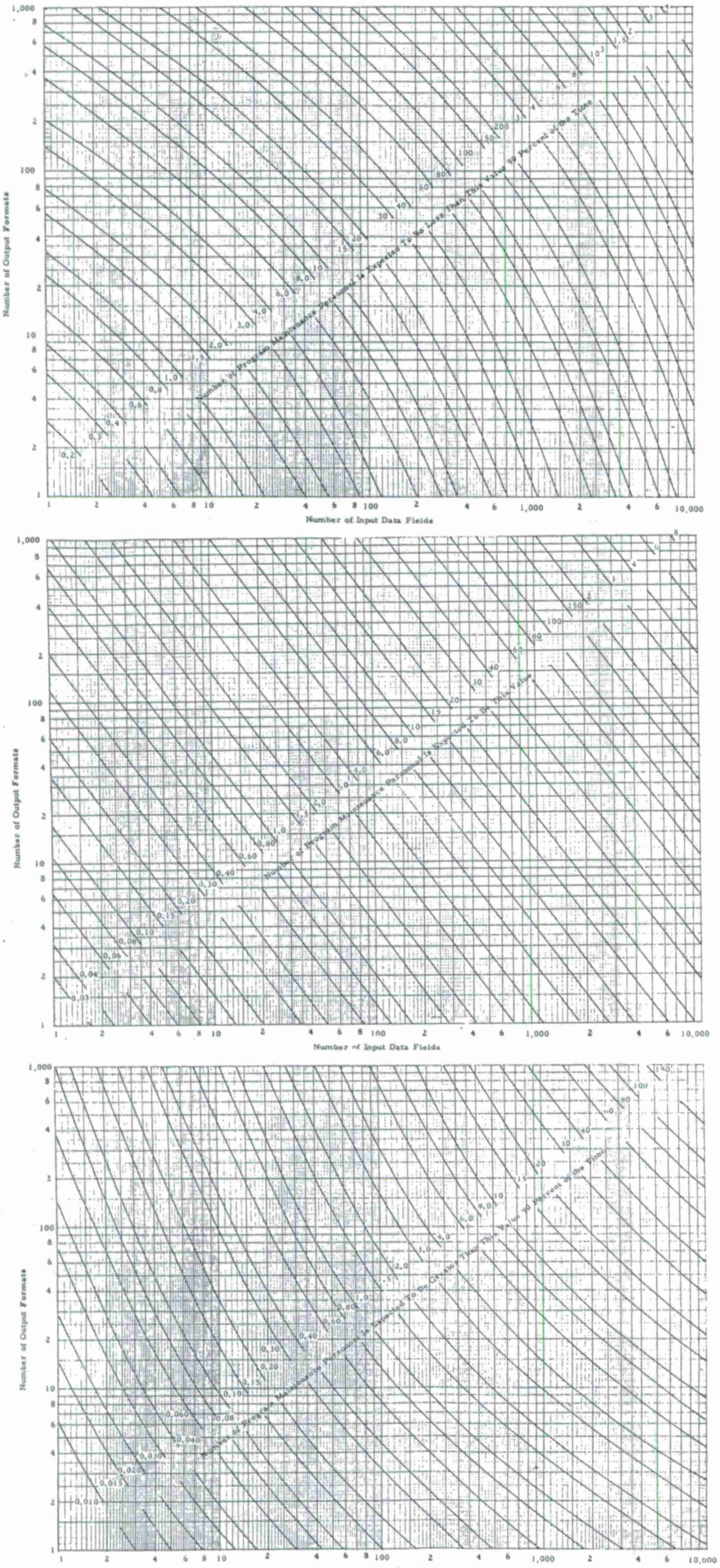




<u>Cost Estimating Procedure for Man-Months of Development Effort</u>

1. Find the value of Number of Input Data Fields for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in step 3.
5. On the top iso-graph, determine the value that Man-Months of Development Effort is expected to be less than 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Man-Months of Development Effort is expected to be, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Man-Months of Development Effort is expected to be greater than 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.

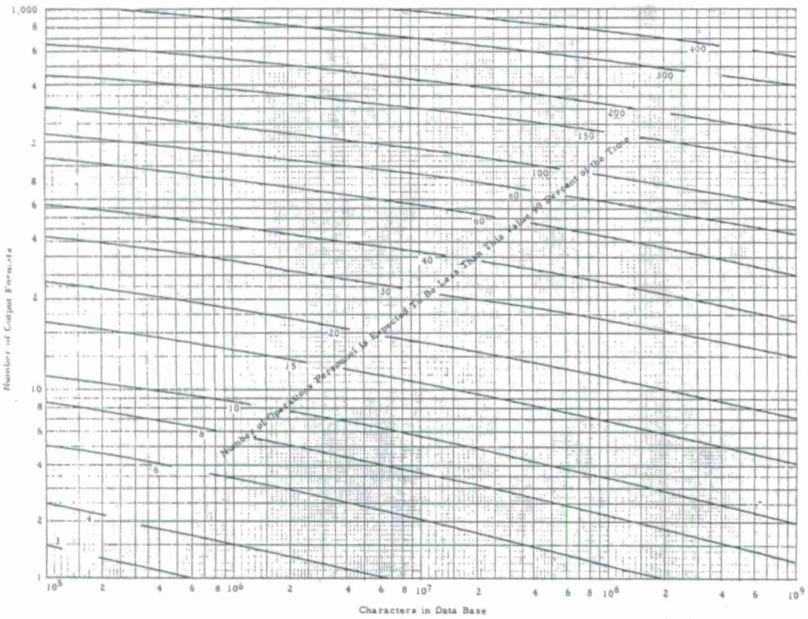
FIGURE 5 - COST ESTIMATING ISO-GRAPH FOR MAN-MONTHS OF DEVELOPMENT EFFORT

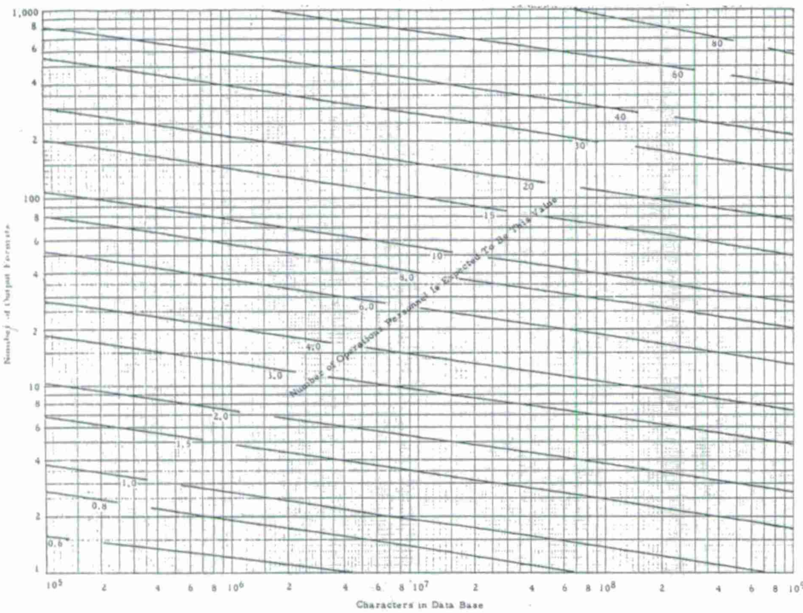


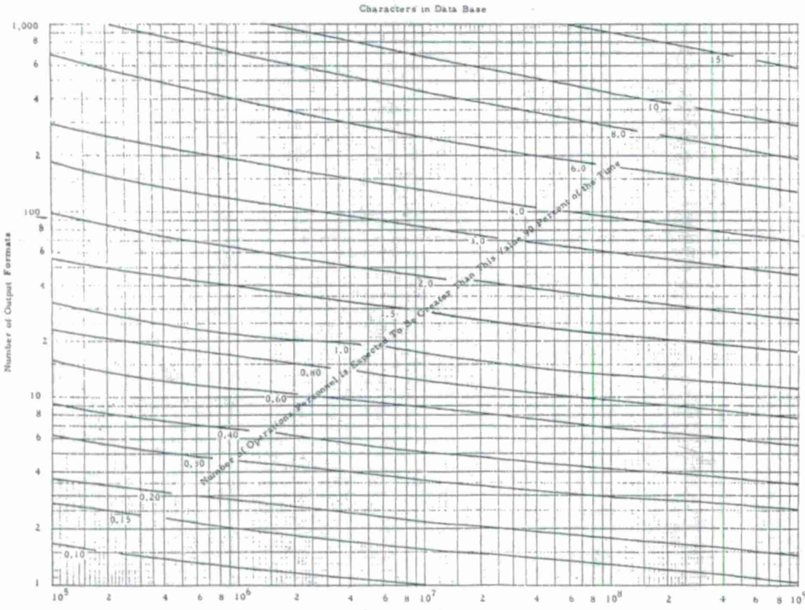
Cost Estimating Procedure for Number of Program Maintenance Personnel

1. Find the value of Number of Input Data Fields for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in Step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in Step 3.
5. On the top iso-graph, determine the value that Number of Program Maintenance Personnel is expected to be less than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (Step 2) and horizontal (Step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Number of Program Maintenance Personnel is expected to be, by logarithmically interpolating the intersection point of the vertical (Step 2) and horizontal (Step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Number of Program Maintenance Personnel is expected to be greater than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (Step 2) and horizontal (Step 4) lines between adjacent iso-lines.

FIGURE 6 - COST ESTIMATING ISO-GRAPHS FOR NUMBER OF PROGRAM MAINTENANCE PERSONNEL



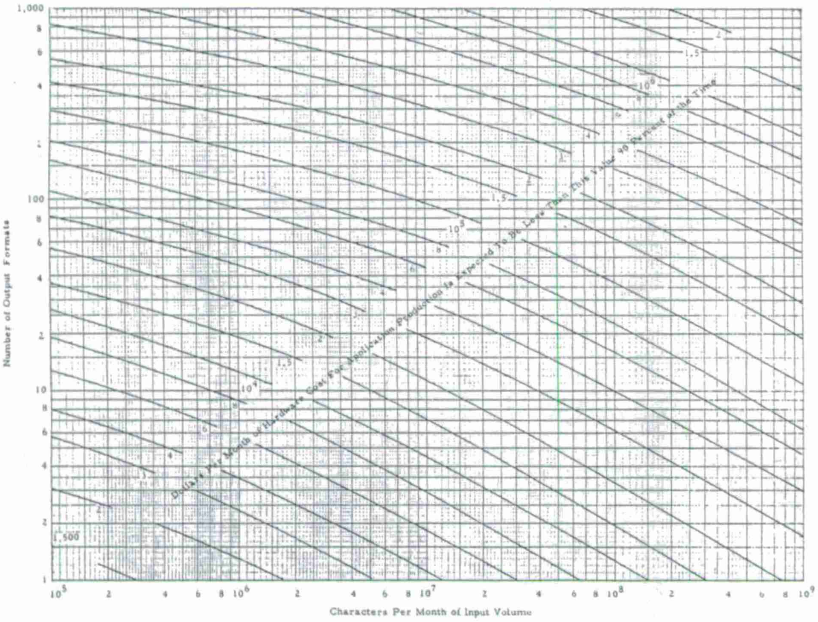


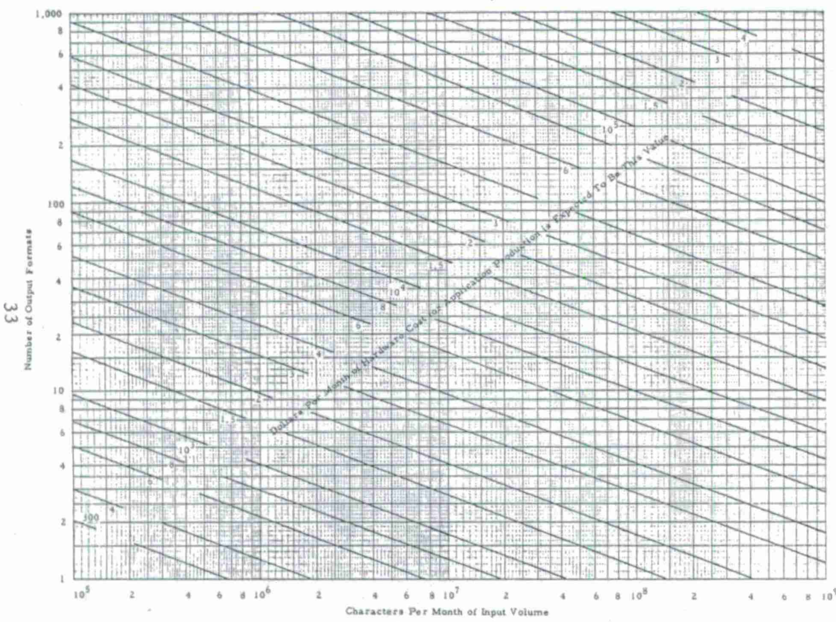


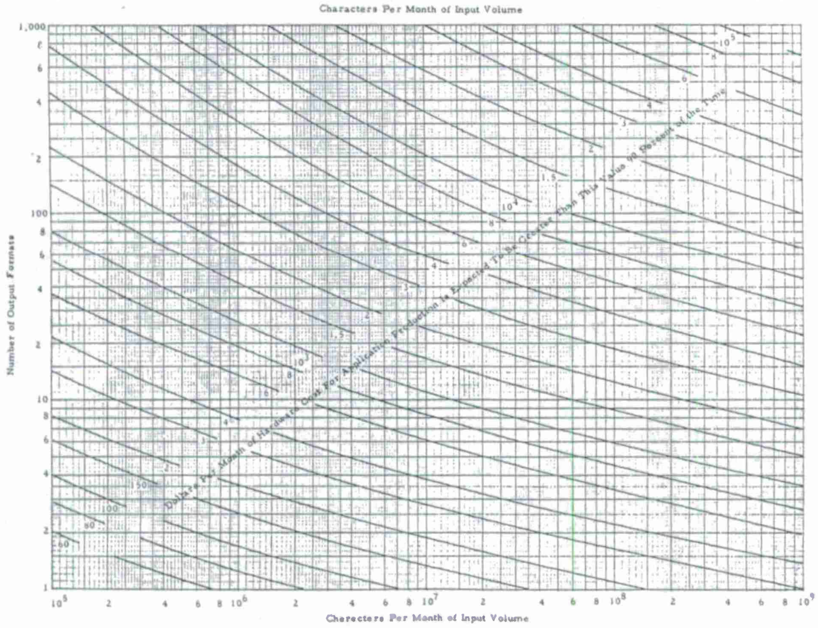
<u>Cost Estimating Procedure for Number of Operations Personnel</u>

1. Find the value of Characters in Data Base for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in step 3.
5. On the top iso-graph, determine the value that Number of Operations Personnel is expected to be less than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Number of Operations Personnel is expected to be, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Number of Operations Personnel is expected to be greater than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.

FIGURE 7 - COST ESTIMATING ISO-GRAPH FOR NUMBER OF OPERATIONS PERSONNEL



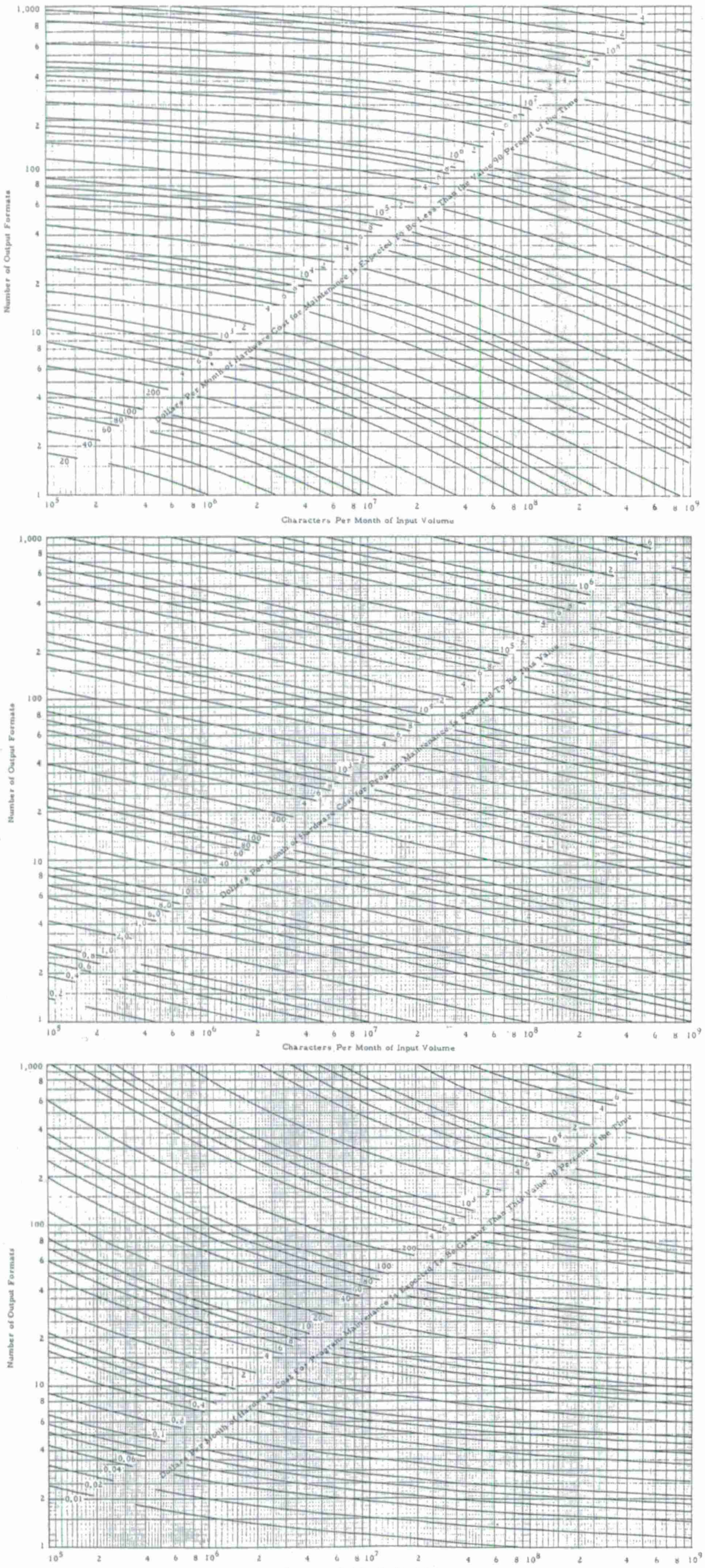




Cost Estimating Procedure for Dollars Per Month of Hardware Cost for Application Production

1. Find the value of Characters Per Month of Input Volume for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in step 3.
5. On the top iso-graph, determine the value that Dollars Per Month of Hardware Cost for Application Production is expected to be less than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Dollars Per Month of Hardware Cost for Application Production is expected to be, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Dollars Per Month of Hardware Cost for Application Production is expected to be greater than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.

FIGURE 8 - COST ESTIMATING ISO-GRAPH FOR DOLLARS PER MONTH OF HARDWARE COST FOR APPLICATION PRODUCTION



Cost Estimating Procedure for Dollars Per Month of Hardware Cost for Program Maintenance

1. Find the value of Characters Per Month of Input Volume for the proposed ADPS on the horizontal scale of any one of the three iso-graphs.
2. Draw a vertical line through all three iso-graphs at the value established in step 1.
3. Find the value of Number of Output Formats for the proposed ADPS on the vertical scale of each of the three iso-graphs.
4. Draw a horizontal line on all three iso-graphs through the values established in step 3.
5. On the top iso-graph, determine the value that Dollars Per Month of Hardware Cost for Program Maintenance is expected to be less than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
6. On the center iso-graph, determine the value that Dollars Per Month of Hardware Cost for Program Maintenance is expected to be, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.
7. On the bottom iso-graph, determine the value that Dollars Per Month of Hardware Cost for Program Maintenance is expected to be greater than, 90 percent of the time, by logarithmically interpolating the intersection point of the vertical (step 2) and horizontal (step 4) lines between adjacent iso-lines.

FIGURE 9 - COST ESTIMATING ISO-GRAPH FOR DOLLARS PER MONTH OF HARDWARE COST FOR PROGRAM MAINTENANCE

III. SYSTEM DESCRIPTIONS

SYSTEM: Project ADOBE Data Reduction--ADOBE (IBM 7040/1401)

DATA SYSTEM DESIGNATOR: B104

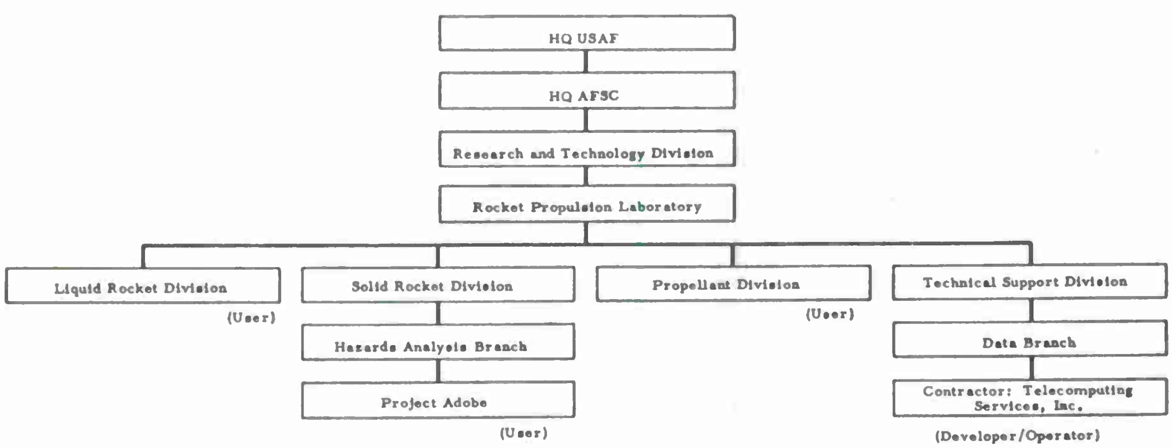
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Air Force Rocket Propulsion Laboratory Edwards Air Force Base Edwards, California
Development	Air Force Rocket Propulsion Laboratory Edwards Air Force Base Edwards, California
Maintenance	Air Force Rocket Propulsion Laboratory Edwards Air Force Base Edwards, California
Pilot Installation	None
First Operational Installation	Air Force Rocket Propulsion Laboratory Edwards Air Force Base Edwards, California
Number of Operational Installations	1

FUNCTION: The users of ADOBE are the Propellant, Liquid Rocket, and Solid Rocket Divisions of the Rocket Propulsion Laboratory. One of the most important missions of these divisions is to test and verify operation of rocket motors by static firing. The exhausts of some of these rocket motors contain hazardous beryllium pollutants. ADOBE functions as a research and development support system to predict the distribution and level of these downwind pollutant concentrations in order to schedule and control rocket firings. ADOBE reduces data recorded in real time at a rocket test site into reports that aid the users in evaluating test results. The data reduction is performed in a non-real-time mode.

ORGANIZATION:



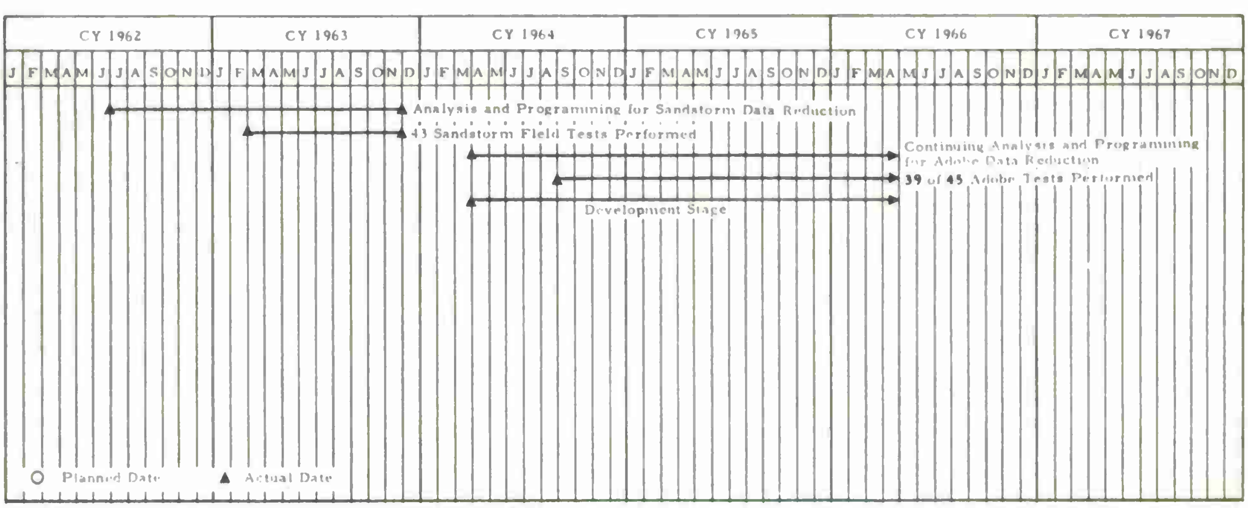
HISTORY: In 1963 the Air Force Rocket Propulsion Laboratory (AFRPL) and Air Force Cambridge Research Laboratories directed Project Sandstorm, a series of 43 field tests to study the diffusion of exhaust clouds from small solid rocket motors containing beryllium. Tests were conducted with grains weighing from 8 to 65 pounds, with their exhausts diffusing over a two-square-mile instrumented course. The data reduction programs originated as a part of Project Sandstorm--the first effort in the beryllium diffusion area for AFRPL. The basic design for the 204' tower wind speed and direction programs was embodied in an IBM 650 program previously developed at AFRCL. It was planned to convert the code directly to the IBM 1401, but this did not prove feasible and the programs were completely rewritten for the IBM 7040. Also in 1963, the original data reduction program for exposure was written.

The test results from Project Sandstorm could not be extrapolated to larger motor sizes of current interest with any degree of confidence. In 1964 Project Adobe began, using 500- to 4000-pound grains that diffuse their exhausts over a 28-square-mile instrumented course. Both previous computer programs were extensively revised, and data reduction programs for temperature differential, 12-foot wind, and cloud tracking were added to the capability. This programming was completed in 1965, with the exception of cloud tracking, which is still continuing.

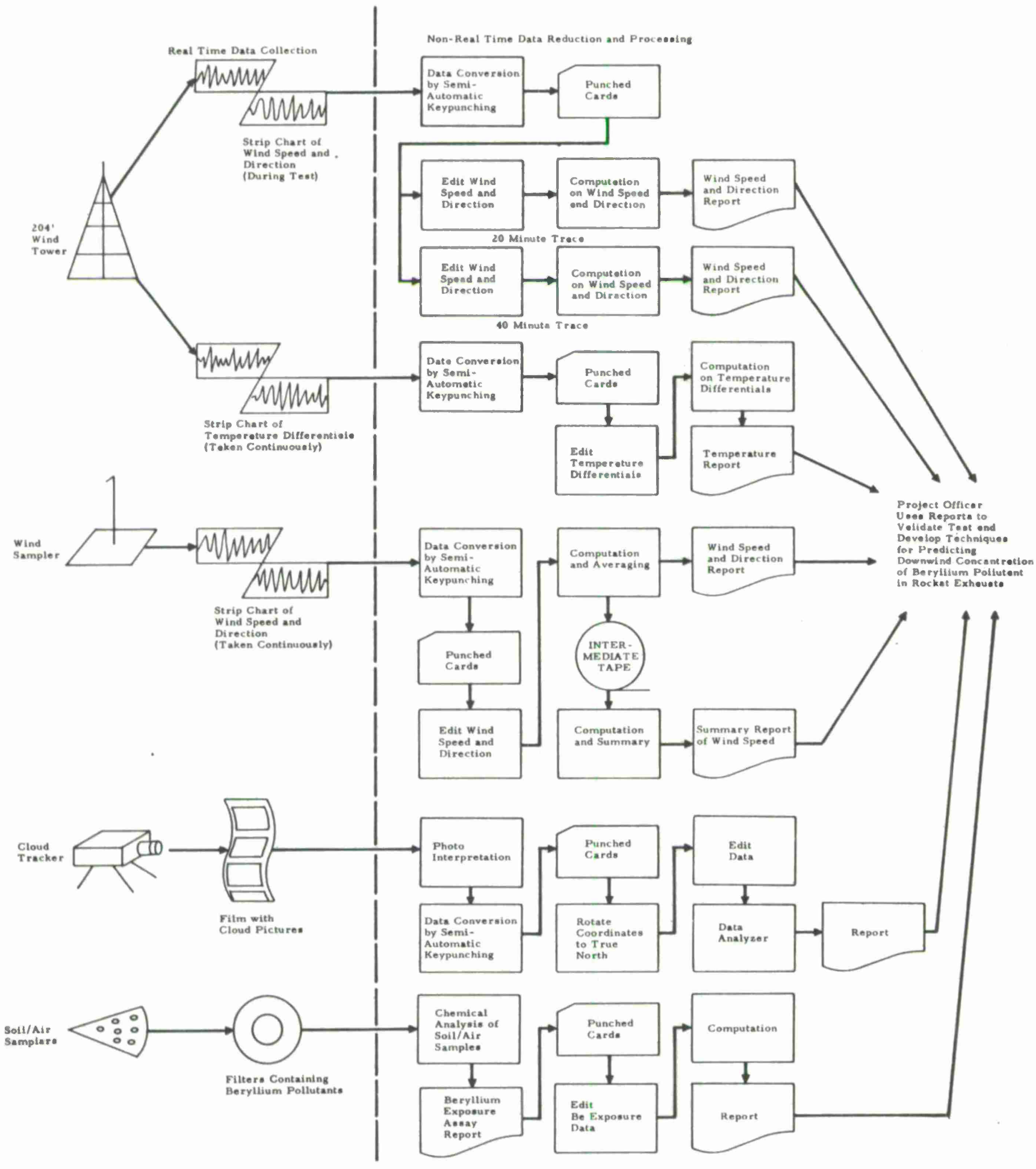
Communication between the user and the programmer analyst was informal. The user would complete a work order requesting a particular programming effort, and the user and programmer supervisor discussed the job. The user then informally discussed the details with the programmer assigned to the task. For the remainder of the development effort, the user, programmer supervisor, and programmer communicated verbally approximately on a weekly basis. After the program was operational, the original programmer did any needed program maintenance. The programmer functioned as an analyst, programmer, and maintenance programmer.

A small amount of AFRPL's computer inputs, outputs, and library tapes were classified as confidential, but security measures have not significantly hindered ADPS installation or operation.

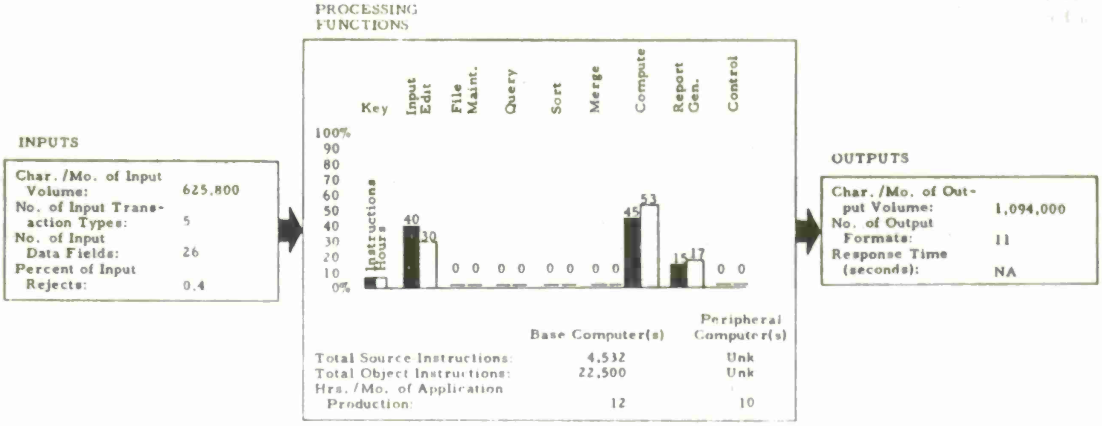
SCHEDULE:



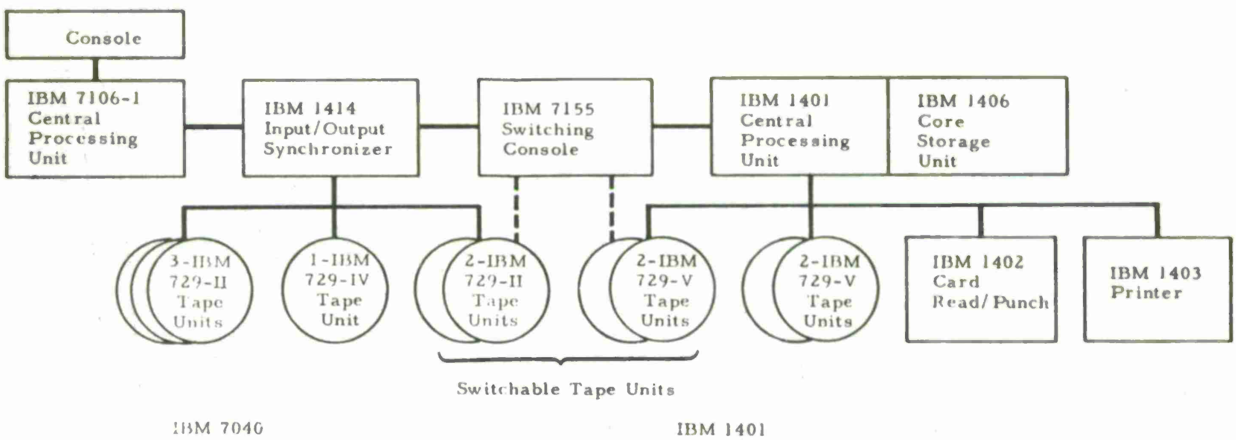
DESCRIPTION: The ADOBE system reduces instrumentation data obtained from a 204-foot meterological tower, 12-foot wind sets, air and soil samplers, and phototheodolite cameras. The raw data are converted from analog strip charts to digital punched cards by an operator on a Benson Lehner Oscar J., or from handwritten reports directly to punched cards.



WORKLOAD:



HARDWARE:



				Internal Storage			External Storage		Peripheral Devices: Card Reader/Punch			Peripheral Devices: Printer	
Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Cycle Time (μs)	Word/Char. Size (bits)	Word/Char. Capacity	No. Mag Tapes	Trans. Rate	No.	Read Speed (cards/min)	Punch Speed (cards/min)	No.	Speed (lpm)
IBM 7040	4/63	Word	16	8	36	4,096	5-729 II 1-729 IV	15K to 62.5K	None	---	---	None	---
IBM 1401	9/60	Char.	230	11.5	6	4K	4-729 V	60K	1-1402	800	250	1-1403	600

Comment: The equipment has been highly reliable: approximately 98% uptime.

SOFTWARE: Software for the IBM 7040 consisted of an IBSYS monitor executive system, a FORTRAN IV compiler, and a MAP assembler. All software was delivered by IBM with the machine in September 1963.

COMMENT: There is currently one person assigned full time to system programming at RPL. His time is mainly spent updating the software according to frequent manufacturer modifications. The software has caused no problems in the development or operations of the ADOBE system.

APPLICATION PROGRAM DEVELOPMENT: Two of the five ADOBE data reduction programs were extensively revised from Project Sandstorm effort as discussed in the history section. The other programs were designed and coded in FORTRAN IV by contractor personnel from Telecomputing Services, Inc., who received details by written work order and verbal communication. Documentation was informal and not at a system level, because of the extreme independence of the programs, but in the form of program listings held by the cognizant programmer. The existing IBM 7040/1401 computer system was used for testing with no new hardware or software capabilities required. Turnaround time was normally 4 to 8 hours. The program independence negated the need for an integrated system test. Development is currently going on and records were not kept of the number of hours of testing that have been utilized. Daily time cards, with time allocated to the appropriate work order, and monthly time reports were submitted during development. Program status reports were kept by Telecomputing Services, Inc. personnel only.

FILE CONVERSION: No file conversion was involved in ADOBE development.

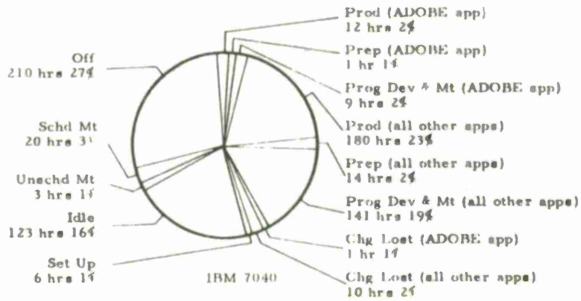
DOCUMENTATION: No formal documentation exists.

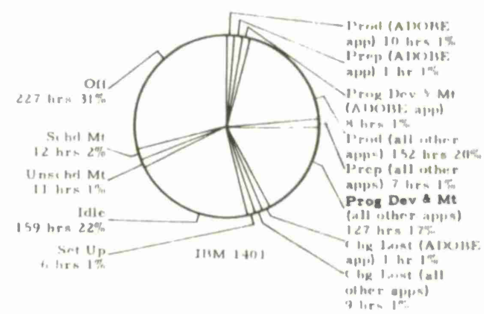
PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Scientific Computation	Number of Years: Of College
Development	Manager	5	0.1	10.5	3.5	3.0
	Analyst	None: Programmers Function as Programmer/Analysts				
	Programmer	5	7.0	3.5	2.0	3.0
Operations	Manager	5	0.1	10.5	3.5	3.0
	Operator	1	1.0	5.0	3.5	

OPERATIONS: The computer operation at RPL is staffed 24 hours a day Monday through Friday and 8 hours on Saturday. It operates as a closed shop. ADOBE is one of many applications on the IBM 7040/1401 system. Generally, an 8-hour backlog exists. There is no schedule other than for IBM maintenance. Processing is on a normal and hot priority basis, with "first come first served" scheduling.

Comment: The idle time is large for this type of installation, possibly due to the scheduling concept.





APPLICATION PROGRAM MAINTENANCE: The application program maintenance effort is essentially a continuation of the application program development effort. The development programmer/analysts are also the maintenance programmers, and the same informal methods of communication between them and the user are used. Most of the effort is improvement rather than error correction.

COMMENT: The program maintenance effort is driven by the continually changing data reduction requirements. The requirements change because new meteorological instrumentation is installed in the field and because the user desires different outputs.

BENEFITS: Proposed: ADOBE was preceded by Project Sandstorm, which existed to study the exhaust clouds from small, solid rocket motors with grain weights between 8 and 65 pounds and instrumentation over a 2-square-mile instrumented course. Benefits ADOBE was to offer above Project Sandstorm include the ability to handle rocket motors of 500- to 4,000-pound grains, instrumentation over a 28-square-mile course, and additional instrumentation. ADOBE was to provide an improved data processing capability, which included programs for processing temperature differentials, outputs from 12-foot wind towers, and cloud trackings.

Actual: The increased quantity and variety of instrumentation required was procured, enabling the test of 500- to 4,000-pound grains. Testing was expanded to include detonation/burn tests and contamination tests as well as diffusion of rocket motor exhausts. The required data processing capability was realized with the exception of cloud tracking, the development of which is continuing at present.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: 15

Actual: 21

Comment: ADOBE is in continuing development due to system refinements and requirement changes. The project's development is estimated to be 90 percent complete at the current 21 man-months.

Months of Elapsed Development Time (Dev.)

Proposed: Unk

Actual: 25

Comment: Forty-five test firings were scheduled to be completed between July 1964 and July 1965, by a test directive which was prepared in place of a DAP. At present, 39 test firings have been completed. The schedule slippage was due to weather conditions.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: Unk

Comment: Records of computer hours for program checkout were not kept. Records of computer hours by application were not produced before 1966 except by DSAP code, which is too general to isolate ADOBE programs.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 12

Comment: The actual number reflects usage on the IBM 7040 during April 1966. Ten hours were used for ADOBE application production on the peripheral IBM 1401.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 9

Comment: The actual number reflects usage on the IBM 7040 during April 1966. Eight hours were used for ADOBE program maintenance on the IBM 1401.

Number of Operations Personnel (Op.)

Proposed: 1

Actual: 1.1

Comment: In addition to one operator, one manager spends 10 percent of his time on ADOBE.

Number of Program Maintenance Personnel (Op.)

Proposed: 1

Actual: 1.2

Comment: The actual number of personnel is prorated from 7 programmers on the basis of time spent on ADOBE program maintenance. There is also one system programmer assigned full time to software maintenance for all applications at RPL.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 4,363

Comment: The actual dollar value is based on 16 hours of application production and 9 hours of program maintenance.

FUTURE PLANS: A DAP is being processed for an on-line micrometeorological recording and display system (MICROMET). MICROMET will provide input for further processing by ADOBE. Since MICROMET will perform data calibration, formatting and editing, the processing time for ADOBE will be reduced. In the MICROMET system, meteorological instrumentation output will be fed through A/D converters to an on-line computer. The on-line computer will reduce the incoming data and drive output equipment including a display map of wind vectors and temperature readings. The number of manual steps in preparing data for ADOBE will thus be reduced, improving accuracy and timeliness.

SYSTEM: Accrued Military Pay System--AMPS (NCR390)

DATA SYSTEM DESIGNATOR: H003A

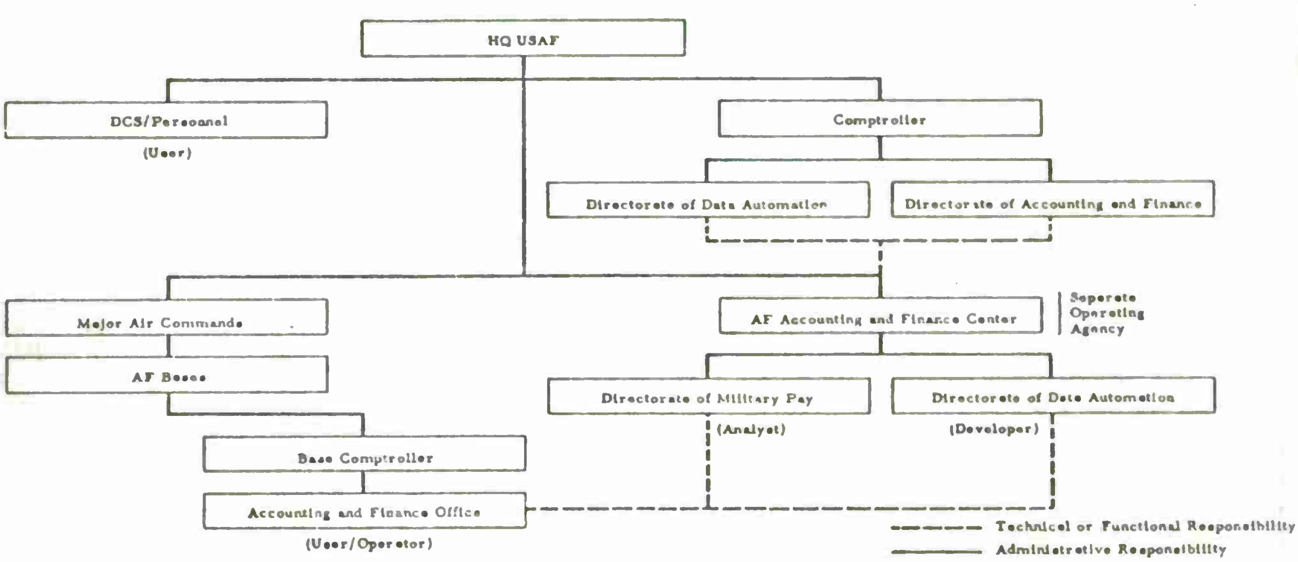
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Directorate of Data Automation Air Force Accounting and Finance Center 3800 York Street Denver, Colorado
Development	Air Force Accounting and Finance Center Denver, Colorado
Maintenance	Air Force Accounting and Finance Center Denver, Colorado
Pilot Installation	Ent Air Force Base Colorado
First Operational Installation	Ent Air Force Base Colorado
Number of Operational Installations	125

FUNCTION: The users of the system are Air Force bases throughout the world, the Air Force Director of Personnel Planning, and the Director of the Budget. A common mission of the users is military pay distribution and accounting control. AMPS functions as a management support system to prepare paychecks for military personnel and to provide accrual accounting of the military pay funds. The reports of accountability are consolidated at the Air Force Accounting and Finance Center (AFAFC) and forwarded to the Air Force Director of Personnel Planning and the Director of the Budget.

ORGANIZATION:



HISTORY: The 1949 pay system, using a hand-posted military pay record for each Air Force member, recorded the pay dollars actually disbursed to a member. It did not record or report amounts "earned by" and "properly payable to" each member monthly. Yet the total amount earned, or accrued, represented the true total dollar liability against the Air Force appropriation. This liability, considerably greater than the total dollars actually spent in cash or checks, is a critical budget factor needed and wanted by the Director of Personnel Planning and the Director of Budget in the Pentagon.

From the many pay studies and tests undertaken by Air Force specialists came two concepts for a new pay system. The first called for centralized control of all Air Force pay accounts using a high-speed communication system linked to a large-scale computer at the Air Force Accounting and Finance Center (AFAFC). The other concept approached the problem on a decentralized basis, using desk-size computers at paying bases. Both systems prescribed mechanized record-posting and provided for accumulating and reporting pay management data on an accrual basis.

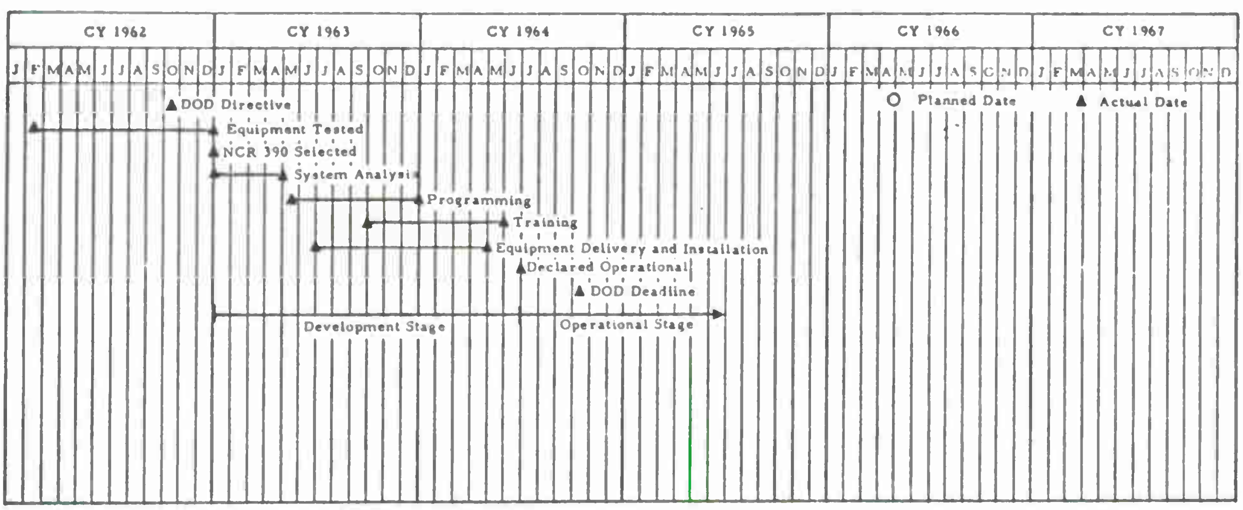
In October 1962, Department of Defense Directive 7040.3 directed all military services to implement an accrual accounting system for military pay within 2 years. Since the centralized computer system could not be operational within this tight time frame, the Comptroller of the Air Force directed that the decentralized system be implemented and operational by July 1964. The system would be known as the Air Force Accrued Military Pay System (AMPS).

Planning sessions were held in January and February 1962 with representatives of Headquarters USAF, AFAFC, and the major air commands. The group's recommendations resulted in Headquarters USAF being responsible for policy guidance, systems and program approvals, and AFAFC for systems, procedures, and program development and implementation, and the major air commands for full program support and execution at command and base levels.

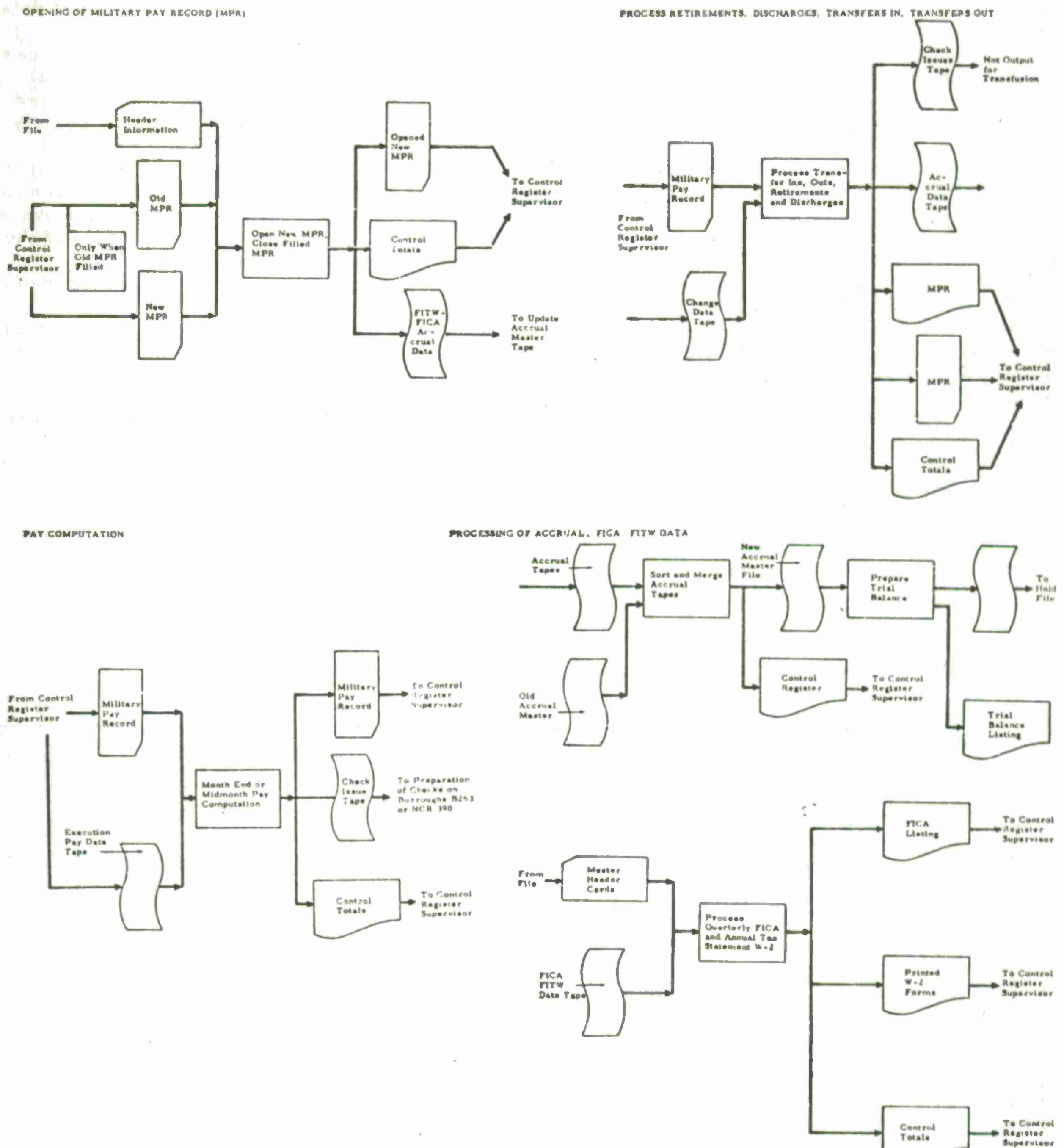
The use of the NCR 390 computer was specified to the Air Force Accounting and Finance Center by Headquarters, USAF, Accounting and Finance and had been used at Ent AFB, Colorado, in a single base prototype system. Operators of the system were sent to a special Air Training Command School on AMPS at Sheppard AFB prior to the actual use of the system on an Air Force base. The system is operational on 174 computers located at 125 Air Force bases.

The AMP system design was a cooperative effort of the Directorates of Military Pay and Data Automation at the Air Force Accounting and Finance Center. The Directorate of Military Pay developed requirements for program development and changes while ensuring the integrity of the Military Pay System. The Directorate of Data Automation was responsible for system analysis and programming.

SCHEDULE:



DESCRIPTION: The primary function of AMPS is to prepare paychecks for military personnel. The pay computations are run twice a month. In addition to check issuance, AMPS has the capability for accepting temporary and permanent pay changes for military personnel and for producing quarterly accrual FICA (Federal Insurance Contributions Act) and FITW (Federal Income Tax Withheld) reports. A punched paper tape with all accrued expenditures by categories is also prepared by each base. These tapes are sent by each base to AFAFC, which consolidates them on the RCA 501 to prepare an Air Force-wide RAOMP (Report of Accrued Obligations for Military Pay). The RAOMP report is forwarded to Hq. USAF Director of Personnel Planning and the Director of the Budget.



WORKLOAD:

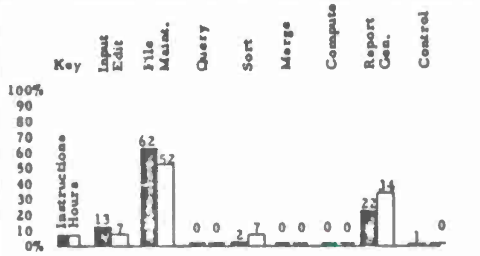
DATA BASE

Char. in Data Base:	13,210,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	3
No. of Data Base Records:	5,000
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	940,800

INPUTS

Char./Mo. of Input Volume:	940,800
No. of Input Transaction Types:	14
No. of Input Data Fields:	118
Percent of Input Rejects:	0.5

PROCESSING FUNCTIONS

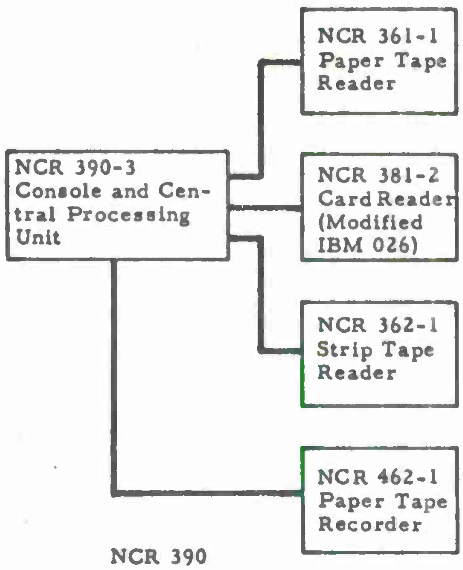


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	14,140	NA
Total Object Instructions:	14,140	NA
Hrs./Mo. of Application Production:	277	NA

OUTPUTS

Char./Mo. of Output Volume:	1,007,000
No. of Output Formats:	11
Response Time (seconds):	NA

HARDWARE:



NCR 390

				Internal Storage			Peripheral Devices					
							Card Reader		Paper Tape Reader		Paper Tape Punch	
Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Cycle Time (μs)	Word Size (Numeric Char.)	Word Capacity	No.	Read Speed (cards/min)	No.	Read Speed (char./sec)	No.	Punch Speed (char./sec)
NCR 390	5/61	Numeric Char.	11,300	1,200	12	200	1-381-2	15	1-361-1 1-362-1	400	1-462-1	17

Comment: The carriage of the NCR 390 reads information from magnetic ledger cards, which contain up to 200 words in magnetic strips.

SOFTWARE: The NCR 390 does not have assemblers, compilers, or an executive system.

Comment: Conventional software is not supplied with the NCR 390 because of the extremely small scale of the machine.

APPLICATION PROGRAM DEVELOPMENT: The system design was a cooperative effort of the Directorates of Military Pay and Data Automation within AFAFC. The Directorate of Military Pay was responsible for analysis and determination of military pay requirements and AMPS system design. The Directorate of Data Automation was responsible for program design, coding, and program checkout. All programs were written in absolute machine language. The programmers operated their own programs, and were able to make roughly two checkout runs per day. The computer operated two shifts a day, 6 days a week during program checkout. NCR allowed 330 days of free use for as many hours as desired. An estimate of 12 hours a day or 3,744 hours of a possible 7,920 hours were used for checkout. The Directorate of Military Pay compiled an exhaustive set of test data for the system test, and subsequently verified the results of the system test with the Directorate of Data Automation. PERT charts, progress charts, and work measurement charts were maintained during development for management control.

FILE CONVERSION: File conversion was performed on a decentralized basis by the AFO's responsible for the payroll records. Conversion was made from manual payroll records to magnetic ledger report forms. Information from manual payroll records was manually converted to Form 1926 Alphanumeric Header Data on punched cards and to Form 1927 Military Pay Record Opening Data on punched paper tape. These inputs were then submitted to the normal MPR opening subsystem to generate the master file of MPR's. At a typical base the conversion process was accomplished within a two-week period (between pay dates) using the entire AFO staff (between 15 and 40 people depending on base size) working on a two-shift basis plus overtime.

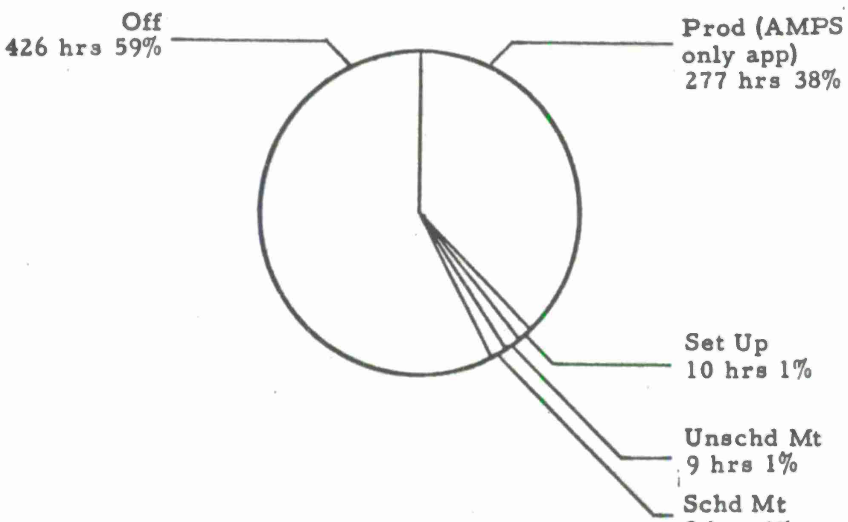
DOCUMENTATION: The basic system description and user's manual is AF 177-105, which is very voluminous and exhaustive. Effort is presently being expended to make the material of this manual more understandable. The basic documentation of AMPS programs and program operation is AF 171-15; it contains program narratives, detailed data formats, flow charts, and program operating instructions. When a change is made to a program affecting AF 171-15, a change sheet for insertion or replacement is provided to all bases along with a new program tape. Any changes to the programming system are originated by an "ADP Projects Request/Authorization" form, which is signed and approved by responsible parties in both the Directorate of Military Pay and Data Automation.

PERSONNEL:

Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Military Pay	Of College
Development	Manager	9	5.3	12.5	17.0	4.5
	Analyst	23	23.0	14.5	21.5	Unknown
	Programmer	22	22.0	4.0	1.5	Unknown
Operations	Manager	1	0.5	2.0	4.0	
	Operator	6	3.0	2.0	2.0	

OPERATIONS: The computer operation is staffed at Lowry AFB 8 hours a day, 5 days a week. It operates as a closed shop. AMPS is the only application on the NCR 390 computer. A monthly master schedule is prepared for each of the operational computers located throughout the world.

Comment: All development and maintenance of AMPS is performed on one NCR 390 computer dedicated exclusively to program development and maintenance at AFAFC.



NCR 390

APPLICATION PROGRAM MAINTENANCE: Problems arising at the installations are transmitted to the Directorate of Data Automation at AFAFC, where the problems are analyzed. The installations are advised immediately of any temporary changes required until the Directorate can release a new program tape and documentation. Along with the eight programmers involved in program maintenance at AFAFC, there are a branch chief and systems analyst who also spend full time on the system. Sixty percent of the people involved in program maintenance were involved in the original development of the system. The program maintenance activity is divided into three areas: (1) program corrections, 5 percent; (2) program improvements, 25 percent; and (3) changes due to legislative requirements such as FICA and FITW, 70 percent. The average turnaround time for checkout work is 24 hours.

Comment: None.

BENEFITS:

Proposed: Benefits which AMPS was designed to provide that the existing manual system did not provide include: (1) reporting of military pay accounting information on an accrual basis to the Director of Personnel Planning and the Director of the Budget; (2) more timely reporting of military pay accounting, FICA, and FITW data; and (3) a net cost saving of approximately $1.7 million annually. This was justified on an estimated saving of approximately 1,200 military pay personnel. The personnel saving would be $6.0 million while added machine rental and maintenance would be $4.3 million, resulting in a net saving of $1.7 million annually.

Actual: (1) reporting of military pay accounting information on an accrual basis to the Director of Personnel Planning and the Director of the Budget was accomplished; (2) more timely reporting of military pay accounting, FICA and FITW data was accomplished after some initial problems with the AMPS computer system and operations personnel; and (3) revised manpower requirements permitted the elimination of only approximately 240 personnel, corresponding to about $1.2 million annually. Since additional equipment costs were $4.3 million, this resulted in a net annual additional cost of $3.1 million over the existing manual system.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 704

Comment: No formal DAP was prepared for AMPS. A DOD directive of October 1962 directed that all branches of the service establish accrual pay systems by October 1964. This directive did not state an estimate for man-months of development effort.

Months of Elapsed Development Time (Dev.)

Proposed: 18

Actual: 18

Comment: July 1, 1964 was the operational date established by Hq. USAF.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 37,178

Comment: The number of hours of actual checkout was 3,744 hours. This was computed by multiplying a productive checkout estimate of 12 hours/day by 344 days, the actual number of days used for program checkout. NCR allowed 330 days of unlimited daily free use for checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 277

Comment: The actual number reflects usage on the NCR 390 during March 1966 at Lowry AFB.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: 0

Actual: 0

Comment: All AMPS program maintenance is done only at AFAFC, where it is estimated that 176 hours/month are used for that purpose. The NCR 390 at AFAFC is used only for AMPS program maintenance.

Number of Operations Personnel (Op.)

Proposed: 3.5

Actual: 3.5

Comment: The actual number represents three full-time operators and one analyst devoting 50 percent of his time to AMPS at Lowry AFB. There are two full-time AMPS operators at AFAFC.

Number of Program Maintenance Personnel (Op.)

Proposed: 0

Actual: 0

Comment: The actual number represents maintenance programmers at any operational site. Eight maintenance programmers at AFAFC perform all AMPS maintenance. A branch chief and one analyst also spend full time on AMPS.

Dollars/Month of Hardware Cost (Op.)

Proposed: 1,725

Actual: 1,725

Comment: This amount is the basic rental charge per month for a single NCR 390 at any operational site and the NCR 390 used exclusively for program maintenance at AFAFC.

FUTURE PLANS: AMPS is a decentralized interim system which was quickly implemented to meet a DOD directive. Future plans call for the installation of a centralized system to replace AMPS. System study of the centralized system is presently being conducted.

SYSTEM: Data Services Workload Control System--DSWC (IBM 7080/1401)

DATA SYSTEM DESIGNATOR: P044

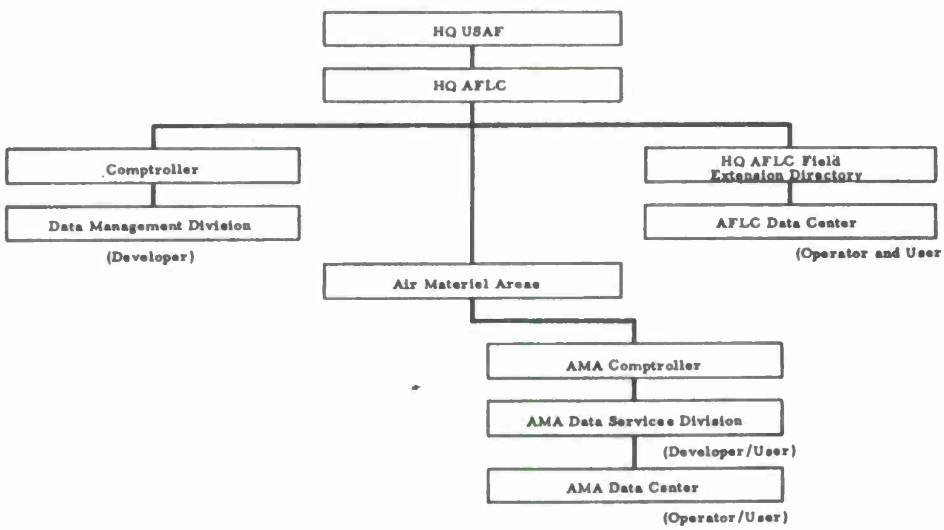
DATA COLLECTION DATE: July 1966

LOCATION:

Contact for Additional Information	SACS San Antonio Air Materiel Area Kelly Air Force Base San Antonio, Texas Comptroller (Data Management Division) Hq., Air Force Logistics Command Wright-Patterson Air Force Base Dayton, Ohio
Development	San Antonio Air Materiel Area Kelly Air Force Base Texas Ogden Air Materiel Area Hill Air Force Base Utah Comptroller (Data Management Division) Hq., Air Force Logistics Command Wright-Patterson Air Force Base Ohio
Maintenance	San Antonio Air Materiel Area Kelly Air Force Base Texas
Pilot Installation	None
First Operational Installation	San Antonio Air Materiel Area Kelly Air Force Base Texas
Number of Operational Installations	8

FUNCTION: The users of DSWC are the Data Center and Data Services of the AFLC Air Material Areas, and the Data Center and Data Management Division of Headquarters AFLC. The mission of the users is the efficient processing of data and the generation of desired information products. DSWC functions as a management support system to provide a standard system for use by the AFLC Data Centers for the identification and control of data services operations and products and the scheduling of data services resources. It also provides the Data Management Division of Headquarters AFLC with management reports containing the actual and forcasted use of automatic data processing equipment and personnel.

ORGANIZATION:

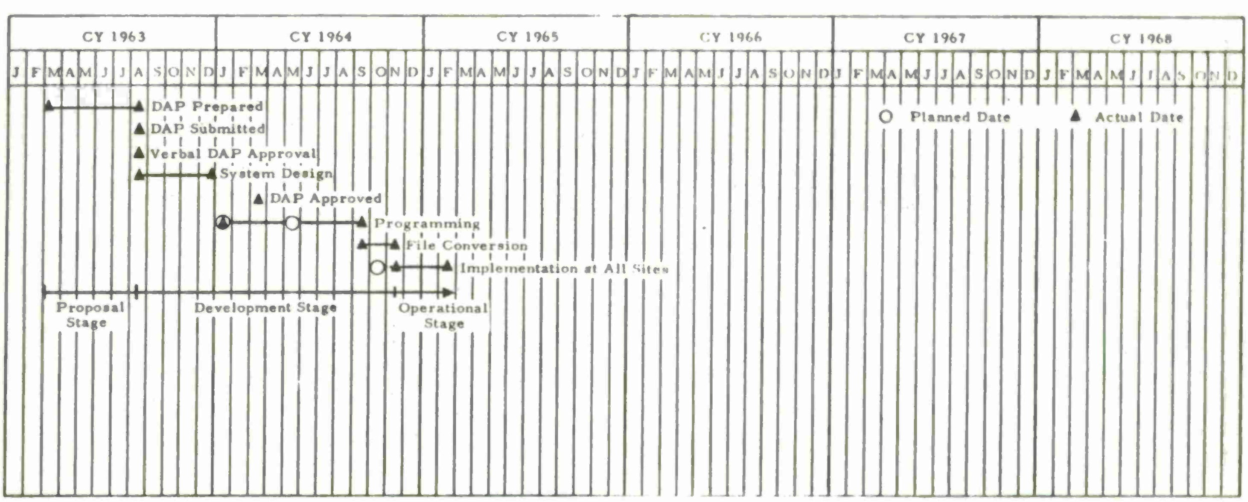


HISTORY: Prior to 1963 several efforts to develop automated methods for manpower control and workload scheduling were underway at Headquarters Air Force Logistics Command (AFLC) and at some of the AFLC Air Materiel Areas (AMA's). The manager of the Data Management Division of Headquarters AFLC became aware of the duplicated efforts and formed a task force with the responsibility to develop a means of consolidating these efforts into a single automated system. The task force derived a data system specification in a report titled The Automatic Data Processing Resources Management System (ARMS). The AMA's received this report in August 1963 and their criticism and comments were requested. After receiving their replies, the system was redesigned and the specifications in the form of a DAP were submitted to AFADA. Based on verbal approval by AFADA, the Data Management Division of AFLC began work on the project in January 1964. The San Antonio Air Materiel Area (SAAMA) was designated as the development site with support supplied by Ogden Air Materiel Area (OOAMA). The proposed initial operational date of July 1964 proved unreasonable and was changed to October 1964. The system went operational simultaneously at all AMA's in January 1965.

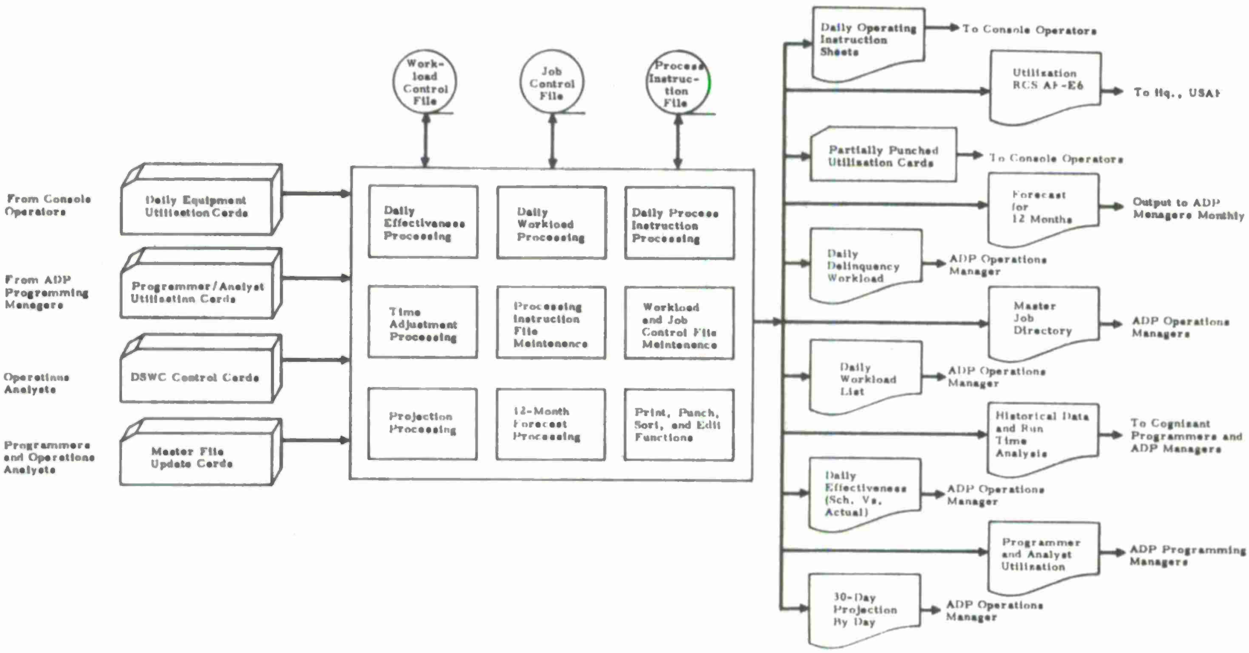
A system monitor from the Data Management Division, Headquarters AFLC, supervised the entire development at SAAMA. Analysts were located at SAAMA and two programming groups were formed, one at SAAMA and one at OOAMA. The group at OOAMA was in daily telephone contact with the analysts at SAAMA throughout the system development.

DSWC is operational at the following eight sites: Rome AMA, Sacramento AMA, San Bernardino AMA, San Antonio AMA, Oklahoma City AMA, Ogden AMA, Warner Robbins AMA, and Hq. AFLC.

SCHEDULE:



DESCRIPTION: The Data Services Workload Control system identifies, plans, controls, and schedules all AFLC data services operations. The AFLC data processing installations are provided with uniform procedures for manpower and EDPE scheduling and other benefits such as mechanically prepared operator instructions (run sheets), external tape labels, and partially prepunched utilization cards. Headquarters, AFLC, receives data showing actual and forecast use of system analyst/programmer personnel by data system at each installation as well as showing EDPE use by data system, projected by 12 months (AF-E6, part 8B). Inputs consist of manpower and EDP utilization in the form of either cards or reports punched on cards. The outputs consist of a series of reports on data system equipment and requirements, labor (programmer/analyst) availability, monthly and daily work schedules and status reports, and a master directory of mechanized operations.



WORKLOAD:

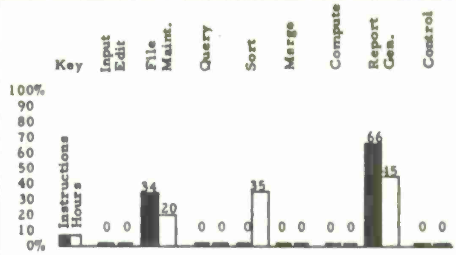
DATA BASE

Char. in Data Base:	17,270,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	3
No. of Data Base Records:	203,500
Percent Growth Rate/Mo.:	0.2
Char./Mo. of Update Input:	1,836,000

INPUTS

Char./Mo. of Input Volume:	1,836,000
No. of Input Transaction Types:	38
No. of Input Data Fields:	237
Percent of Input Rejects:	Unk

PROCESSING FUNCTIONS

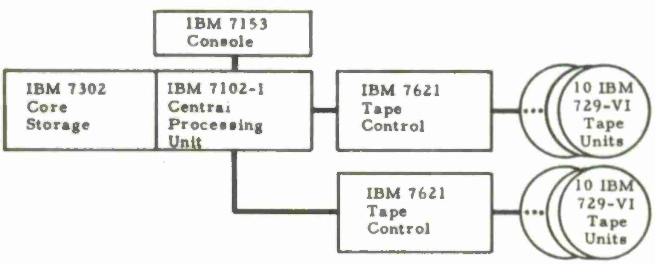


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	208,100	Unk
Total Object Instructions:	208,100	Unk
Hrs./Mo. of Application Production:	14	67

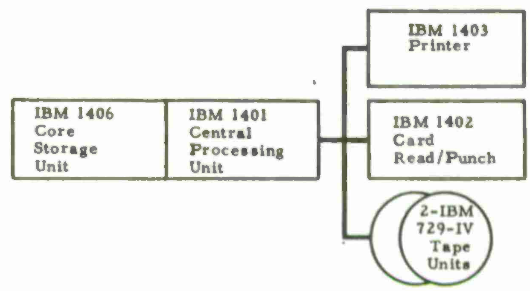
OUTPUTS

Char./Mo. of Output Volume:	13,070,000
No. of Output Formats:	33
Response Time (seconds):	NA

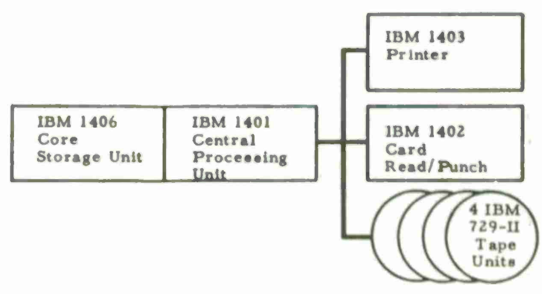
HARDWARE:



2-IBM 7080's



4-IBM 1401's



1-IBM 1401

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Internal Storage: Cycle Time (μs)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Storage: No. Mag. Tapes	External Storage: Trans. Rate	Peripheral Devices: Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)
2-IBM 7080	9/61	Char.	11	2	6	160,000	20-729 VI	to 90K	None	---	---	None	---
4-IBM 1401	9/60	Char.	230	11.5	6	8,192	2-729 IV	22.5K-62.5K	1-1402	800	250	1-1403	600
IBM 1401	9/60	Char.	230	11.5	6	8,192	4-729 II	15K-41.6K	1-1402	800	250	1-1403	600

Comment: The equipment configuration varies with the installation, both between AMA's and Hq AFLC. The configuration depicted above is for the San Antonio AMA.

SOFTWARE: Software for both the IBM 7080 and IBM 1401 consisted of an Autocoder assembler and general input and output utility routines. The IBM 7080 also had a sort program available.

Comment: The software is maintained by IBM. The DSWC system used the available software extensively.

APPLICATION PROGRAM DEVELOPMENT: Policy and system design criteria were developed under the direction of the Data Management Division, Hq. AFLC. SAAMA personnel, augmented by personnel from OOAMA, were responsible for the development and initial implementation. The programmers coded the programs in Autocoder II from flow charts and specification documents. Each program, 17 for the IBM 1401 and 9 for the IBM 7080, was checked out independently at both SAAMA and OOAMA using the partially built files which were being built at each site on already existing hardware common to all AMA's and AFLC. The system checkout, which lasted two weeks and used live data, was performed at SAAMA with some assistance from OOAMA personnel. The computer checkout hours were mostly on the IBM 1401 with 1,350 hours logged and the IBM 7080 with 230 hours logged. Each program was well documented, as was the entire system design during development by 2 or 3 persons involved full time with documentation. The entire development was supervised by a system monitor from the Data Management Division, Hq. AFLC.

FILE CONVERSION: An extensive period of file conversion went on simultaneously with the development of the system. The three files, A, B, and C, had to be built to help with checkout. Checkout at both Ogden and San Antonio was performed with these partially built files. Two individuals were required full time to build these files at each AMA. One was the system monitor, who, together with a clerk assistant, worked closely with the individual programmers of each AMA. All programmer/analysts in AFLC were required to participate part time in the collation of program data for the files. It took about five months to complete these files at the AMA's.

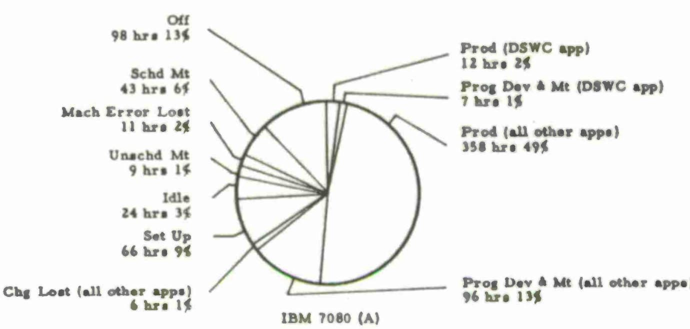
DOCUMENTATION: Each program was initially documented with a file of input and output formats and a description of the system design. During the development phase 2 or 3 persons worked full time with documentation. The major documents of this system are (1) Data Services Workload (P044), AFLCM 300-38, 26 Aug. 1964 (a users' manual and system description with format specifications); (2) maintenance documents (a file containing program listing, transmittal letters with attachments, etc.); and (3) related documents on administrative regulation, such as AFLCR 300-10, which are used to create or modify files of P044.

PERSONNEL:

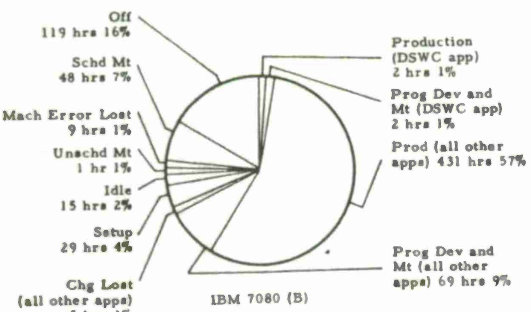
Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Area	Of College
Development	Manager	1	1	20	20	Unknown
	Analyst/Programmer	16	16	11	11	Unknown
Operations	Manager	4	0.1	Unknown	Unknown	Unknown
	Operator	89	2	2	Unknown	

OPERATIONS: The computer operation is staffed at SAAMA 24 hours a day, 7 days a week. It operates as a closed shop. DSWC is one of many applications on the IBM 7080's and 1401's. DSWC is the master scheduler for both the daily and the monthly schedules. The daily schedule for each computer is displayed on closed circuit TV. Five IBM 1401 computers are used to process DSWC. The pie chart below reflects utilization as if one IBM 1401 did all of the DSWC application processing, and not all five computers, which is actually the case.

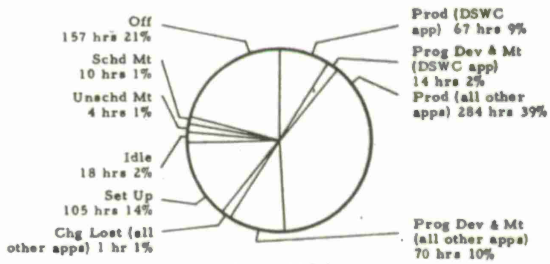
Comment: The SAAMA installation does all the program development and maintenance for all the operational sites of DSWC.



IBM 7080 (A)



IBM 7080 (B)



IBM 1401 (A)

APPLICATION PROGRAM MAINTENANCE: The program maintenance is currently performed at SAAMA by 5 programmer/analysts who were all involved in the original development of DSWC. Problems arising at any of the AMA's are isolated and pertinent information is transmitted to SAAMA. Resultant corrections from SAAMA are inserted at each AMA by resident analysts or programmers.

Comment: None.

BENEFITS: Proposed: DSWC was designed to provide ADP management with responsive tools to make timely and accurate decisions on ADP resources (including ADP personnel and ADPE) utilization. DSWC was to make uniform methods of computing, scheduling, and reporting available throughout the AFLC. Computer operations also were to be simplified and streamlined by providing operator sheets, tape labels, and partially prepunched computer utilization cards.

Actual: DSWC is operational on an IBM 7080/1401 system at each Air Materiel Area (AMA) of the AFLC. Scheduled operations are put on a large board, which is then displayed by closed circuit TV to the operator. DSWC also provides Hq. AFLC with forecasts of ADPE and ADP personnel use, and subsequently compares actual usage with the forecast.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 86

Comment: A task force, formed at Hq. AFLC in early 1963, prepared a report called the ADP Resources Management System (ARMS). The system specifications from this report were used to prepare a DAP in August 1963, which was approved verbally by AFADA in January 1964 and officially in May 1964. No estimate of man-months was contained in the DAP.

Months of Elapsed Development Time (Dev.)

Proposed: 8

Actual: 12

Comment: The DAP stated that command-wide implementation would be completed by 1 September 1964. The programming phase of development took longer than planned, causing schedule slippage.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 140,660

Comment: Program checkout required 230 hours on the IBM 7080 computer and 1,350 hours on the IBM 1401 computer.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: 10

Actual: 14

Comment: Sixty-seven hours were used for DSWC application production on the peripheral IBM 1401's. The actual number reflects usage during March 1966 on the IBM 7080. The DAP stated an estimate of 30 hours/month per AMA for the IBM 1401 computers.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 9

Comment: The actual number reflects usage during March 1966 on the IBM 7080. Program maintenance for DSWC is done only at SAAMA. The operational AMA's and Hq. AFLC have monitor programmer/analysts who collect program error data to send to SAAMA and install corrections from SAAMA. Fourteen hours were used for DSWC program maintenance on the peripheral IBM 1401's at SAAMA.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 2

Comment: The actual number of personnel is prorated from 89 operators at SAAMA on the basis of machine time used for DSWC.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 5

Comment: The actual number of personnel represents full-time DSWC maintenance programmer/analysts at SAAMA. There are programmer/analysts at each AMA and at Hq. AFLC who isolate problems and transmit program error data to SAAMA for correction, as well as install program corrections from SAAMA.

Dollars/Month of Hardware Cost (Op.)

Proposed: 1,208

Actual: 10,960

Comment: The actual dollar amount includes the cost of program maintenance done only at SAAMA. This program maintenance cost is approximately $4,289 per month at SAAMA.

FUTURE PLANS: There are no indications of changes or additions to this system at this time.

SYSTEM: Base Level Inventory Control System--GE/BSS (GE 225)

DATA SYSTEM DESIGNATOR: D002

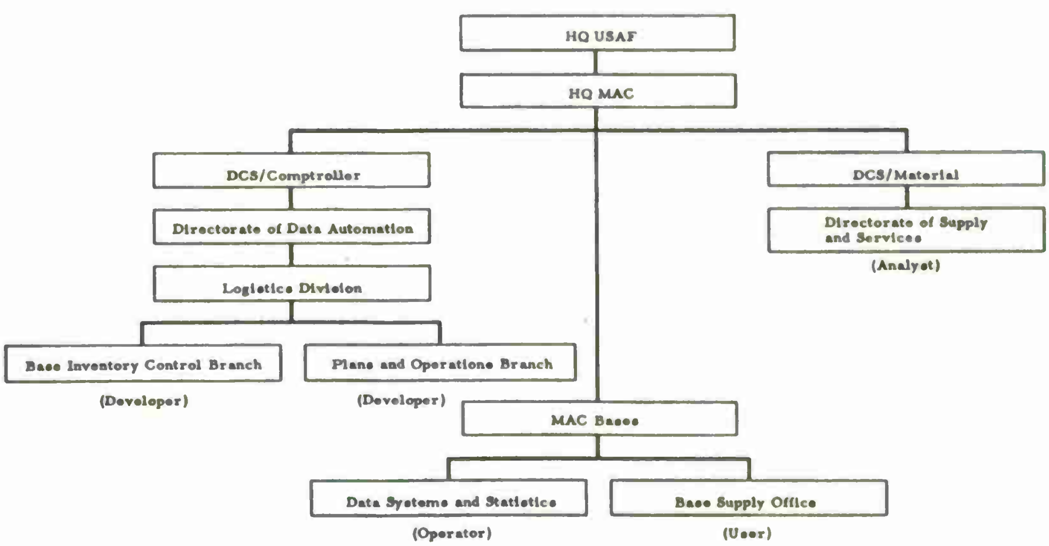
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Directorate of Data Automation Military Airlift Command Scott Air Force Base Belleville, Illinois
Development	Scott Air Force Base Illinois
Maintenance	Scott Air Force Base Illinois
Pilot Installation	None
First Operational Installation	Scott Air Force Base Illinois
Number of Operational Installations	7

FUNCTION: The prime users of GE/BSS are the base supply offices at the various Military Airlift Command bases. The only other user is the Accounting and Finance Office, which processes the financial aspects of the inventory system. The mission of the prime user is controlling the distribution, ordering, and inventory level of aircraft replacement parts for the Military Airlift Command. GE/BSS functions as a management support system in processing real-time supply transactions and generating management reports.

ORGANIZATION:



HISTORY: GE/BSS evolved from an attempt in the late 1950's to simultaneously introduce automation techniques to a variety of the Military Airlift Command (MAC) functions using an IBM 7070 computer at Charleston AFB. The attempt was too ambitious for the system technology of the period and resulted in degrading the inventory function as the requirements for real-time operation could not be met.

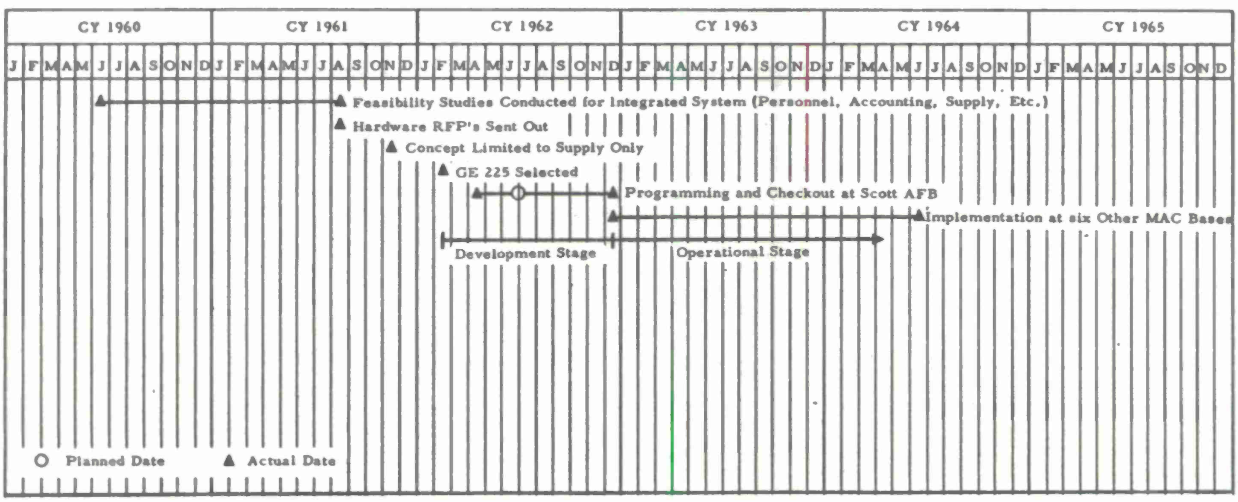
Headquarters USAF decided to transfer the functions one at a time to another computer and employ the modular concept of design. Of the 33 functions in the Charleston system, base supply was given the highest priority for the new system and is the only function presently operating in the new computer.

The project began at Scott AFB in April 1962 with the programming a joint Air Force and General Electric effort. The amount of coding required was underestimated and therefore the available manpower was insufficient to meet the schedule. An additional time-lag factor in development was the inclusion of new requirements and design factors for MILSTRIP. The system became operational at Scott AFB in December 1962 and during the next 18 months six more similar systems were developed for installation at other bases in the Military Airlift Command.

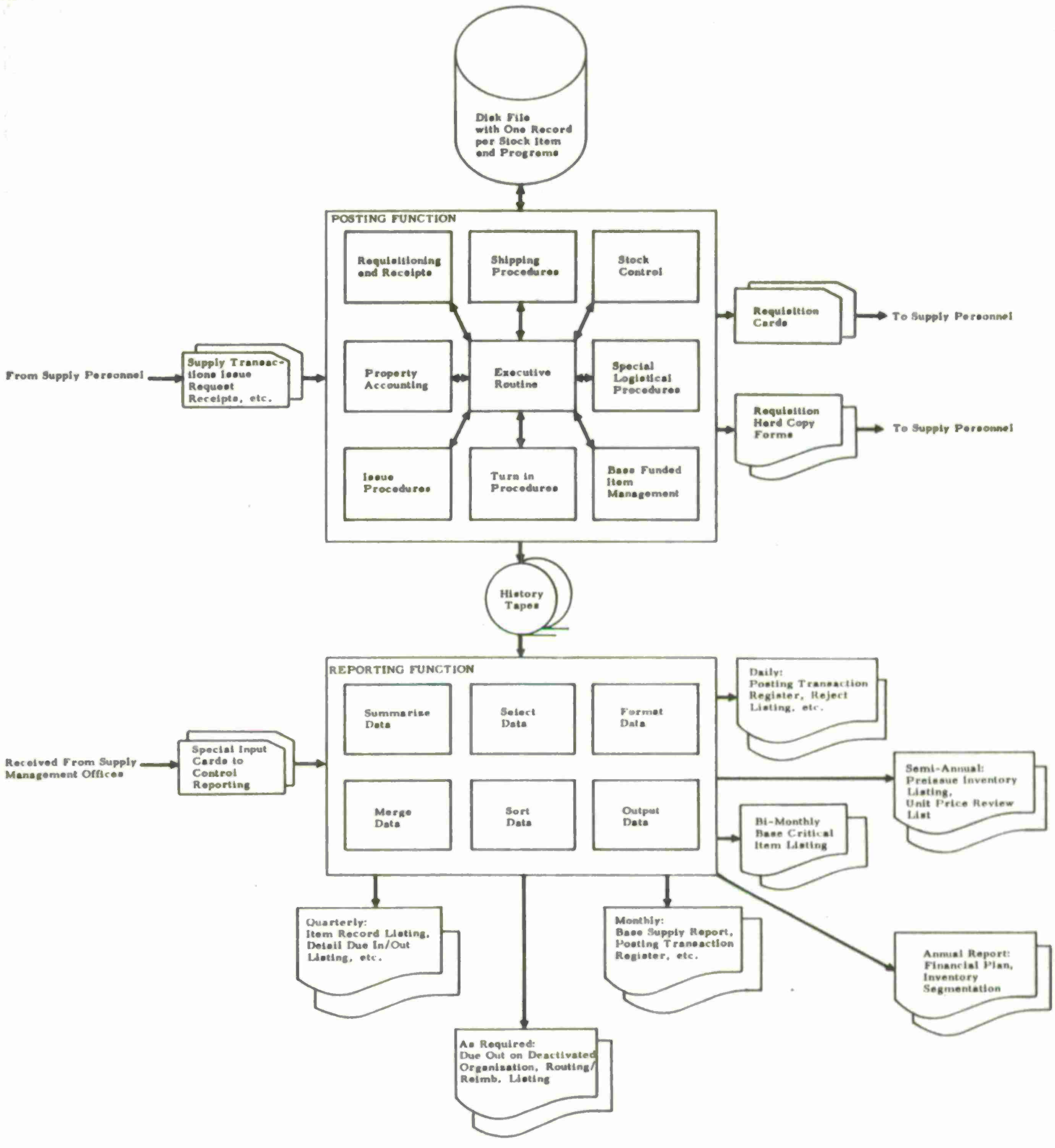
System analysts from the Base Supply Office provided technical guidance to the General Electric programmers. The number of contractor programmers was inadequate and Air Force and Civil Service programmers were added to the effort. Small groups under close supervision of Air Force programmers were formed and assigned specific tasks for the remainder of the development.

GE/BSS is operational at the following seven AFB's: Lajes AFB, Travis AFB, Scott AFB, Hunter AFB, McGuire AFB, Charleston AFB, and Dover AFB.

SCHEDULE:



DESCRIPTION: There are two main system functions: (1) posting, i.e., the processing of real-time supply transactions, and (2) report generation. Posting input is by punched cards representing supply transactions; for example, a request for an aircraft part by maintenance or the recording of new stock purchases. Each transaction updates the supply record on the disk and records the transaction on the history tape. A requisition form is output when a part has been requested. The history tape is used to produce management reports.



WORKLOAD:

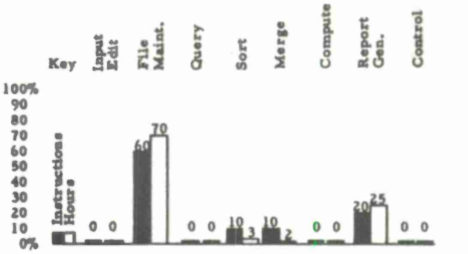
DATA BASE

Char. in Data Base:	27,000,000
Percent of Char. on D/A Storage:	100
Milliseconds of Access Time for D/A:	180
No. of Data Base Record Types:	11
No. of Data Base Records:	180,000
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	4,000,000

INPUTS

Char./Mo. of Input Volume:	4,000,000
No. of Input Transaction Types:	42
No. of Input Data Fields:	465
Percent of Input Rejects:	1.0

PROCESSING FUNCTIONS

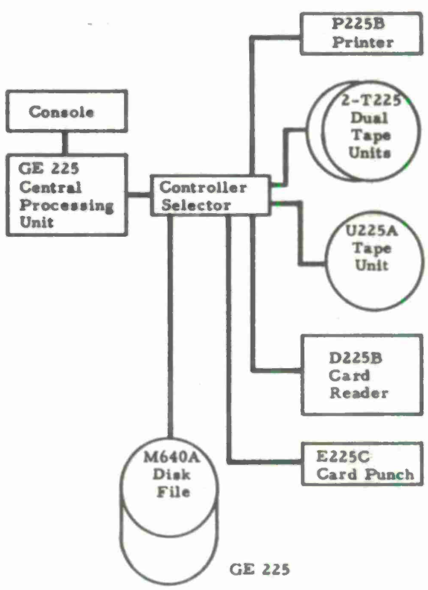


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	150,000	NA
Total Object Instructions:	150,000	NA
Hrs./Mo. of Application Production:	176	NA

OUTPUTS

Char./Mo. of Output Volume:	40,310,000
No. of Output Formats:	43
Response Time (seconds):	2

HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Internal Storage			External Storage						Peripheral Devices					
							Mag Tapes		Disk				Card Reader/Punch				Printer	
				Cycle Time (us)	Word Size (bits)	Word Capacity	No. Mag Tapes	Trans. Rate	No. Disks	Trans. Rate	Char. Capacity	Access Time (ms)	No.	Read Speed (cards/min)	No.	Punch Speed (cards/min)	No.	Speed (lpm)
GE 225	1/61	Word	36	18	20	4,096	3	15K to 60K	1	62.5	28M	180	1	400	1	100	1	900

Comment: At Travis AFB there are two hardware configurations to handle an unusually heavy workload and at Scott AFB an extra core memory module was added to facilitate development programming.

SOFTWARE: Software for the GE 225 consisted of a GAP assembler, program diagnostics, and utility routines. The software was delivered by GE with the equipment in early 1962.

Comment: The software performed well and has required little modification or correction. One exception was the routine which randomly accessed the disk file and which required considerable reprogramming. It was felt by the developers that the software contributed significantly to system development.

APPLICATION PROGRAM DEVELOPMENT: The GE/BSS proposal called for all programming to be done exclusively by GE programmers with technical direction from Air Force system analysts. The development approach adopted was to begin work on the most critical aspects of the system first, solve them, and then work on the next most important areas of the system. This resulted in some unnecessary redesign work. The technical effort suffered due to some design shortcomings, resulting from an overly optimistic technical estimation by GE and the Air Force system analysts and an apparently arbitrary and short USAF schedule. Air Force and Civil Service programmers were added when it became apparent that the number of GE programmers was inadequate. The programs were all written in GE assembly language, GAP. Each function was divided into subprogram segments of approximately 1,000 words each because of limited core space. The posting programs were written almost entirely without benefit of GE software. The programmers operated the computer themselves during the six months checkout period, getting 4 to 5 short test runs on the 24-hours-per-day continually operating computer. The criteria for the system test were specified by the supply analysts. During development a thorough documentation file was maintained of each program's interaction with its environment. Proposed design features, changes to programs, additional requirements, and detected conflicts were documented in an internal document series known as Program Information Letters (PIL). This was an effective programming control during the development period and has been praised by the technical staff involved. Daily progress reports from the programmers were collected and analyzed.

Comment: Another cause for schedule slippage was the inclusion of additional requirements, such as MILSTRIP, which required redesign and additional coding. A frozen set of specifications would have significantly aided the development phase.

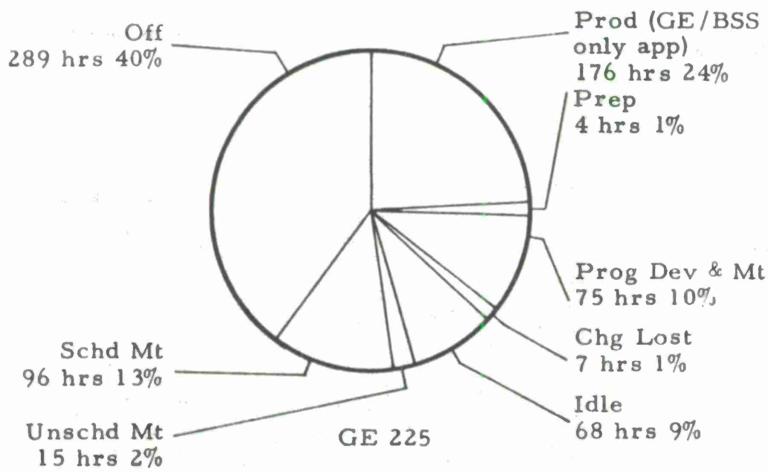
FILE CONVERSION: The data base to be employed in the GE 225 system was essentially the same as that used on the IBM 7070 system at Charleston AFB except for differences in format. The conversion was done by special programs written for the IBM 7070 which dumped the file onto magnetic tape and punched cards in a format acceptable as input to the GE 225. Approximately 200,000 records of about 100 characters each were converted. Three weeks were required to complete the down-loading of the IBM 7070 and up-loading of the GE 225. The system data were audited before and after the loadings to verify the conversion.

DOCUMENTATION: At the completion of development (December 1962), the system documentation was produced: System Requirements (AF 67-1), Program Description (MM 67-4) and User's Manual (MM 171-14).

PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Supply	Number of Years: Of College
Development	Manager	16	6	9.0	8.0	3.5
	Analyst	6	8	5.0	12.0	Unknown
	Programmer	7	24	4.0	3.5	Unknown
Operations	Manager	1	1	4.0	1.0	Unknown
	Operator	3	7	5.0	3.0	

OPERATIONS: The computer operation is staffed at Scott AFB as required by workload. It operates as a closed shop. GE/BSS is the only application on the GE 225 computer. A monthly schedule is utilized by the operational sites with the allowance of priority runs at any time. Comment: All development and maintenance of GE/BSS is performed at Scott AFB. The average production time is 312 hours/month for the operational sites, excluding Scott AFB, with a maximum of 488 hours/month. Machine maintenance time is large (15 percent).



APPLICATION PROGRAM MAINTENANCE: All program modifications and improvements are done at Scott AFB. Other site programmers are used exclusively to gather data pertaining to program errors and to install program changes. The operational programs have required little maintenance or modification.

Comment: The small requirement for program maintenance probably arises from the fact that the system has been operational for a relatively long period of time.

BENEFITS: Proposed: GE/BSS was proposed to provide increased management control, reduction of supply manpower, and more timely fulfillment of maintenance requests in the Military Airlift Command. The concept of an automated supply system had been demonstrated through a pilot automation effort on the IBM 7070 at Charleston AFB.

Actual: GE/BSS provided increased management control and more timely fulfillment of maintenance requests.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: 55

Actual: 375

Comment: It was felt by the developers that the schedule imposed on the programming group by Hq. USAF was highly optimistic and apparently arbitrarily short. This unrealistic schedule led to a poorly designed system that required some unnecessary redesign work. Air Force and civil service programmers were added to the development effort when it became apparent that the number of GE programmers was inadequate.

Months of Elapsed Development Time (Dev.)

Proposed: 5

Actual: 10

Comment: GE/BSS was decreed operational on 1 July 1962 by Hq. USAF directive. Equipment selection was made in February 1962. Program checkout was begun in April 1962. Insufficient manpower and inclusion of new requirements, such as MILSTRIP, during the development delayed system operation to December 1962.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 212,000

Comment: The checkout computer was in constant 24-hour use for 6 months of the period April to December 1962. It was felt by the developers that the supplied software contributed significantly to system development. An approximate total of 4,512 hours was used for program checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 176

Comment: The actual number reflects usage on the GE 225 during June 1965 at Scott AFB. The six operational GE/BSS installations, excluding Scott AFB, averaged 316 hours. Maximum usage was 488 hours at Travis AFB.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 75

Comment: The actual number reflects usage on the GE 225 during June 1965 at Scott AFB. All GE/BSS program maintenance is done at Scott AFB. Field program maintenance activity at the other operational sites is concerned only with the collection of program error data to send to Scott AFB and the installation of corrections from Scott AFB.

Number of Operations Personnel (Op.)

Proposed: 5

Actual: 8

Comment: The actual number of operators at Scott AFB is 6. The other 6 operational sites average 8 operators, with a maximum of 12 at Travis AFB.

Number of Program Maintenance Personnel (Op.)

Proposed: 3

Actual: 4

Comment: There are programmers at the operational sites, other than at Scott AFB shown here, but they are used exclusively to collect program error data to send to Scott AFB and install corrections. There are two programmers at each operational site except Travis and McGuire AFB's, which have three programmers each.

Dollars/Month of Hardware Cost (Op.)

Proposed: 9,400

Actual: 9,400

Comment: This amount is the basic rental charge per month for all operational sites except Travis AFB.

FUTURE PLANS: This system is currently being phased out. All base supply functions are being transferred to the AF standard base supply system on the UNIVAC 1050-II.

SYSTEM: Global Weather Central--GWC (IBM 7094 Mod I)

DATA SYSTEM DESIGNATOR: L001

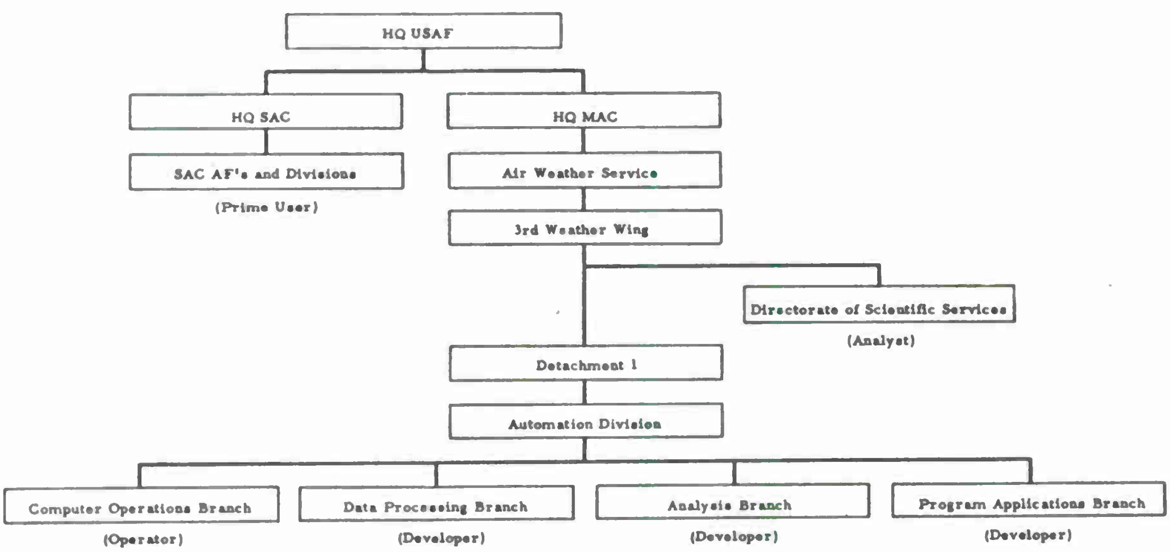
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	3rd Weather Wing Offut Air Force Base Omaha, Nebraska
Development	SAC Headquarters Offut Air Force Base Nebraska
Maintenance	SAC Headquarters Offut Air Force Base Nebraska
Pilot Installation	None
First Operational Installation	SAC Headquarters Offut Air Force Base Nebraska
Number of Operational Installations	1

FUNCTION: The user of GWC is the 3rd Weather Wing--Air Weather Service of the Military Airlift Command. The mission of the user is to support the Strategic Air Command and classified military activities with scheduled and tailored weather products. GWC functions as an operational and intelligence system to produce weather products such as analyses, prognoses, and forecasts for dissemination to supported units throughout the continental United States and overseas. Teletype information containing observations of weather conditions at the earth's surface and at various altitudes is input to GWC and the data are analyzed and correlated with previous weather conditions to prepare the weather products.

ORGANIZATION:



HISTORY: The GWC was developed in response to ever-increasing weather requirements being levied on the manual weather prediction and analysis capability of the 3rd Weather Wing. The initial system design was based on certain programs operating on the SAC IBM 704 and on a system developed by the Joint Numeric Weather Prediction Unit (JNWPU) at Suitland, Maryland. Initially, paper tape from teletype was used as the primary input source of observation data. The basic system was subsequently modified substantially by changing forecasting and analysis models, adding new products, upgrading the IBM 7090 to an IBM 7094 Mod I, installing an ADX ITT 7300 communication computer, and adding another IBM 7094 Mod I computer.

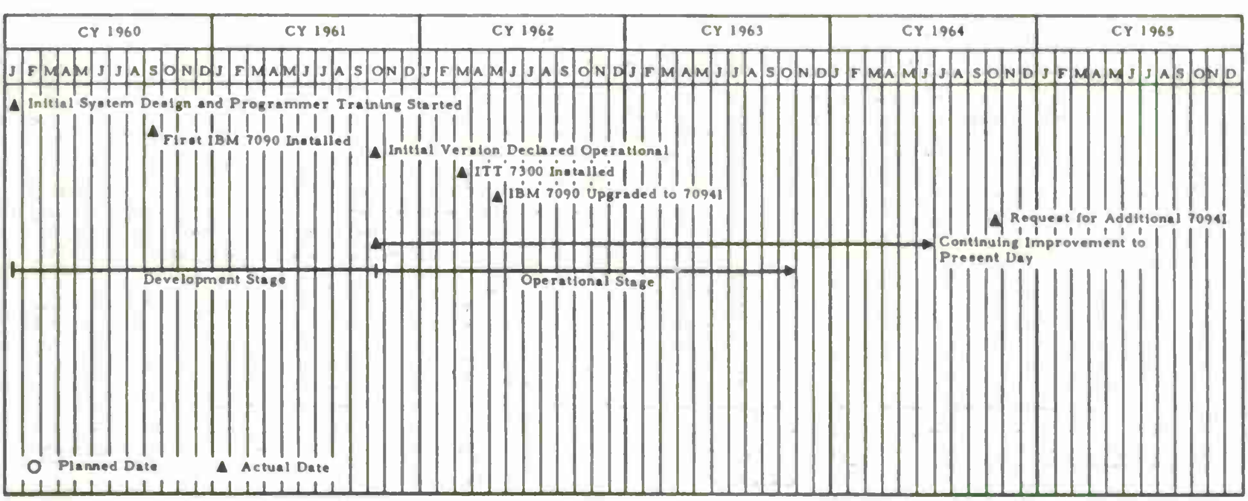
The development personnel for the GWC system were weather specialists with a very high average educational level, cross-trained to utilize computer skills. This approach was adopted because of difficulty in obtaining data processing personnel and because of the complexity of the weather application. The basic plan for system implementation was to replace manually generated weather products with the automatically generated products only after the automatic system had been fully verified. This approach enabled the system to be developed in a time-phased manner.

The development activity was performed primarily by the Directorate of Scientific Services and the Automation Division. The Directorate of Scientific Services was responsible for the formulation of the basic models used in the system. In many cases, personnel of the Directorate wrote programs to verify the concepts and models which they had developed. The actual production programs were written by personnel in the Automation Division. No clear distinction between programmer and system analyst was made, since virtually all people doing programming had a meteorology background.

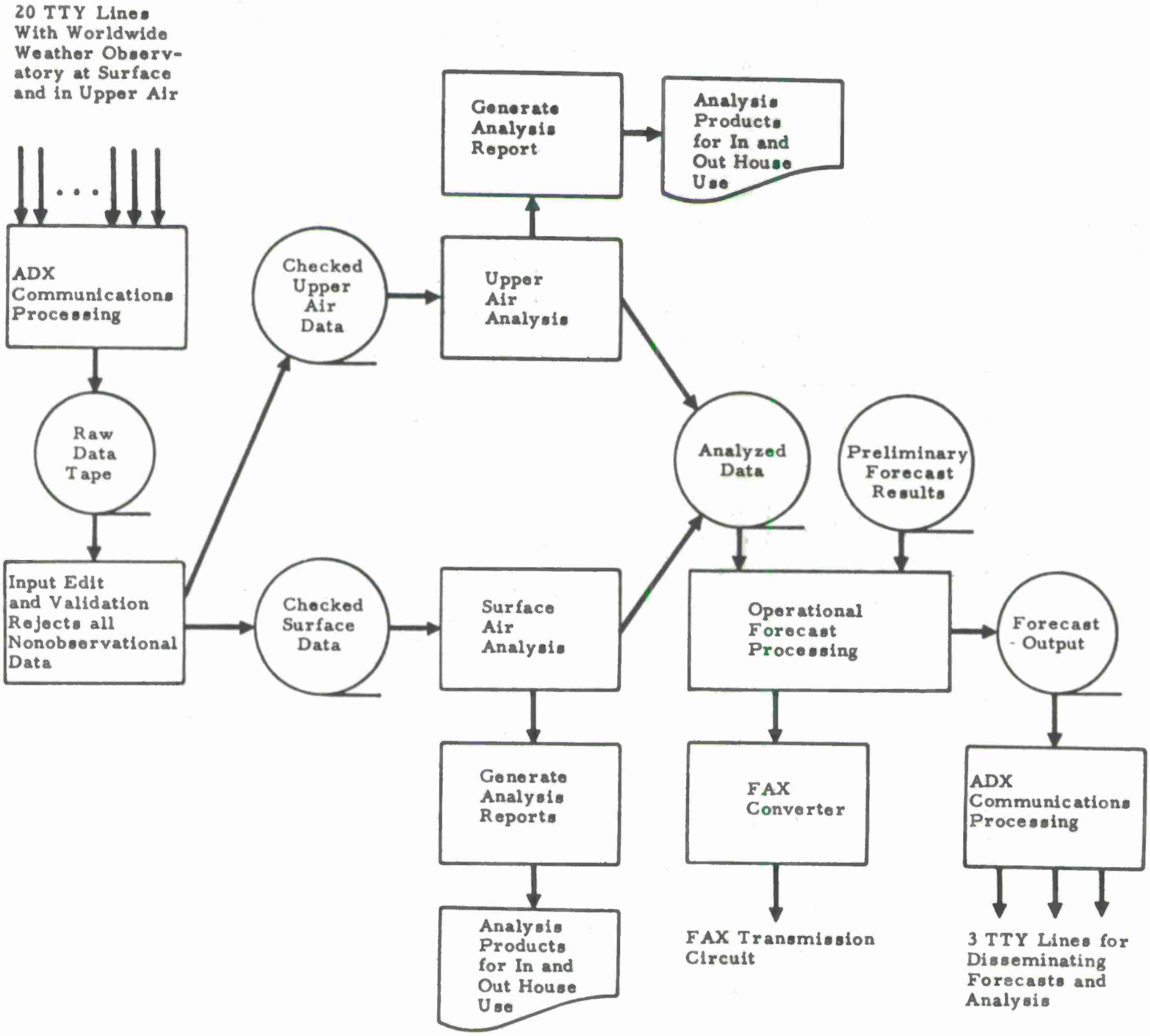
GWC is housed in two separate facilities approximately one mile apart. One of these facilities is in a hardened underground area resulting in materially increased costs for this facility. Due to the distance between the two sites, an IBM 7711 data transmission unit is necessary which would not have been required for a single facility. The estimated facility preparations costs for the non-hardened installation were $100,000.

A large portion of the GWC output is unclassified. During the development and production of highly classified outputs the environment is so secure that many programmers involved in checkout of less highly classified projects are denied access to the computer room, resulting in less efficient checkout than could have been accomplished otherwise.

SCHEDULE:



DESCRIPTION: GWC input containing observations of weather conditions at the earth's surface and at various altitudes in the upper air is received via teletype. All input except for relevant observations is stripped off prior to further analysis. About 50 percent of the data monitored over the teletype wires is not useful to GWC. The observations are then analyzed and correlated with previous weather conditions and forecasts are prepared. Analysis and forecast runs are made four times daily. The runs at 0600 and 1800 hours are not transmitted to the field but are analyzed in-house and used in the production runs at 0000 and 1200 hours.



WORKLOAD:

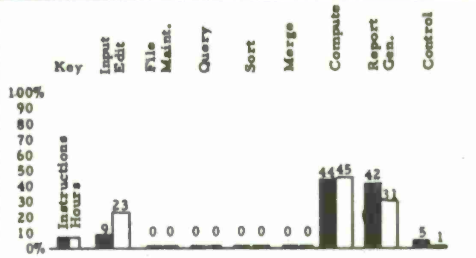
DATA BASE

Char. in Data Base:	3,790,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	7
No. of Data Base Records:	Unk
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	Unk

INPUTS

Char./Mo. of Input Volume:	715,400,000
No. of Input Transaction Types:	24
No. of Input Data Fields:	418
Percent of Input Rejects:	4.5

PROCESSING FUNCTIONS

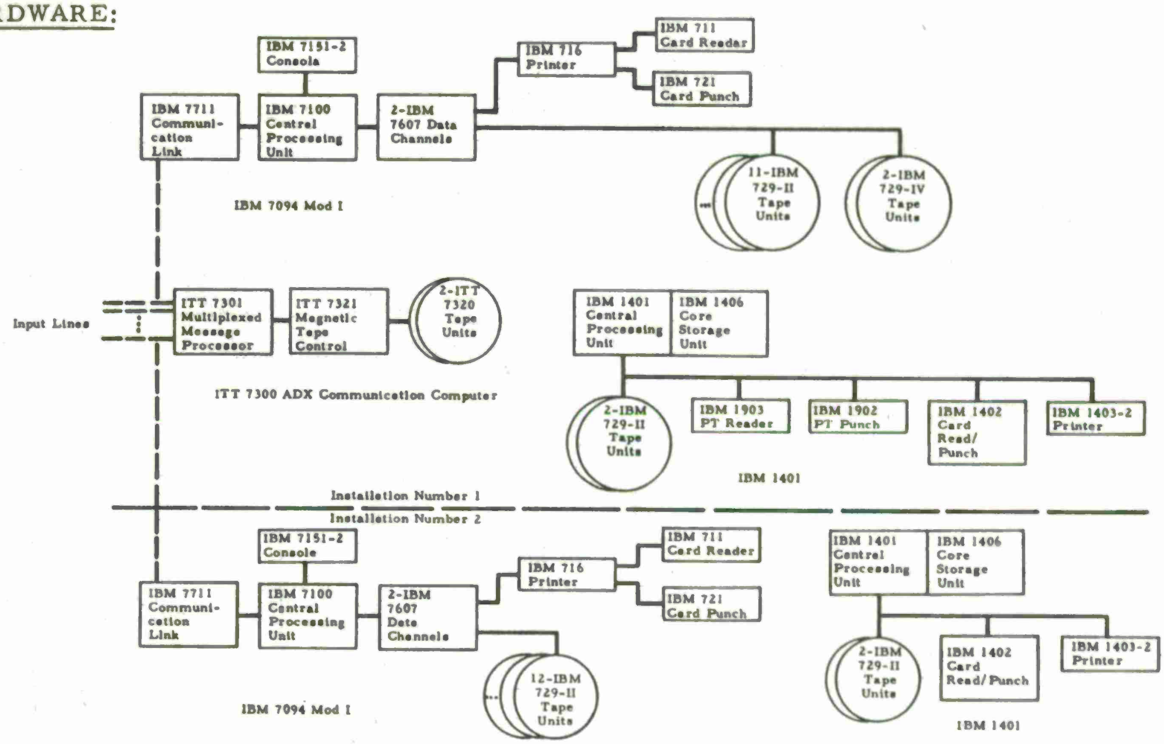


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	99,790	Unk
Total Object Instructions:	124,200	Unk
Hrs./Mo. of Application Production:	500	1040

OUTPUTS

Char./Mo. of Output Volume:	598,000,000
No. of Output Formats:	121
Response Time (seconds):	NA

HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mech.	Add Time (μs)	Internal Storage: Cycle Time (μs)	Internal Storage: Word/Char. Size (bits)	Internal Storage: Word/Char. Capacity	External Storage: No. Mag Tapes	External Storage: Trans. Rate	Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)	PT Reader: No.	PT Reader: Read Speed (char./sec)	PT Punch: No.	PT Punch: Punch Speed (char./sec)
IBM 7094	9/62	Word	4	2	36	32K	2-729 IV 11-729 II	22.5K-62.5K 15K-41.6K	1-711	250	100	1-716	150	None	---	None	---
IBM 7094	9/62	Word	4	2	36	32K	12-729 II	15K-41.6K	1-711	250	100	1-716	150	None	---	None	---
IBM 1401	9/60	Char.	230	11.5	6	8K	2-729 II	15K-41.6K	1-1402	800	250	1-1403-2	600	1-1903	500	1-1902	150
IBM 1401	9/60	Char.	230	11.5	6	8K	2-729 II	15K-41.6K	1-1402	800	250	1-1403-2	600	None	---	None	---
ITT 7300	unk	Word	10	5	18	32K	2-7320	15K	None	---	---	None	---	Console	400	Console	20

Comment: Other peripheral devices include a Benson Lehner Data Plotter and a CV 1357 Converter.

SOFTWARE: The entire IBM-supplied software packages for the IBM 7094 are available to GWC as is the SHARE library. GWC has been using the FORTRAN monitor system with the FORTRAN II compiler, FAP assembler, and a standard IBM-supplied library including some special GWC routines. GWC has also been using a GWC-developed control program AUTO and the IBM IBSYS executive system in conjunction with FORTRAN IV. The IBSYS executive includes a MAP assembler, a COBOL compiler, Report Program Generator (RPG), and a linkage editor.

Comment: The FORTRAN monitor system and the IBSYS executive system are used for program development but not for production runs. All production is run under AUTO, the GWC-developed control program, which requires considerably less core than either the FORTRAN monitor system or IBSYS. Little of the IBSYS executive's capability is being used. Virtually none of the SHARE library routines are being used at this time, although some were used during the early development stages.

Maintenance of the IBM-supplied software requires two people on a full-time basis, one supplied by IBM and the other by GWC. GWC is very happy with the support received from IBM (on-site and from IBM headquarters) and feels that this support tremendously enhances the maintenance of the support software.

APPLICATION PROGRAM DEVELOPMENT: The GWC development activity was performed by the Directorate of Scientific Services and the Automation Division of the 3rd Weather Wing. The Directorate of Scientific Services was responsible for formulation and verification of the models and computational techniques used in GWC, while the Automation Division was responsible for programming the production programs, integrating these programs into the GWC system and verification of system operation. A clear distinction between analyst and programmer was not made in the GWC system, since virtually all the people doing programming had a strong meteorology background. Development effort from other numeric weather projects such as the Joint Numeric Weather Production Unit was used whenever possible. The programs were coded in FORTRAN II and FAP assembly language. The GWC system is comprised of 86 separate programs, grouped together as 8 packages. Each package is run as a subsystem generating specific output products. The program testing was done using the FORTRAN monitor system. The development of the system was on a time-phased basis such that personnel freed from the manual preparation of products could be utilized in further system development. The time phasing also allowed thorough verification of new products prior to operational use. Quarterly progress reports were submitted during development.

FILE CONVERSION: No file conversion was involved in GWC development.

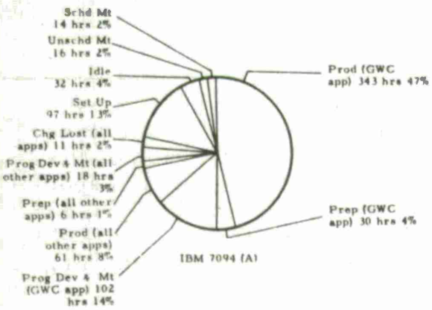
DOCUMENTATION: 3WWM 105-12 describes the centrally prepared products that are transmitted to field units. It provides information on the use of the products and verification information on selected forecast products. Documentation of the intersystem workings and individual programs is generally inadequate. No formalized documents giving system flow charts, program flow charts, or narrative program descriptions were found. Documentation of program operational procedures is complete and is kept on cards for easy maintenance.

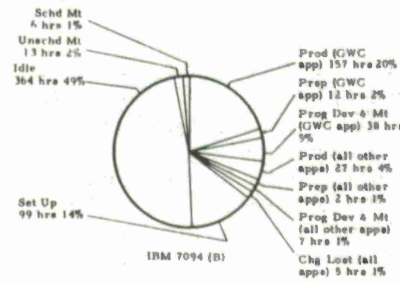
PERSONNEL:

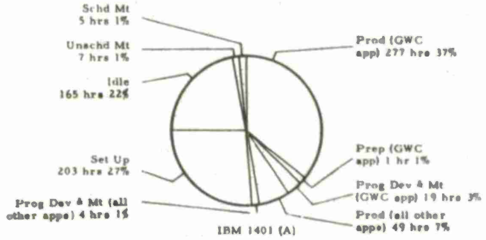
Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Weather	Of College
Development	Manager	6	6	5.0	13.5	6.5
	Analyst	25	25	2.5	13.0	7.0
	Programmer	28	28	2.5	9.5	Unknown
Operations	Manager	18	18	2.0	11.0	3.0
	Operator	73	73	1.5	7.0	

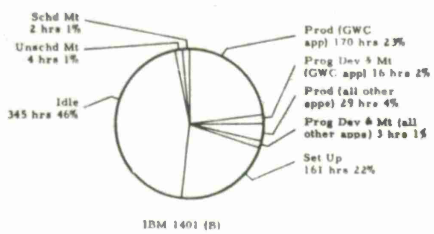
OPERATIONS: The computer operation is staffed 24 hours a day, 7 days a week. It operates as a closed shop. The GWC application shares both IBM 7094/1401 computer systems. The two IBM 7094/1401 installations are located at different sites, approximately 1 mile apart, necessitating transmission between sites of information via the IBM 7711. The IBM 7094/1401 (A) system is owned, while the (B) system is rented.

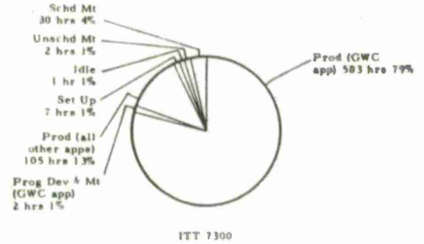
Comment: An excellent daily master schedule is strictly followed to utilize the owned computers as much as possible and to obtain the most updated input before transmitting weather products at fixed intervals. Idle time on the leased computer is nonchargeable by the manufacturer.











APPLICATION PROGRAM MAINTENANCE: Current programming activity involves 59 personnel and is divided into 4 areas: (1) new product programming, 19 percent; (2) program improvements, 60 percent; (3) program corrections, 14 percent; and (4) program and/or product deletions, 7 percent. Program improvements include optimization of running time, tape manipulation changes for more efficient production flow, and improved data processing schemes. The Program Applications Branch is responsible for pre-production testing of all programs prior to their release to production.

Comment: Program development as well as maintenance is a continuing and significant aspect of GWC. Due to the diversity and lack of control of weather observation input formats, program maintenance is constantly required to comply with changes in this area. Increasing requirements in the field of weather analysis and forecasting have caused improvements in old weather models and concepts and the development of new ones. Thus, development programming activity is always in progress with approximately the same number of people involved in development now as were involved during the original system development.

BENEFITS: Proposed: The GWC was proposed to provide weather information, such as forecast, analyses, and special reports to the Strategic Air Command and other AF users. Prior to development of the GWC, these products were manually produced. The manual processing of weather data was rapidly becoming unfeasible by 1960. New weather products including forecasts at high altitudes were required. In addition, requirements existed for increased frequency of weather reports.

Actual: The GWC has evolved over a number of years and is currently providing automated weather products twice daily. A number of new weather products and items or equipment have been added since the initial operational capability. Weather products requirements are continually increasing, requiring plans to be developed for new programs and equipment.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 4,404

Comment: No formal proposal such as a DAP was prepared for the GWC. The GWC ADPS developed from ever-increasing weather requirements, and hence, proposal activities are to be found throughout the GWC development and operation. A substantial portion of the development effort to date, as represented here, may be regarded as program maintenance in the continual development of the GWC.

Months of Elapsed Development Time (Dev.)

Proposed: Unk

Actual: 21

Comment: The initial development effort of the GWC was considered to have begun in January 1960 and ended in October 1961, as represented here, when it became operational. New programs, however, are continually being developed to meet the ever-increasing needs of AF weather users.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: Unk

Comment: No records were kept for computer hours used for GWC program checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 500

Comment: The actual number reflects usage during March 1966 on both IBM 7094 I computers. A total of 1,040 hours was used for GWC application production on the two IBM 1401 computers and the ITT 7300 ADX.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 140

Comment: The actual number reflects usage during March 1966 on both IBM 7094 I computers. A total of 37 hours was used for GWC program maintenance on the two IBM 1401 computers and the ITT 7300 ADX.

Number of Operations Personnel (Op.)

Proposed: 44

Actual: 91

Comment: The proposed number, consisting of 12 operators and 32 data preparation personnel, came from an anticipated manpower projection established in January 1960. The actual number of personnel consists of 73 operators and 18 managers.

Number of Program Maintenance Personnel (Op.)

Proposed: 41

Actual: 59

Comment: The proposed number, consisting of 1 manager, 28 analysts, and 12 programmers, came from an anticipated manpower projection established in January 1960. The ac ual number consists of 6 managers, 25 analysis, and 28 programmers.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 240,297

Comment: None.

FUTURE PLANS: Experience at the GWC has been one of continually adding programs and equipment to meet ever-increasing needs of AF weather users. GWC personnel currently estimate that by FY 1968 the equivalent of five IBM 7094 Mod I computers will be required. To meet these increasing requirements, a DAP is presently being prepared outlining the anticipated future requirements. The proposed system is to include such state-of-the-art features as multiprogramming, multiprocessing, large-scale direct access memory, and on-line consoles.

Because of the huge investment in programming (99 percent of the programs are in IBM 7094 machine language) it is felt that the new computer system must have the capability of emulating the IBM 7094. Other functional refinements desired include the use of a finer mesh grid to improve model accuracy and the use of satellite and aerospace data.

SYSTEM: Merged Accountability and Fund Reporting III--MAFR (RCA 501/301)

DATA SYSTEM DESIGNATOR: H053 and H055

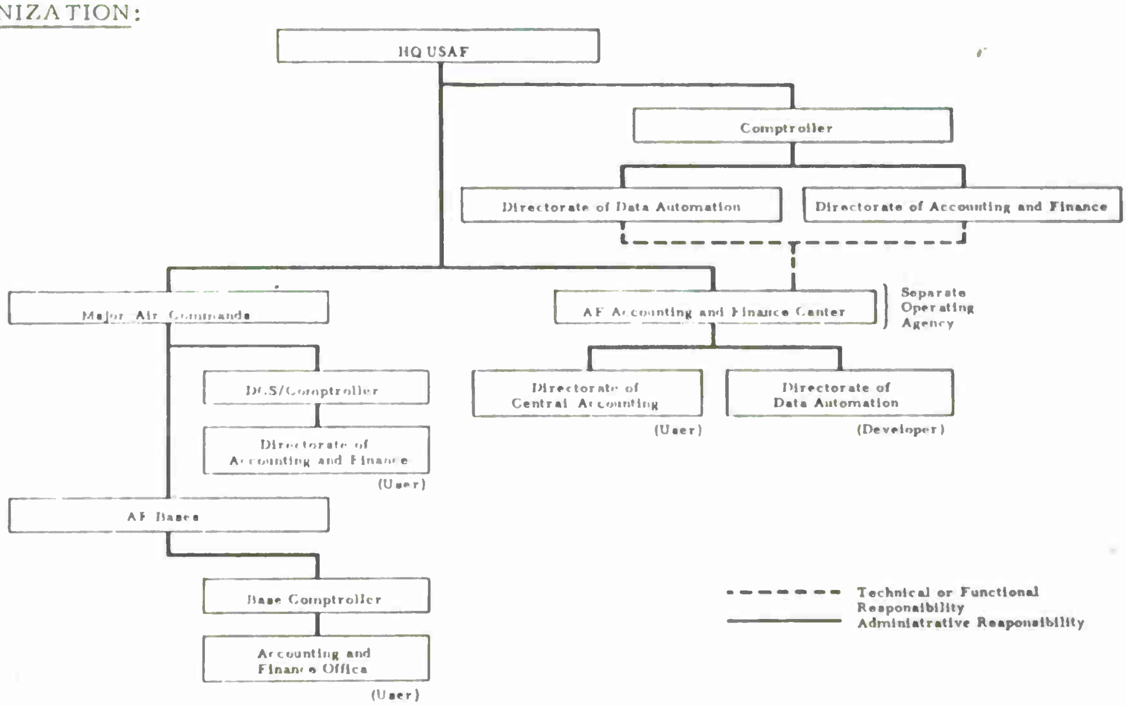
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Directorate of Data Automation Air Force Accounting and Finance Center 3800 York Street Denver, Colorado
Development	Air Force Accounting and Finance Center Denver, Colorado
Maintenance	Air Force Accounting and Finance Center Denver, Colorado
Pilot Installation	None
First Operational Installation	Air Force Accounting and Finance Center Denver, Colorado
Number of Operational Installations	1

FUNCTION: The immediate user of MAFR III is the Directorate of Central Accounting of the Air Force Accounting and Finance Center. Ultimate and prime users of MAFR III are the U.S. Treasury Department and the Air Force Director of the Budget. The mission of the prime users is to monitor Air Force expenditures and maintain an accountability of all Air Force Funds. The Treasury Department, of course, has other missions beyond Air Force accountability. MAFR III functions as a management support system to maintain accountability of cash expenditures and status of funds allocated for specific materials or services and consolidates the data in monthly reports.

ORGANIZATION:



HISTORY: Certain insufficiencies in the MAFR II System necessitated a major reengineering of the system in order to generate the products required by the user. The primary insufficiency was the lack of ability to produce reports on Status of Funds. The accounting categories for Status of Funds for MAFR III are not the same as those used in MAFR II, which necessitated a complete system redesign for MAFR III. The concept for MAFR III was approved by Headquarters, Air Force Accounting and Finance Center (AFAFC) with subsequent approval by Headquarters USAF. The project started in December 1962 and was operational in July 1963. A planned schedule of events during development was prepared and coincided with the actual development schedule.

The reengineering of MAFR II to MAFR III was a joint effort of the Directorate of Central Accounting and the Directorate of Data Automation at AFAFC. Specific tasks were assigned to each with continuous coordination of activities.

In general, the Directorate of Central Accounting was responsible for developing the accounting system concept, input formats, edit and balance criteria, output formats, and providing system test data.

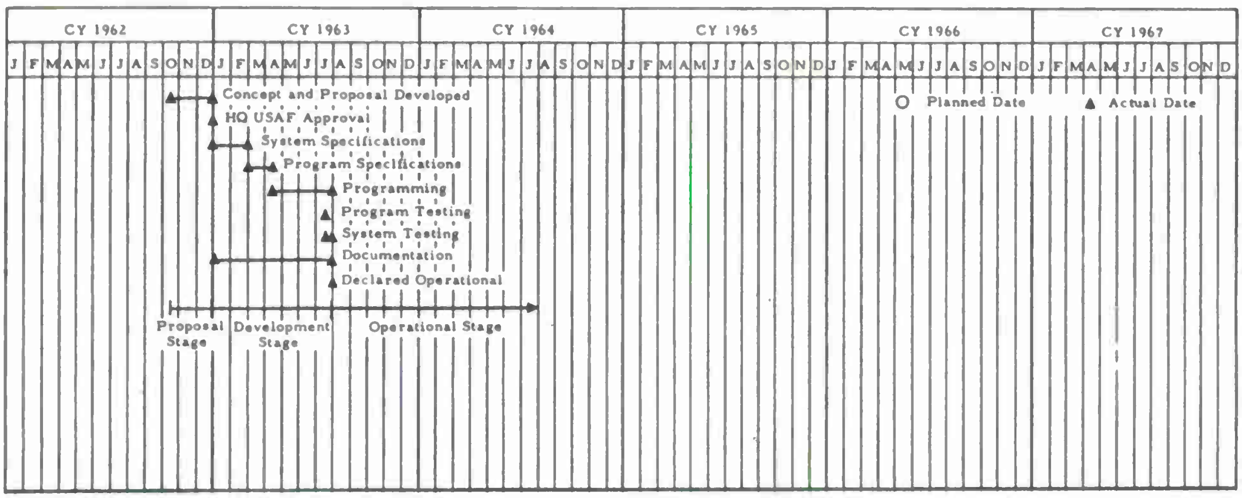
The Directorate of Data Automation was responsible for developing the EDP system concept and specifications, programming and program documentation, and testing and debugging.

A joint responsibility of the two directorates was the implementation plan, developing operational schedules, reviewing systems, test output, establishing "live" operations, and monitoring initial "live" production for conformance to desired output.

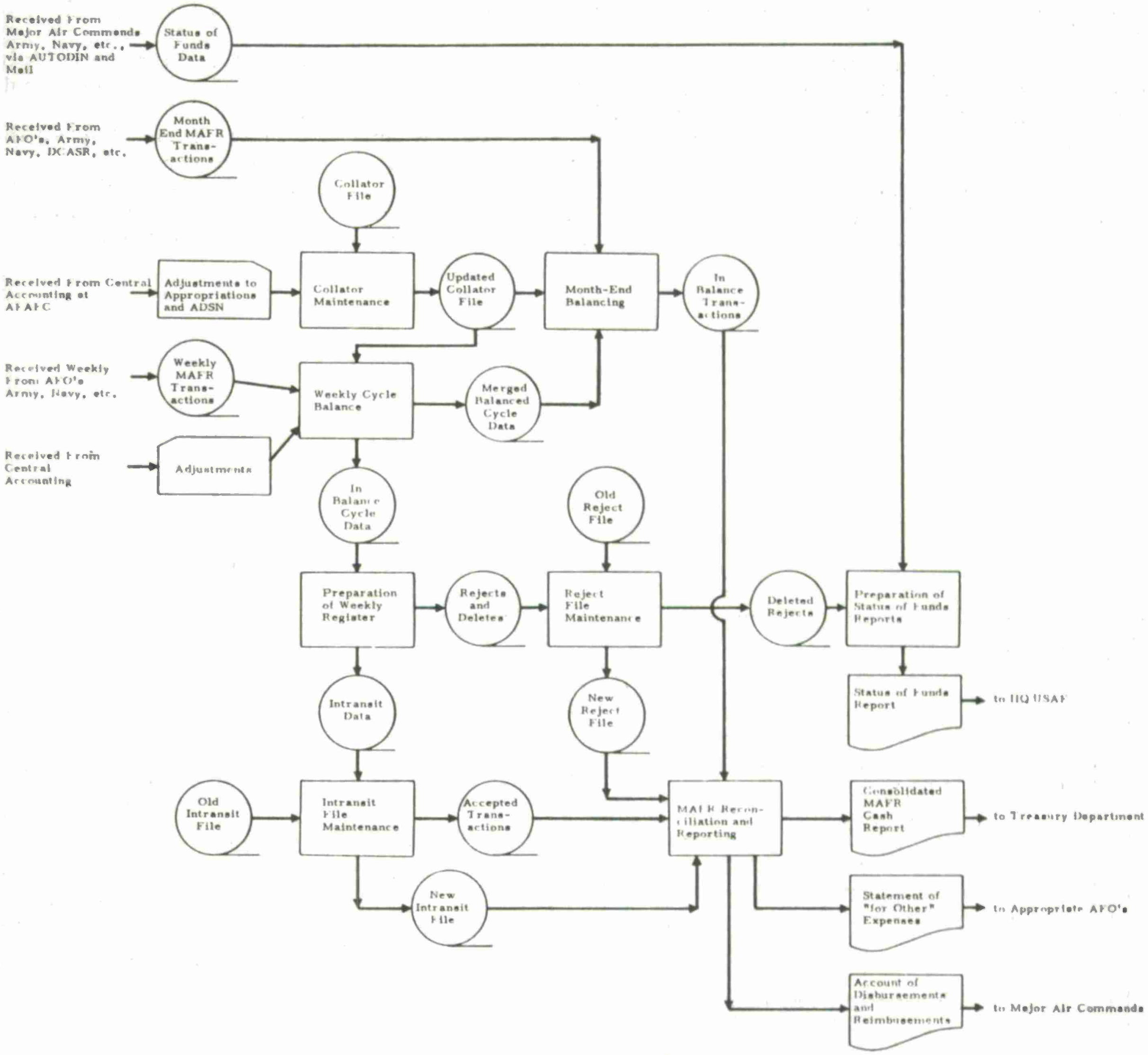
Since MAFR III became initially operational, 63 new programs have been added to the original 95 to add refinements and to satisfy additional customer requirements.

A variety of documents were produced during the development of the MAFR III system. MAFR III is generally a thoroughly documented system, and strong management control resulted in the proper flow and distribution of the generated documentation.

SCHEDULE:



DESCRIPTION: MAFR III is an AF central accounting system for maintaining accountability of cash expenditures and status of funds allocated for specific materials or services. MAFR III enables AFAFC to act as a clearing house for vouchers paid by one Accounting and Finance Office (AFO) for another AFO. Each AFO forwards the vouchers paid for other AFO's to AFAFC along with vouchers for its own payments. AFAFC then forwards the "for others" vouchers to the AFO for whom they were paid. In the process of receiving and distributing these reports, MAFR III maintains a complete Air Force-wide accountability which is consolidated on a monthly basis into the Status of Funds Report and Cash Expenditure Report, which are sent to Hq., USAF, and the Treasury Department, respectively.



WORKLOAD:

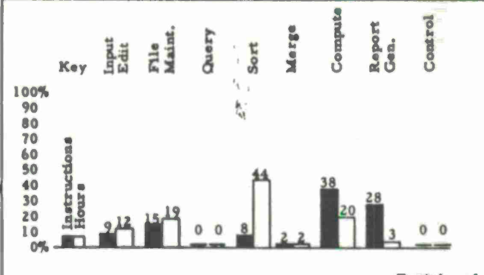
DATA BASE

Char. In Data Base:	28,550,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	11
No. of Data Base Records:	265,000
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	18,880,000

INPUTS

Char./Mo. of Input Volume:	18,880,000
No. of Input Transaction Types:	65
No. of Input Data Fields:	61
Percent of Input Rejects:	1.9

PROCESSING FUNCTIONS

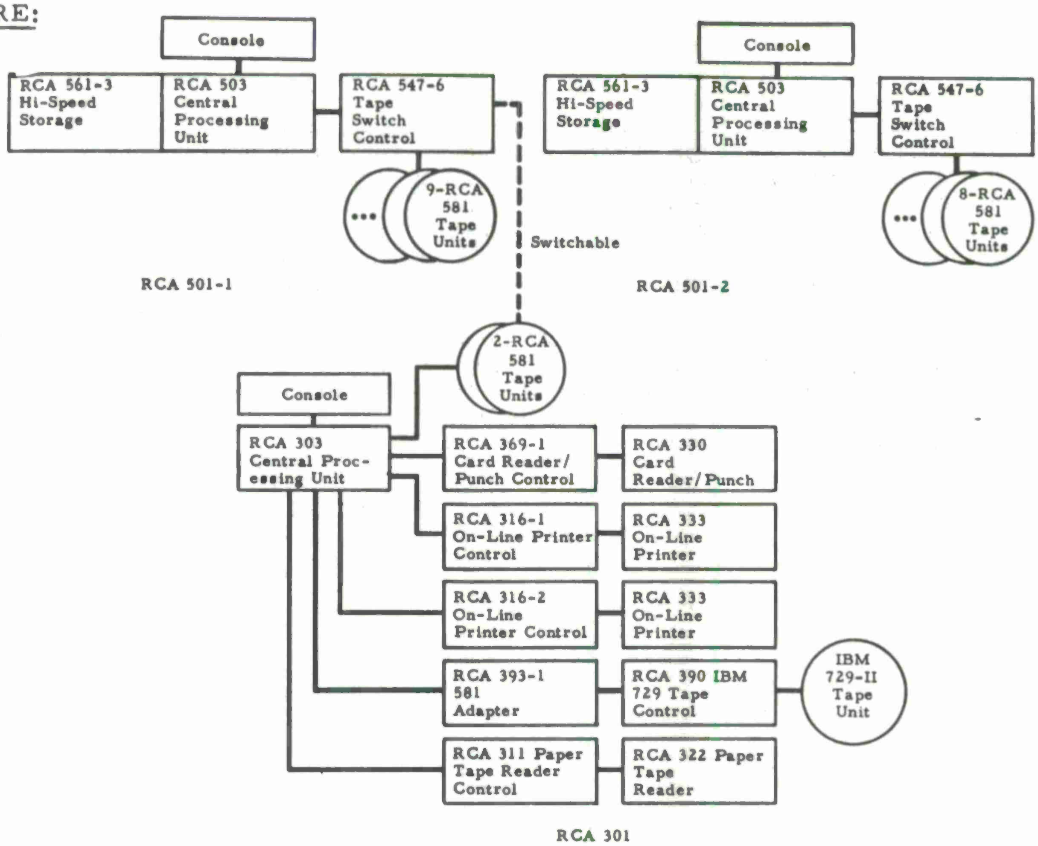


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	25,000	180
Total Object Instructions:	100,200	719
Hrs./Mo. of Application Production:	146	121

OUTPUTS

Char./Mo. of Output Volume:	401,600,000
No. of Output Formats:	156
Response Time (seconds):	NA

HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Internal Storage: Cycle Time (us)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Storage: No. Mag Tapes	External Storage: Trans. Rate	Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)	PT Read/Punch: No.	PT Read/Punch: Speed (char./sec)	PT Read/Punch: Speed (char./sec)
RCA 501	11/59	Char.	360	12	6	32,768	11-581	33K to 66K	None	---	---	None	---	---	---	---
RCA 501	11/59	Char.	360	12	6	32,768	8-581	33K to 66K	None	---	---	None	---	---	---	---
RCA 301	2/61	Char.	67	4.8	6	20,000	1-729-II	15K to 41.6K	1-330	800	250	2-333	1,000	1-322	1,000	100

SOFTWARE: Software for the RCA 501's consisted of the following: (1) a COBOL compiler; (2) an EZCODE assembler; (3) a monitor and loader; (4) a sort and merge program package; and (5) a debugging package.

Comment: Since the RCA computers had already been operational for a considerable period of time prior to MAFR III development, the software was well debugged. The only exception to this was a sort package.

APPLICATION PROGRAM DEVELOPMENT: A systems concept document consisting of flow charts and listings of necessary tasks for the operation of the system was prepared by analysts from the Directorates of Central Accounting and Data Automation within AFAFC. Subsequently, the Directorate of Central Accounting provided the accounting system concept, input formats, edit and balance criteria, output formats, and system test data. The Directorate of Data Automation provided the EDP system concept and specifications, programming and program documentation, testing and debugging. The two directorates jointly provided the implementation plan, operational schedules, a review of the systems test output, and the establishment, monitoring and verification of live operations and production. During checkout of the COBOL programs, the turnaround time was approximately 24 hours. The system was designed to operate on an existing RCA 501 installation. Pert charts, weekly progress reports, and work measurement reports were utilized during development.

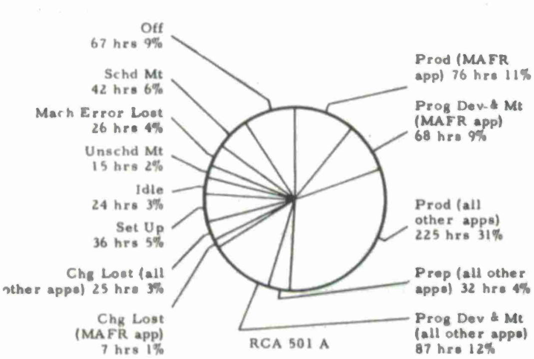
FILE CONVERSION: File conversion to MAFR III formats was an involved process since the file formats of MAFR III differed significantly from those of MAFR II. Special file conversion programs were written to extract information from a number of different MAFR II files and generate the appropriate MAFR III files. Approximately five man-months of effort and 30 computer hours were required to generate the necessary MAFR III data base files prior to system operation.

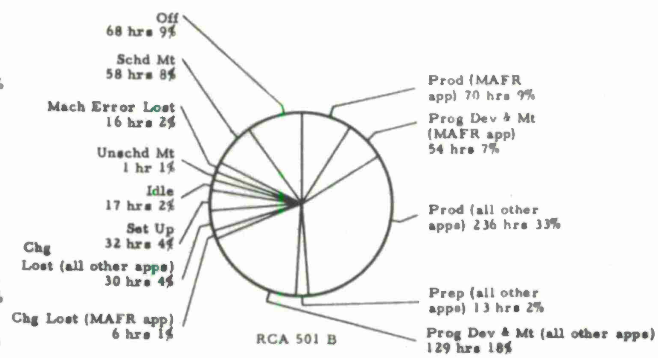
DOCUMENTATION: Documentation was produced during development by both Central Accounting and Data Automation. Among the major documents are the following: Accounting Concepts, ADP System Concept, Customer Requirements, System Specification, Program Packages, Office Instructions, and AF Manuals (a user's manual).

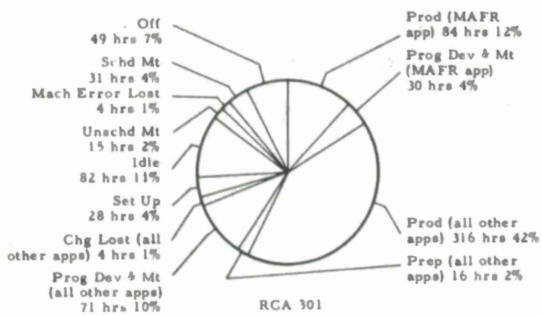
PERSONNEL:

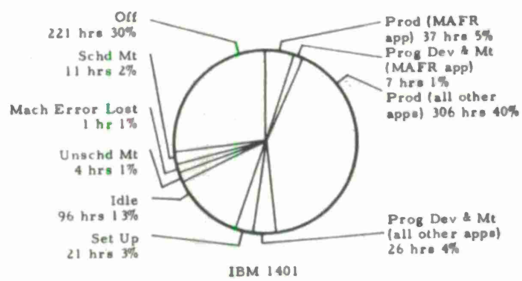
Activity	Function	Number of People Sampled	Number of People Allocated to System	Number of Years In ADP	Number of Years In Accounting	Number of Years Of College
Development	Manager	2	2	11	20.5	4
	Analyst	4	4	4.5	12.5	Unknown
	Programmer	19	19	6	6	Unknown
Operations	Manager	1	0.3	Unknown	Unknown	Unknown
	Operator	8	8	5.5	Unknown	

OPERATIONS: The computer operation is staffed 24 hours a day, 6 and occasionally 7 days a week. It operates as a closed shop. MAFR is only one of several applications run on the two RCA 501's, the RCA 301, and the IBM 1401 computers. A monthly schedule, broken down into a daily and tentative next-day schedule, is utilized.
Comment: The "Other Time" shown in the pie charts is made up of machine maintenance, idle time, machine error lost time, and off time.









APPLICATION PROGRAM MAINTENANCE: There are currently 10 programmers and one analyst involved in program maintenance on MAFR III. Approximately 40 percent of these personnel were involved in the development of MAFR III. Any programming changes resulting in change pages to Customer Requirements, System Specifications, or Supplemental System Specifications must be approved by the Directorates of Central Accounting and Data Automation.

Comment: Program maintenance is driven by the constant system improvement effort and continual changes caused by varying customer requirements. There is very little program correction performed.

BENEFITS: Proposed: MAFR III was to be a reengineering of the existing MAFR II system. MAFR III was to operate on the same equipment as MAFR II. The primary objective of MAFR III (as opposed to MAFR II) was to reduce the undistributed balances so that distributed balances could be used in current Status of Funds reports.

Actual: MAFR II successfully reduced undistributed balances, from $250 to $300 million under MAFR II to approximately $40 million. This enabled more accurate and timely reports of Status of Funds to be produced. The development of MAFR III was based on the improvement of products being produced by MAFR II.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 392

Comment: No formal proposal was prepared for MAFR III. A systems concept was prepared for MAFR III by analysts from Data Automation and Central Accounting within AFAFC. This document consisted of flow charts and listings necessary for the operation of MAFR III.

Months of Elapsed Development Time (Dev.)

Proposed: 7

Actual: 7

Comment: The target operational date established in the systems concept document was 1 July 1963.

Dollars of Hardware Cost for Program Checkout

Proposed: Unk

Actual: 73,900

Comment: Program checkout occurred from April to August 1963 on the RCA 501. A total of 916 hours was used for program and system checkout.

Hours/Month of Hardware Use for Application Production

Proposed: Unk

Actual: 146

Comment: The actual number reflects usage during March 1966 on the two RCA 501 computers. One hundred twenty-one hours were used for MAFR application production on the peripheral RCA 301 and the IBM 1401.

Hours/Month of Hardware Use for Program Maintenance

Proposed: Unk

Actual: 122

Comment: The actual number reflects usage during March 1966 on the two RCA 501 computers. Thirty-seven hours were used for MAFR program maintenance on the peripheral RCA 301 and the IBM 1401.

Number of Operations Personnel

Proposed: Unk

Actual: 8.3

Comment: The actual number of personnel is prorated from 35 people based on machine hours for MAFR.

Number of Program Maintenance Personnel

Proposed: Unk

Actual: 11

Comment: The actual number of personnel represents 10 programmers and 1 analyst allocated to MAFR program maintenance.

Dollars/Month of Hardware Cost

Proposed: Unk

Actual: 32,259

Comment: None.

FUTURE PLANS: A conversion to RCA 3301 computers is planned to relieve the overloaded RCA 501 computers. The programming impact of this conversion will be minimal since the vast majority of application programs are written in COBOL. Studies are being made to include long-range AF and DOD objectives which could result in major changes in the MAFR III system; however, no specific plans have been approved at this time.

SYSTEM: Air Force MILSTAMP Central Data Collection--MILSTAMP (UNIVAC 1050/1107)

DATA SYSTEM DESIGNATOR: O025E

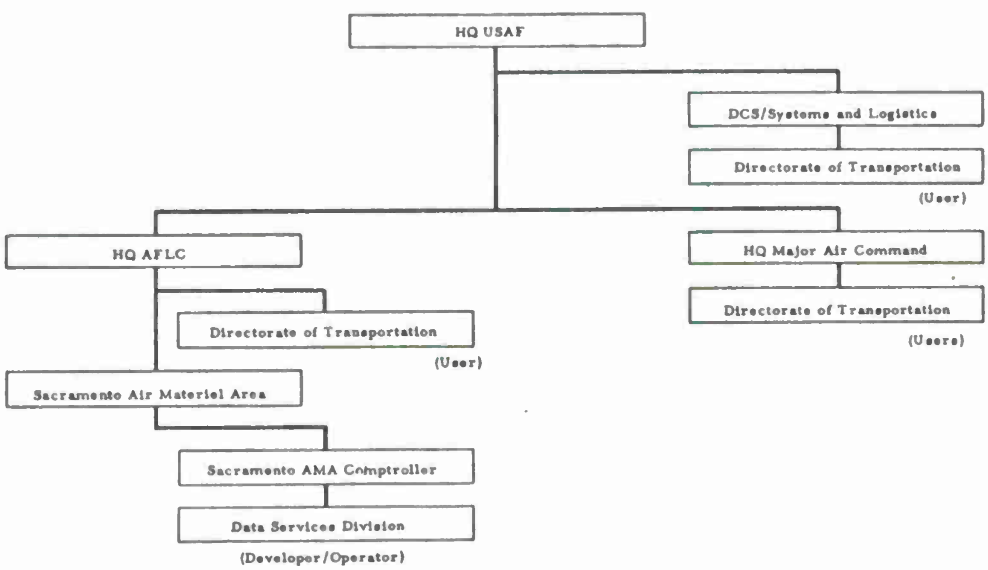
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Data Services Division Sacramento Air Materiel Area McClellan Air Force Base Sacramento, California
Development	Sacramento Air Materiel Area McClellan Air Force Base California
Maintenance	Sacramento Air Materiel Area McClellan Air Force Base California
Pilot Installation	None
First Operational Installation	Sacramento Air Materiel Area McClellan Air Force Base California
Number of Operational Installations	1

FUNCTION: The users of MILSTAMP are the Directorate of Transportation, Headquarters USAF; Directorate of Transportation, Headquarters AFLC; and the Directorates of Transportation of USAF Air Command. A common mission of the users is to evaluate military and civilian carrier performance by measuring and establishing standard transit and hold times. MILSTAMP functions as a management support system to prepare reports from "in transit" data pertaining to worldwide Air Force shipment and transshipment activities on a monthly basis for the users.

ORGANIZATION:



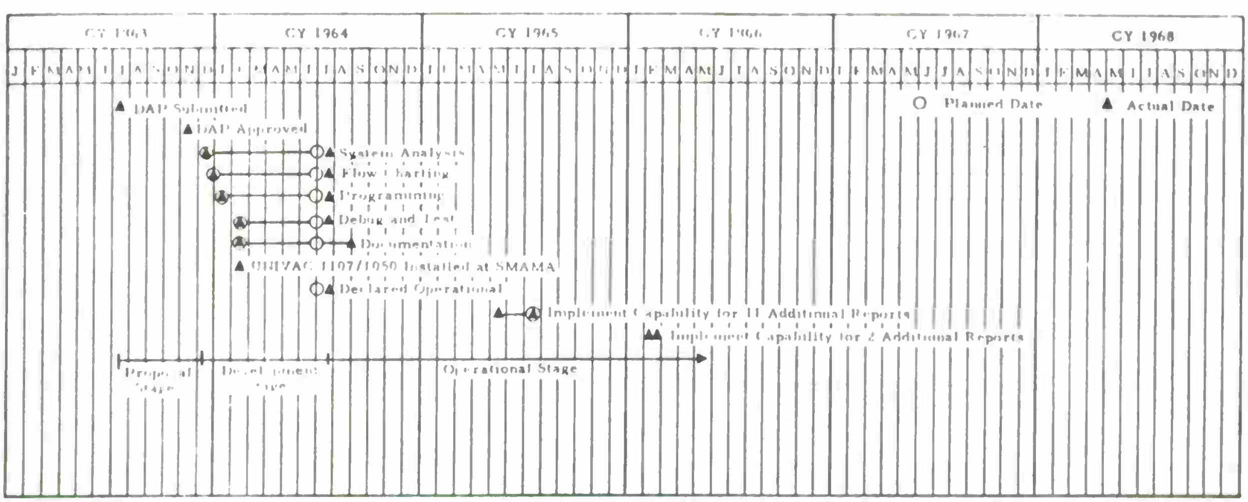
HISTORY: A Data Automation Proposal to develop the Air Force MILSTAMP Central Data Collection system was forwarded by Headquarters AFLC to Headquarters USAF in July 1963, based on a DOD directive to implement Military Standard Transportation and Movement Procedures (MILSTAMP) by October 1963. Approval of this system was granted by Headquarters USAF in a letter of 13 November 1963, which directed the collection of MILSTAMP intransit data to begin in April 1964 and implementation of the ADPS by July 1964 at the Sacramento Air Materiel Area, utilizing the UNIVAC 1050/1107 scheduled for implementation in February 1964.

In the system implemented in July 1964, the Sacramento Air Materiel Area was receiving intransit data cards and transportation control and movement documents and producing five transit reports. In May 1965 an additional requirement to provide 11 pipeline reports was imposed by Headquarters AFLC with Headquarters USAF approval. The second phase consisted of modifications to the Shipment Status Report from the Inventory Management Stock Control and Distribution System to prepare the additional reports. This modification increased the number of computer runs from 13 to over 30. Implementation of this phase was accomplished on schedule in July 1965.

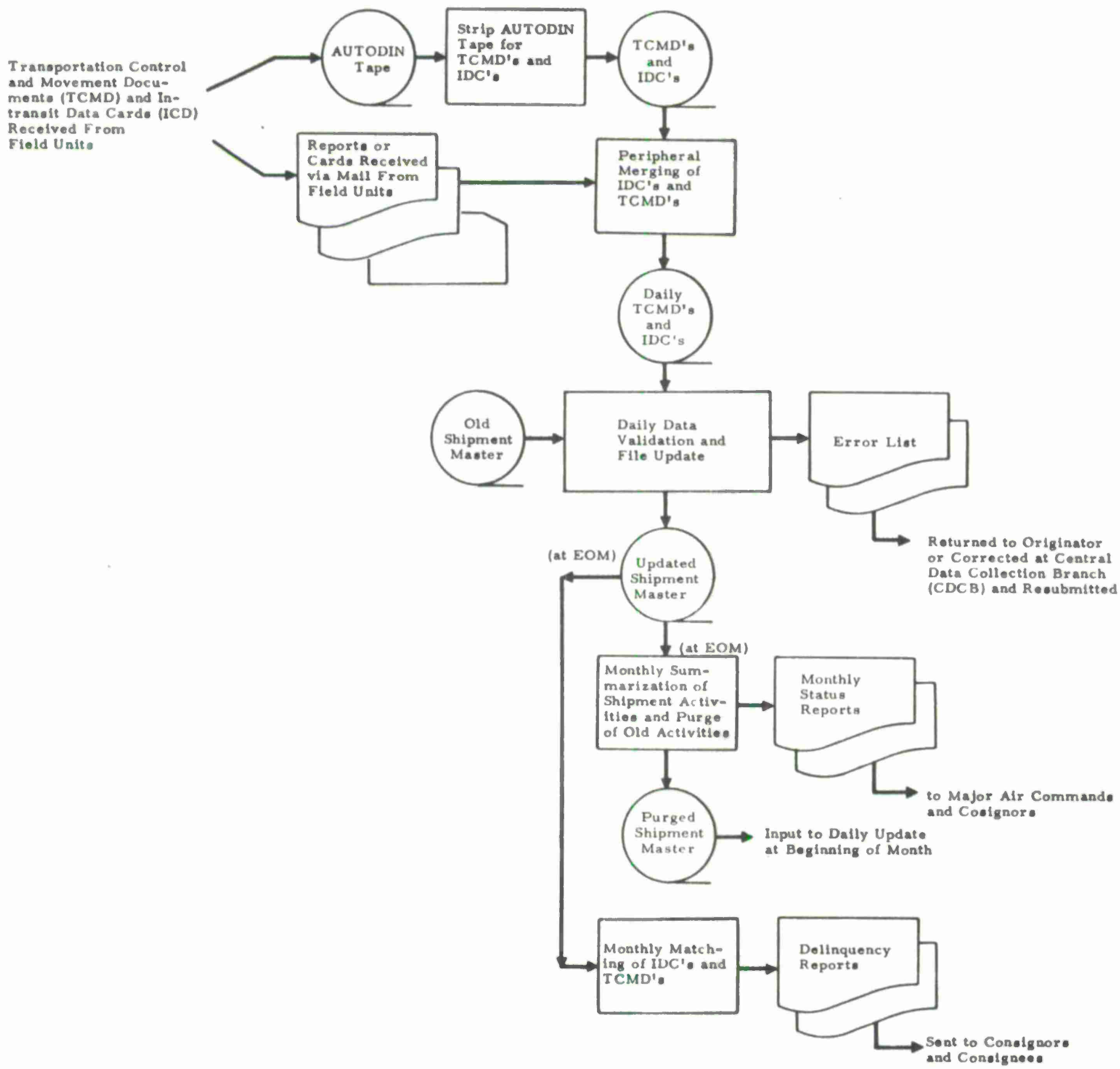
Due to the size of the development activity (six people), the management procedures were quite informal. All progress reporting between the programmers and the project leader were informal. The project leader prepared monthly progress reports for AFLC showing percentage of completion and man-hours expended. The development and implementation were on schedule.

The system has never been fully documented. All documentation at Sacramento is still in rough draft form. The project leader does most of the documentation with contributions from the programmers. AFLC Manual 300-78 will contain the system documentation when it is completed.

SCHEDULE:



DESCRIPTION: Field units submit Transportation Control and Movement Documents (TCMD) and Intransit Data Cards (IDC). The TCMD serves as advance notice of a shipment and is used primarily for suspense and control. The IDC reflects the history of a shipment. The submissions, which are by card, paper document, and AUTODIN, are stored on magnetic tape for input to the computer. On a daily basis, all new TCMD's and IDC's go through a complete data validation. Erroneous data are recycled to their source for correction, and valid data are placed on a master file. Each month, (1) all TCMD and IDC areas are summarized by activity, and reports are sent to major air commands and field activity areas to police MILSTAMP procedures; (2) IDC's and TCMD's held in suspense are compared to detect delinquent shipments; and (3) management reports are produced.



WORKLOAD:

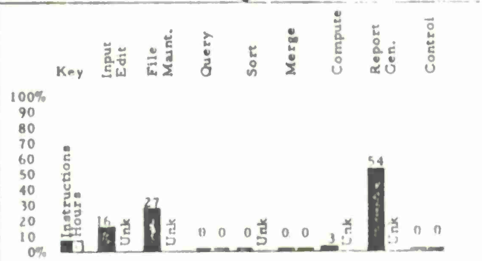
DATA BASE

Char. in Data Base:	28,680,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	3
No. of Data Base Records:	399,880
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	57,880,000

INPUTS

Char./Mo. of Input Volume:	57,880,000
No. of Input Transaction Types:	3
No. of Input Data Fields:	60
Percent of Input Rejects:	8

PROCESSING FUNCTIONS

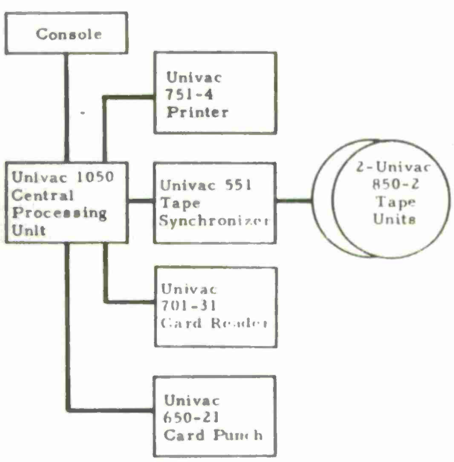


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	24,310	Unk
Total Object Instructions:	97,250	Unk
Hrs./Mo. of Application Production:	41	29

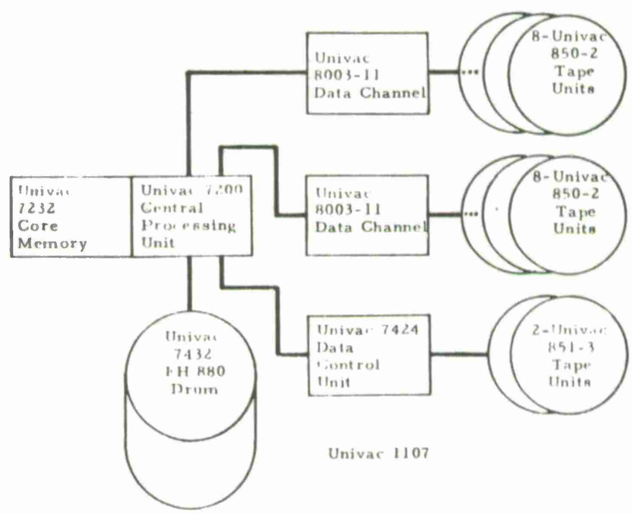
OUTPUTS

Char./Mo. of Output Volume:	11,950,000
No. of Output Formats:	21
Response Time (seconds):	NA

HARDWARE:



Univac 1050



Univac 1107

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (µs)	Internal Storage: Cycle Time (µs)	Internal Storage: Word/Char. Size (bits)	Internal Storage: Word/Char. Capacity	External Storage, Mag Tapes: No. Mag. Tapes	External Storage, Mag Tapes: Trans. Rate	External Storage, Drum: No. Disks	External Storage, Drum: Trans. Rate	External Storage, Drum: Char. Capacity	External Storage, Drum: Access Time (ms)	Peripheral Devices, Card Reader/Punch: No.	Peripheral Devices, Card Reader/Punch: Read Speed (cards/min)	Peripheral Devices, Card Reader/Punch: No.	Peripheral Devices, Card Reader/Punch: Punch Speed (cards/min)	Peripheral Devices, Printer: No.	Peripheral Devices, Printer: Speed (lpm)
UNIVAC 1050	9/63	Char.	117	4.5	6	12K	2-850-2	8K to 133K	None	---	---	---	1-701-31	900	1-650-21	300	1-751-4	900
UNIVAC 1107	9/62	Word	4	4	36	32,768	16-850-2 2-851-3	8K to 133K 25K to 120K	1-FH-880	360K	4.7M	17	None	---	None	---	None	---

Comment: The UNIVAC 1050 is used as the peripheral computer while the UNIVAC 1107 does the main system processing.

SOFTWARE: Software delivered with the equipment by UNIVAC consisted of a COBOL compiler, an assembler, hardware diagnostics, debugging aids, an Executive Control System and various utility routines. The MILSTAMP system used the following software packages on the UNIVAC 1050: (1) card to tape; (2) tape to card; (3) tape to printer; and (4) card to printer. On the UNIVAC 1107, MILSTAMP used the following software: (1) a sort package; (2) a merge package; (3) an Executive Control System; and (4) a COBOL compiler.

Comment: The Executive Control System provided for automatic sequencing of a scheduled set of computer jobs, allocation of memory and peripheral equipment, input/output operations, and concurrent processing of 1107 programs. Difficulties experienced with use of the software during program checkout were attributed to inadequate documentation. Discrepancies in the documentation of the typewriter messages from the Executive Control System presented a particular problem. Three UNIVAC programmer/analysts were extremely useful in locating software problem areas.

APPLICATION PROGRAM DEVELOPMENT: The task of developing the system at SMAMA was assigned to the System Section of the Centralized Command Systems Branch within the Data Services Division. Hq. AFLC supplied the system specifications from which came the system design to provide the required reports. The analyst responsible for the system design then assigned and supervised the program development effort through to final implementation. Five programmers were utilized to develop the system and write the programs in COBOL. Each program was checked out separately, using dummy test input from the analyst, with no formal system test. A 24-hour turn-around was normal during the development period, with the programmers being allowed to stand by during their tests to aid the operators in locating difficulties. The redesign of the system was accomplished to produce 11 more reports and accept additional input. Of the original 13 programs, 8 required revision, which tended to reduce the system efficiency. Difficulties with the software were experienced during program checkout and this was attributed to inadequate documentation. Discrepancies in the documentation of the typewriter output messages from the Executive System presented a particular problem. The programmers relied heavily upon 3 programmer/analysts supplied by UNIVAC to locate problem areas not locatable from the Executive output. The original system checkout used 95 hours on the 1107, and 114 hours on the 1050. The redesigned system checkout required 100 hours on the 1107, and 200 hours on the 1050. Due to the size of the development activity (six people), the management procedures were quite informal. All progress reporting between the programmers and the project leader was informal. The project leader prepared monthly progress reports for AFLC showing percentage of completion and man-hours expended. These reports were approved by the Branch Chief to whom the project leader made periodic informal progress reports.

FILE CONVERSION: The TCMD and IDC records were used daily as input for creation of MILSTAMP files. There was no requirement, therefore, for a one-time conversion of any records or files.

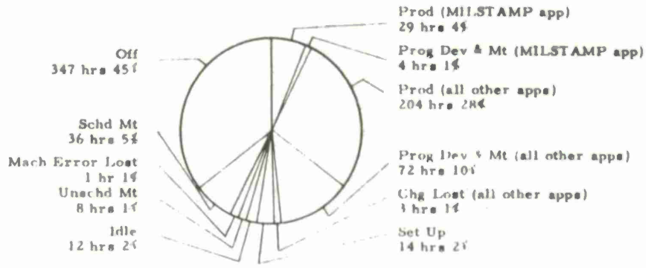
DOCUMENTATION: System documentation has not progressed beyond a draft form. It is planned that formal documentation of MILSTAMP will be put into AFLC Manual 300-78.

PERSONNEL:

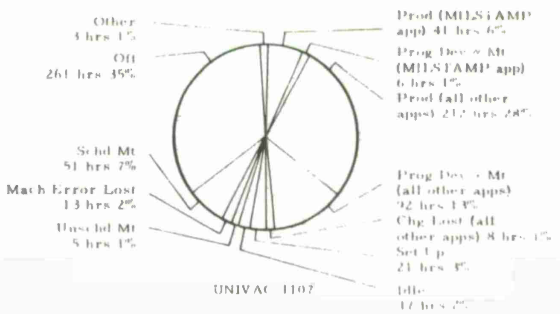
Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Logistics	Of College
Development	Manager	1	1	9	4	4
	Analyst	1	1	9	4	Unknown
	Programmer	2	5	7	1.5	Unknown
Operations	Manager	None	Unknown	Unknown	Unknown	Unknown
	Operator	None	4.5	Unknown	Unknown	

OPERATIONS: The computer operation is staffed regularly 8 hours a day, 5 days a week, plus any additional time required due to workload. It operates as a closed shop. MILSTAMP is one of several applications run on the UNIVAC 1107/1050 computers. A daily schedule is followed by the installation.

Comment: The "Other Time" in the pie chart is manufacturer modification time.



UNIVAC 1050



UNIVAC 1107

APPLICATION PROGRAM MAINTENANCE: Currently there are two programmers (vacancies exist for two more) and one system analyst involved in program maintenance. Each of the programmers spends 75 percent of his time on MILSTAMP, with 50 percent for the analyst. Much of the programming maintenance activity is developing programs and procedures for special reports required by Headquarters USAF. In 1965, 30 such reports were produced. Program corrections and improvements take up the remainder of the time.

Comment: None.

BENEFITS: Proposed: DOD directed all DOD agencies to implement MILSTAMP procedures. The Air Force MILSTAMP Central Data Collection System at the Sacramento Air Materiel Area was proposed to supply data on all AF transportation activities to the Defense Supply Agency (DSA). DSA was to be responsible for consolidating transportation information from all DOD agencies. Benefits to result from MILSTAMP implementation were to include the capability to establish standard transit and hold times, permitting an evaluation of military and civilian carrier performance. Further benefits were reduction in pipe-line times, resulting in reduction in materiel inventories.

Actual: MILSTAMP potential benefits have been affected by lack of response from consignors or consignees and a high error rate from those who have responded. Since implementation, response has continually improved and the error rate gradually reduced due to education and aggressive policing action.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 61

Comment: The DAP prepared for MILSTAMP did not state the man-months that would be required for initial development of the system. It did state, however, that two analysts and three programmers would be provided for initial program development from existing AFLC resources. A major redesign of MILSTAMP, called Phase II development, was accomplished in the period May to July 1965. Ten actual man-months of development effort were needed for Phase II. The actual number represents both Phase I and Phase II development efforts.

Months of Elapsed Development Time (Dev.)

Proposed: 7

Actual: 11

Comment: A letter from Hq. USAF approving the AFLC DAP for MILSTAMP stated that MILSTAMP would be operational not later than 1 July 1964. Many problems were experienced with the software during initial Phase I program checkout because of inadequate documentation. It is believed that this factor contributed significantly to the 1-month schedule slippage. The actual number shown here reflects the 8 months elapsed for the initial Phase I development and the 3-month Phase II development.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 70,847

Comment: Program checkout for Phase I development occurred during the period 17 March to 31 July 1964. Program checkout for Phase I required 95 hours on the UNIVAC 1107 computer and 114 hours on the UNIVAC 1050 computer. Phase II program checkout was accomplished in the period May to July 1965, when 2-1/2 hours each day were allocated to program checkout. Phase II program checkout required 100 hours on the UNIVAC 1107 and 200 hours on the UNIVAC 1050. The actual cost shown here is for both Phase I and Phase II.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 41

Comment: The actual number reflects usage during March 1966 on the UNIVAC 1107. Twenty-nine hours were used for MILSTAMP application production on the peripheral UNIVAC 1050.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 6

Comment: The actual number reflects usage during March 1966 on the UNIVAC 1107. Four hours were used for MILSTAMP program maintenance on the peripheral UNIVAC 1050.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 4.5

Comment: The DAP for MILSTAMP stated a proposed number of 31 operators on the basis of a normal 24-hour, 7-day week operation. The actual number of personnel is prorated from 24 operators based on machine hours for MILSTAMP.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 2

Comment: The actual number of personnel is prorated from 2 programmers and 1 analyst based on time spent on MILSTAMP program maintenance.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 18,280

Comment: None.

FUTURE PLANS: Currently, there are no plans to make any major improvements in the programs or the system. There is a requirement, however, that MILSTEP be implemented 1 October 1966. There is also some discussion that DOD would like SMAMA to become the central collection agency for all DOD activities. It is estimated that this action would require 13 new processing runs and modification to 8 of the current MILSTAMP runs.

SYSTEM: Missile Simulation--MISSIM (IBM 7094)

DATA SYSTEM DESIGNATOR: B154 and B276

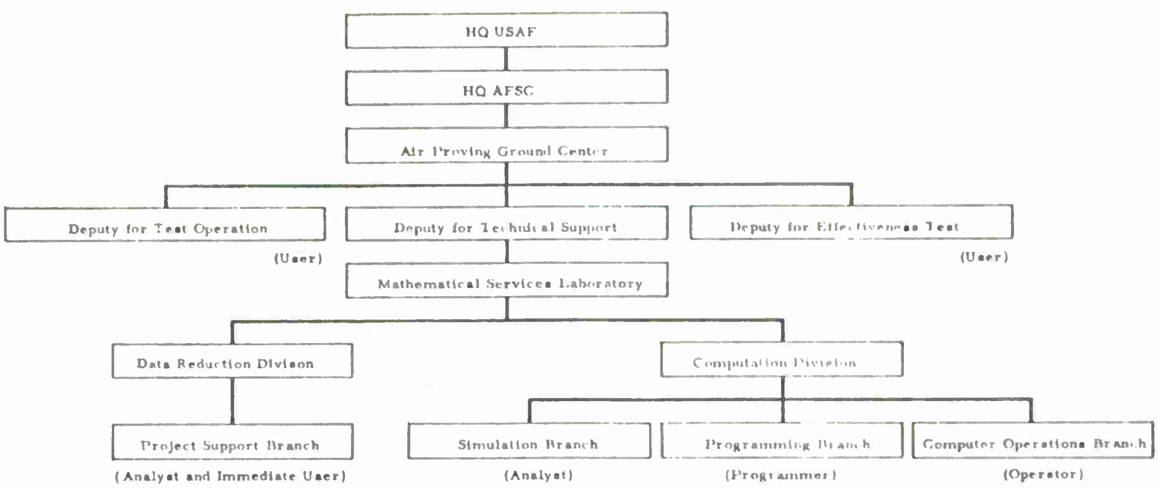
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Data Systems and Statistics Mathematical Services Laboratory Eglin Air Force Base Valparaiso, Florida
Development	Air Proving Ground Center Eglin Air Force Base Florida
Maintenance	Air Proving Ground Center Eglin Air Force Base Florida
Pilot Installation	None
First Operational Installation	Air Proving Ground Center Eglin Air Force Base Florida
Number of Operational Installations	1

FUNCTION: The users of MISSIM are the Deputy for Test Operations and the Deputy for Effectiveness Test, Air Proving Ground Center of the Air Force Systems Command. The mission of the users is to conduct and evaluate Air Force weapons effectiveness tests. MISSIM functions as a research and development support system to simulate the firing of one or more ground-to-air missiles at an aircraft target for purposes of determining the closest approach of the missiles to the target. The flight path of the target is described with data from a control radar tracking an actual aircraft flying a simulated sortie.

ORGANIZATION:



HISTORY: Informal discussion at the Air Proving Ground Center (APGC) between the user (Deputy for Test Operations) and the developer/operator (Mathematical Services Laboratory) resulted in a letter dated 14 February 1963, directing the Mathematical Services Laboratory to produce "a missile simulation and target track comparator program" for the IBM 7094. The specifications for the desired programs likewise grew from informal discussions and meetings.

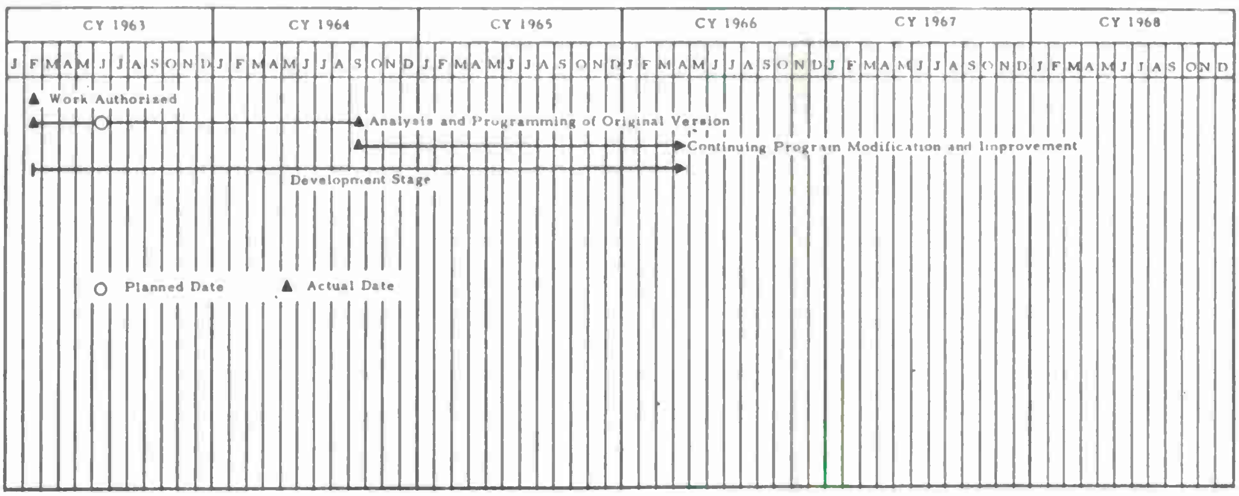
The first target track comparison program became operational in August 1963 and the first missile simulation program became operational in September 1964. Because the physical characteristics of the guidance radar and the missile being simulated have changed continually, the Missile Simulation development has been marked by continually evolving programs. When the program changes become extensive on a cumulative basis, the Mathematical Services Laboratory rewrites the entire program.

Until August 1965, the Missile Simulation suffered from a relatively low priority compared with other APGC projects. Since that time, events exterior to APGC have caused the simulation to enjoy a high priority.

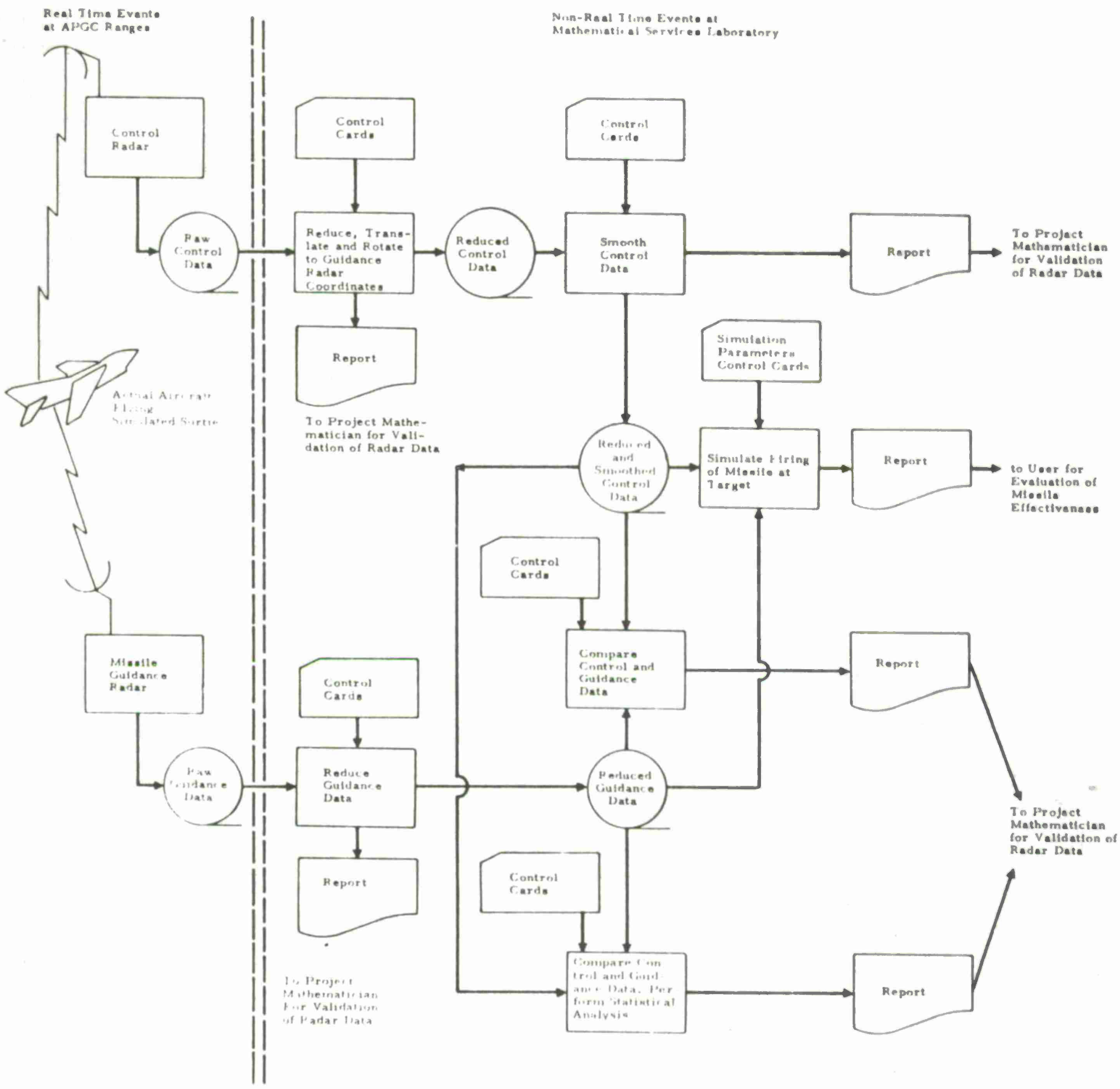
The communication flow from user to project mathematician to programmer was rigidly adhered to. There was virtually no skipping of rungs on the communication ladder. The project mathematicians acted in a coordinator/analyst role between the user and programmer, principally for the more technically oriented radar and missile portions of the simulation. Communication between the user and analyst was infrequent, whereas communication between the analyst and programmer occurred daily. There was no comprehensive system design document.

The Missile Simulation inputs and outputs are classified, as are the particular technical characteristics of the equipment being simulated. The initial analysis was somewhat hindered by these security factors, resulting in a delay in development.

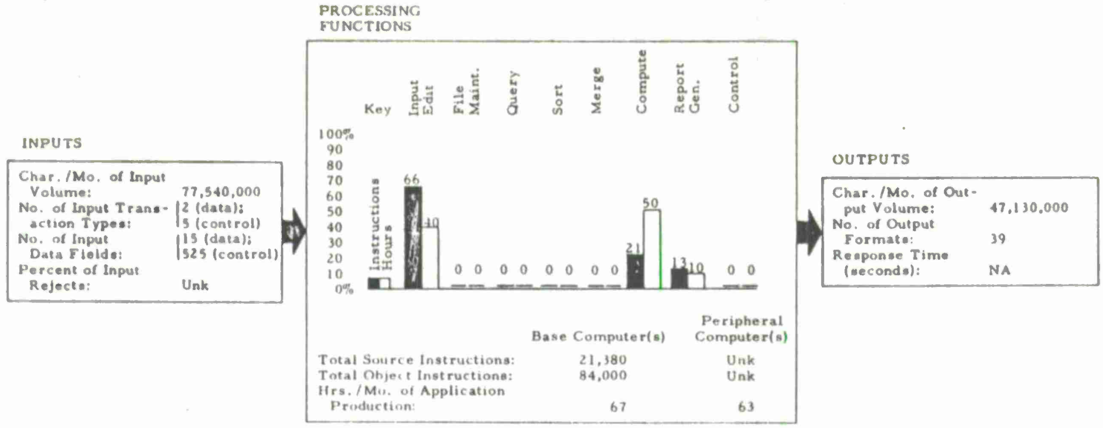
SCHEDULE:



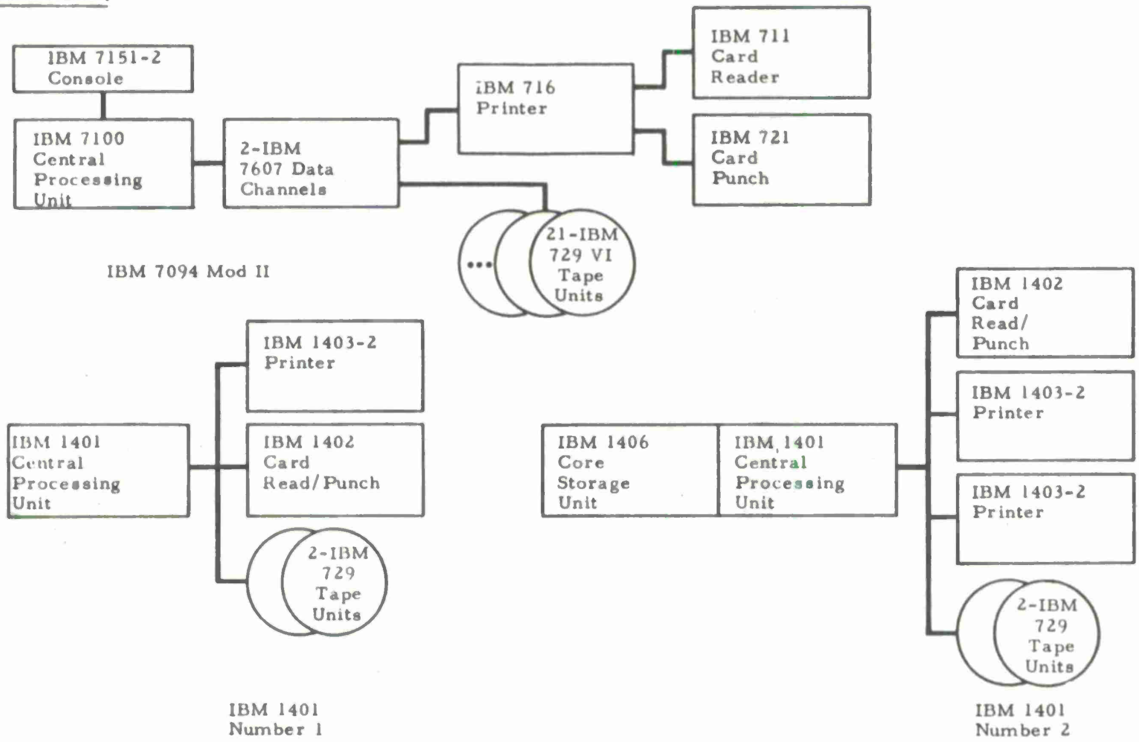
DESCRIPTION: The firing of one or more ground-to-air missiles is simulated to determine the closest approach of the missiles to the target. Actual target track data are gathered at APGC test ranges by flying simulated missions with actual aircraft. Two radars collect data: a control radar with pre-established accuracy and an experimental missile guidance radar.



WORKLOAD:



HARDWARE:



				Internal Storage			External Storage		Peripheral Devices				
									Card Reader/Punch			Printer	
Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Cycle Time (us)	Word/Char. Size (bits)	Word/Char. Capacity	No. Mag Tapes	Trans. Rate	No.	Read Speed (cards/min)	Punch Speed (cards/min)	No.	Speed (lpm)
IBM 7094-II	4/64	Word	1.4	1.4	36	32K	21-729 VI	22.5K-62.5K	1-711	250	100	1-716	150
IBM 1401	9/60	Char.	230	11.5	6	4K	2-729	22.5K-62.5K	1-1402	800	250	1-1403	600
IBM 1401	9/60	Char.	230	11.5	6	8K	2-729	22.5K-62.5K	1-1402	800	250	2-1403	600

Comment: Due to a stauration condition on the large computer a second IBM 7094-II has been delivered recently.

SOFTWARE: Software for the IBM 7094 consisted of an IBSYS Executive Monitor, a FORTRAN IV compiler, and a FAP assembler. The software was delivered by IBM with the equipment in April 1966.

Comment: The only shortcoming of the software was the inability of IBSYS to handle real-time inputs.

APPLICATION PROGRAM DEVELOPMENT: The communications between user, project mathematician, analyst, and programmer were well defined by management. The user interfaced only with the project mathematician or analyst who in turn interfaced with the programmer. Communication between user and analyst was infrequent and informal, while communication between analyst and programmer was informal with little documentation. There was no comprehensive system design document. The programming effort, conducted at the Mathematical Services Laboratory, utilized an existing IBM 7090 (later 7094) computer configuration. Three concurrent programming activities proceeded during development: (1) writing new programs to reduce the raw data from the guidance radar; (2) modification of existing data reduction and comparative programs to accept a new type guidance radar data; and (3) programming the missile simulation program itself. The programs, written in FORTRAN IV and FAP assembly language, were checked out individually and not as a system due to their extreme independence. Checkout of the simulation program was hampered by lack of radar data tapes. Records of program development hours were not kept. The programmers documented their programs when they became operational.

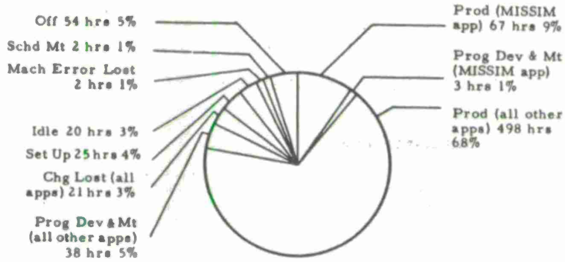
FILE CONVERSION: No file conversion was involved in MISSIM development.

DOCUMENTATION: Design documentation was limited; communication occurred on an informal basis between analyst and programmer. At the time of initial operation, the programmer created user documentation on punched cards, which could be updated or listed easily. There was no detailed program documentation.

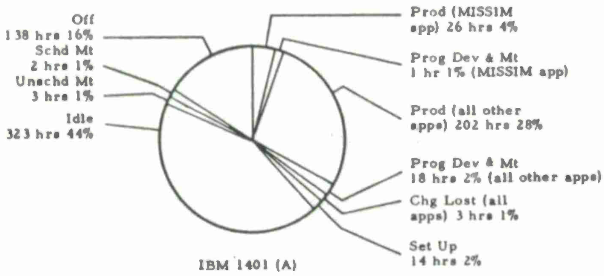
PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Scientific Computation	Number of Years: Of College
Development	Manager	1	1	15.0	15.0	4.0
	Analyst	2	2	12.0	11.0	5.0
	Programmer	3	3	6.0	6.0	4.0
Operations	Manager	3	0.3	10.0	9.0	2.0
	Operator	0	2.1	Unknown	Unknown	

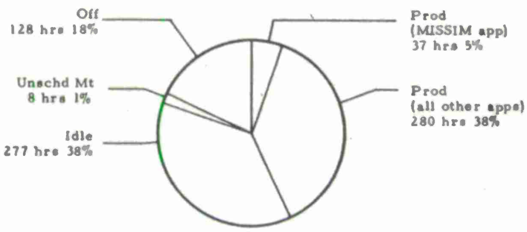
OPERATIONS: The computer operation is staffed 24 hours a day, 7 days a week. It operates as a closed shop. MISSIM, which is run 26 times per month, is one of many applications run on the IBM 7094/1401 (A and B) computers. IBSYS controls operations on the IBM 7094 90 percent of the time, doing stacked jobs. Scheduling is on a "first come, first served" basis, with priority consideration. A 50 to 150-hour backlog normally exists.
Comment: Excellent hardware reliability is reflected in low machine maintenance times. It was not possible to determine the "other time" origin, but it was most likely "off time."



IBM 7094



IBM 1401 (A)



IBM 1401 (B)

APPLICATION PROGRAM MAINTENANCE: The application program maintenance effort is essentially a continuation of the application program development effort. The development analysts and programmers are also the maintenance analysts and programmers and the same informal methods of communication among user, analyst, and programmer are used.

Comment: The program maintenance effort is relatively large because the characteristics of the guidance radar and missile being simulation have changed continually. Also, the users continually impose new requirements in the simulation capability. Programs are completely rewritten when accumulated changes become extensive.

BENEFITS: Proposed: The primary benefit from MISSIM was planned to be a system for missile simulation and target track comparison.

Actual: A system of programs has enabled MISSIM users to simulate the flight of one or more ground-to-air missiles at an aircraft target for the purpose of determining the closest approach of the missile to the target. This represents a capability not formerly available to users at APGC. No cost saving figures are available, since these computations were not made prior to MISSIM.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 66

Comment: No formal proposal was prepared for MISSIM. The project germinated from informal discussions between PGO (user) and PGM (developer). These discussions resulted in a letter from PGO to PGM dated 14 February 1963 requesting that "a missile simulation and target track comparator program" be developed for the IBM 7094 computer. Even though the user did not rigidly specify the system characteristics to the developer, continued informal interaction resulted in a system that satisfies the current user needs.

Months of Elapsed Development Time (Dev.)

Proposed: 4

Actual: 38

Comment: The user, PGO, made the request in their letter to the developer, PGM, for a 15 June 1963 initial capability. It became apparent that this date was unrealistic, and it was disregarded. The actual number of months shown here is from 14 February 1963 to the current date.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: Unk

Comment: Records of computer hours by program were not kept before December 1964. Some programs on which records were kept after that date had more than one application. Other development costs not included were for checkout runs performed to assist engineers in checkout of hardware changes. These factors make it impossible to determine MISSIM program checkout hours.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 67

Comment: The actual number reflects usage during March 1966 on the IBM 7094. Sixty-three hours were used for MISSIM application production on the peripheral IBM 1401 computer.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 3

Comment: The actual number reflects usage during March 1966 on the IBM 7094. One hour was used for MISSIM program maintenance on the peripheral IBM 1401 computer.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 2.1

Comment: The actual number of personnel is prorated from 22 people on the basis of machine hours for MISSIM.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 1.2

Comment: The actual number of personnel is prorated from three programmers, two analysts, and one manager on the basis of time devoted to MISSIM program maintenance. Current programming activity is considered to be more closely related to program development than program maintenance because of the continually evolving development of MISSIM programs.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: $1,566

Comment: None.

FUTURE PLANS: MISSIM undergoes continual modification to reflect changes in the guidance radar inputs and missile parameters. Currently, a new Rigid Body Program, No. 827, is being checked out by Lockheed, Sunnyvale, the program's developers, at the Mathematical Services Laboratory. This program is functionally equivalent to two existing programs, nos. 595 and 708, in that it accepts both real and theoretical flight data. Program 827 also includes new autopilot equations and equations of motion. The majority of output reports from program 827 are in the form of graphs produced on the Stromberg-Carlson 4020 microfilm recorder. It is unlikely that program 827 will completely replace 595 and 708 since it requires four times as much computer time as 595 or 708. Program 595 is thus being modified to output on the SC 4020 in the same manner as 827. Lockheed also is developing a program, no. 802, to produce aircraft flight data which will be input to 827 in the theoretical mode of operation.

SYSTEM: Orbit Determination and Analysis--ORBIT (IBM 7044)

DATA SYSTEM DESIGNATOR: B011

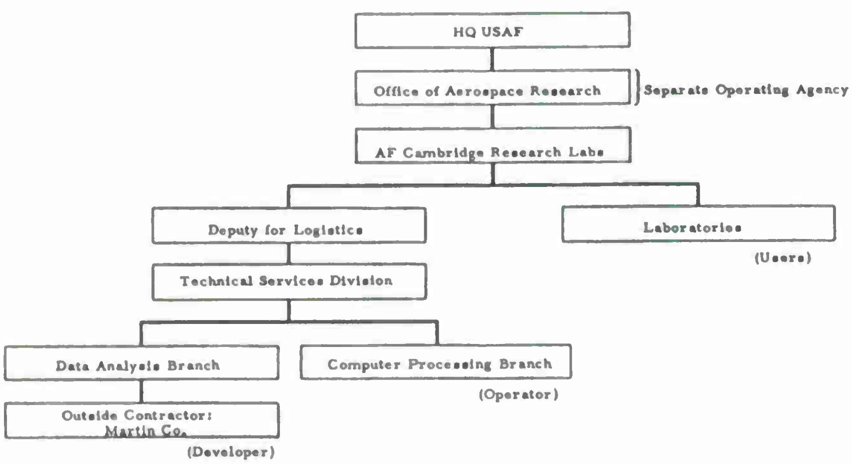
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Data Analysis Branch Technical Services Division Air Force Cambridge Research Labs Hanscom Field, Bedford, Massachusetts
Development	Air Force Cambridge Research Labs Laurence G. Hanscom Field Massachusetts
Maintenance	Air Force Cambridge Research Labs Laurence G. Hanscom Field Massachusetts
Pilot Installation	None
First Operational Installation	Air Force Cambridge Research Labs Laurence G. Hanscom Field Massachusetts
Number of Operational Installations	1

FUNCTION: The users of ORBIT are the various laboratories (Aerospace Instrumentation, Data Sciences, Meteorology, and other) of the Air Force Cambridge Research Laboratories. The mission of the users is to conduct basic and applied research in the environmental sciences and in certain areas of the physical sciences. ORBIT functions as a research and development support system to accurately determine earth satellite orbits by the minimum variance method.

ORGANIZATION:

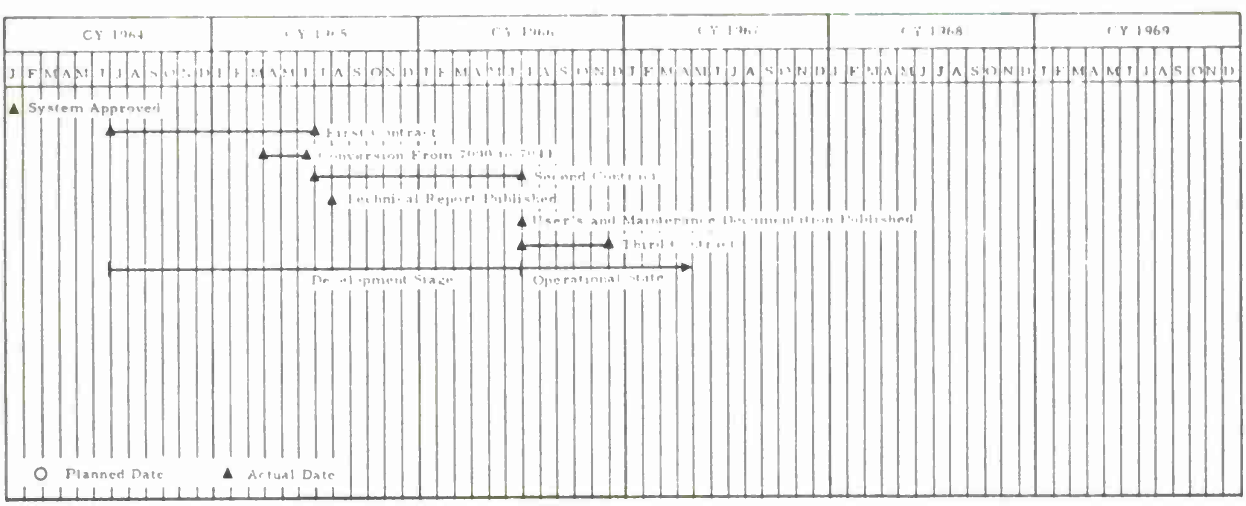


HISTORY: The various laboratories at the Air Force Cambridge Research Laboratories (AFCRL) have the authority to contract out individually for support in their missions if no capability exists in-house. Several requests for support prompted the Data Analysis Branch of the Technical Services Division to ask approval to develop a general orbit determination and analysis system. By creating this capability within the Technical Services Division, duplication of effort would be avoided. Approval from the Technical Services Division was granted in January 1964. A 1-year contract was let to the Martin Company in May 1964 to develop the mathematical approach and to verify it with an operational set of computer programs. At the end of this initial contract period, the report on the mathematical method was published and the contract was renewed. The computer programs were improved and the rest of the documentation produced. May 1966 is considered the operational date, but a usable system of limited capability existed in early 1965.

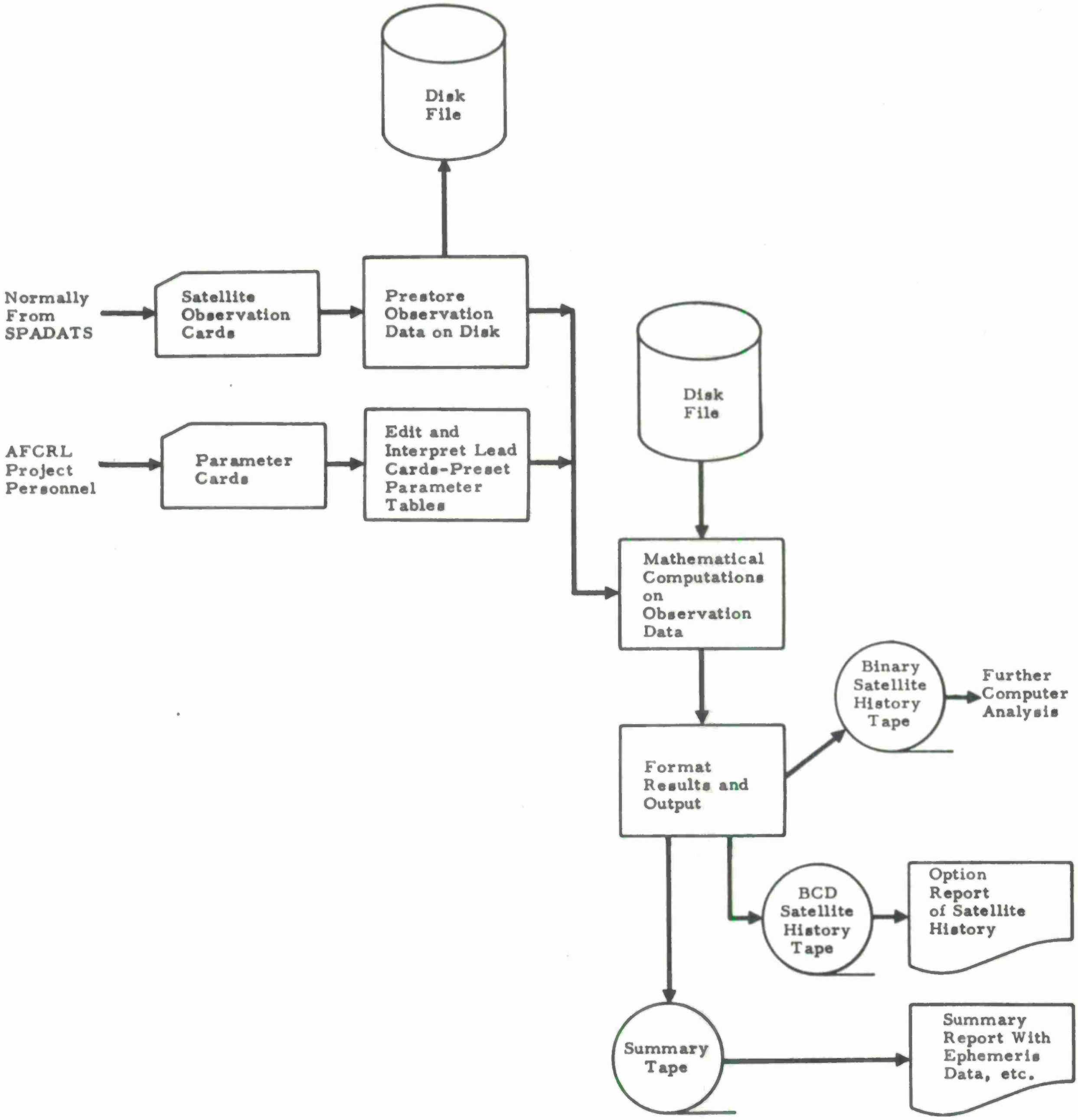
The contract was monitored by a member of the Data Analysis Branch. This contract required very little supervision since it was estimated that only 5 percent of the monitor's time was actively taken with this responsibility. Since the analysis, programming, and checkout were performed on-site, daily communication was possible between the contractor and AFCRL on an informal basis. On an official basis, the contractor was required to submit quarterly progress reports.

Complete maintenance and user documentation were published in May 1966.

SCHEDULE:



DESCRIPTION: This system performs the accurate determination of earth satellite orbits by the minimum variance method. Input consists of lead control cards followed by observation cards (usually from SPADATS). After the lead cards are interpreted, the observation cards are loaded onto the disk to be read when needed during the main processing. A print tape is produced containing ephemeris data as well as a binary history tape which is used for further analysis by other programs.

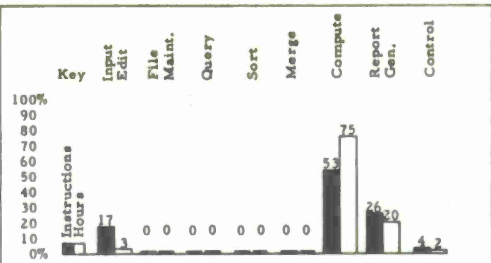


WORKLOAD:

INPUTS

Char./Mo. of Input Volume:	480,000
No. of Input Transaction Types:	3 (data); 17 (control)
No. of Input Data Fields:	23 (data); 75 (control)
Percent of Input Rejects:	5

PROCESSING FUNCTIONS

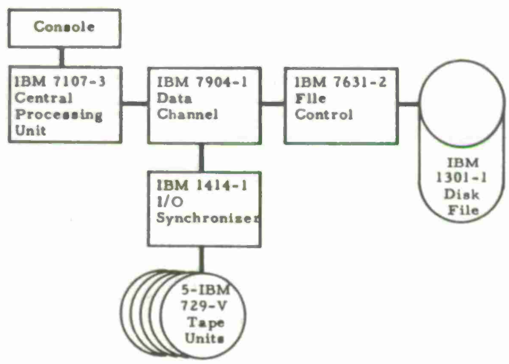


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	4,580	Unk
Total Object Instructions:	16,020	Unk
Hrs./Mo. of Application Production:	1	1

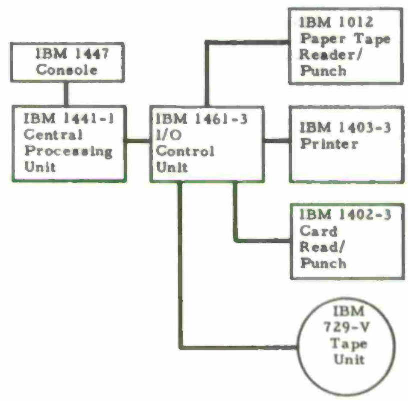
OUTPUTS

Char./Mo. of Output Volume:	3,600,000
No. of Output Formats:	2
Response Time (seconds):	NA

HARDWARE:



IBM 7044



IBM 1460

							External Devices						Peripheral Devices							
				Internal Storage			Mag Tapes		Disk				Card Reader/Punch			Printer		PT Reader/Punch		
Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (µs)	Cycle Time (µs)	Word/Char. Size (bits)	Word/Char. Capacity	No. Mag Tapes	Trans. Rate	No. Disks	Trans. Rate (char./sec)	Char. Capacity	Access Time (ms)	No.	Read Speed (cards/min)	Punch Speed (cards/min)	No.	Speed (lpm)	No.	Read Speed (char./min)	Punch Speed (char./min)
IBM 7044	7/63	Word	5	2.5	36	32K	5-729 V	to 60K	1-1301-1	90,100	27,960,000	180	None	---	---	None	---	None	---	---
IBM 1460	10/63	Char.	108	6	6	8K	1-729 V	to 60K	None	---	---	---	1-1402-3	800	250	1-1403-3	1,100	1-1012	500	150

Comment: The ORBIT system was initially developed for an IBM 7090 system. Time on the IBM 7090 was rented from a service bureau.

SOFTWARE: Software for the IBM 7044 supplied by IBM included an IBSYS executive system which has FORTRAN IV and COBOL compilers, and MAP and BAP (a subset of MAP) assemblers. Software packages also used are the SHARE program library packages, the IBM-distributed program library, a FORTRAN IV computer system library, and the IBM scientific subroutine package for System 360 which was converted to the IBM 7044.

Comment: Since the application programs were originally written partially in FAP for the IBM 7094, they had to be converted to run in MAP on IBSYS. Two people are involved in maintenance of the software.

APPLICATION PROGRAM DEVELOPMENT: Analysts from the Martin Company produced functional flow charts at the subroutine level and described the sequence of computation. The detailed programming problems were left to the programmers. The initial set of operational programs was written in FORTRAN II for an IBM 7090 by Martin Company programmers at AFCRL. They were subsequently redesigned for an IBM 7044 configuration which required the following: (1) segmentation of programs due to the large size of the IBSYS monitor; (2) redesign to take advantage of the disk on the 7044 configuration; and (3) coding changes caused by certain inconsistencies between the 7090 FORTRAN II and 7044 FORTRAN IV languages. Since the analysis, programming and checkout were performed on site, daily communication was possible between contractor and AFCRL, represented by the Data Analysis Branch, on an informal basis. The contractor was required to submit quarterly progress reports. Thirty-one programs make up the ORBIT system. Ten are written in FAP, the rest in FORTRAN IV. Sixty-seven hours of computer time were required for program checkout. Thirty-three of these hours were on the IBM 7044 and 34 hours were on the IBM 7090. Three checkout runs per day on the 7044 to one per day on the 7090 were possible, with the programmers allowed to observe their runs if desired.

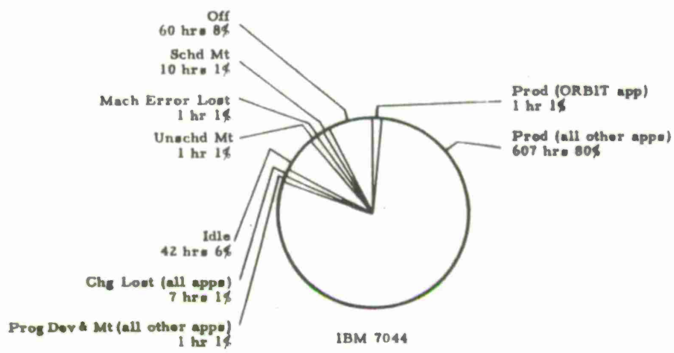
FILE CONVERSION: No file conversion was involved in ORBIT development.

DOCUMENTATION: "Orbit Determination and Analysis by the Minimum Variance Method" (AFCRL 65-579), a document describing the technical approach taken in the development of the system, was published in August 1965. Informal user documentation and program listings were available in early May 1966, followed by complete maintenance and user documentation later that month.

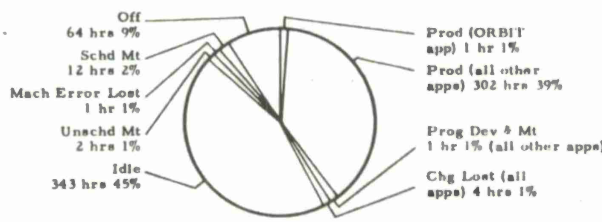
PERSONNEL:

Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Scientific Computation	Of College
Development	Manager	1	1	8.0	8.0	4.0
	Analyst	1	1	8.0	8.0	7.0
	Programmer	2	2	4.0	4.0	5.0
Operations	Manager	6	0.0	11.0	11.0	4.0
	Operator	12	0.1	6.0	6.0	

OPERATIONS: The computer operation is staffed as required. Current workload normally requires staff 24 hours a day, 7 days a week. It operates as a closed shop. ORBIT is one of many applications run on the IBM 7044/1460 computers. All jobs are run under the IBSYS monitor. ORBIT runs an average of six times a month. Only express runs, up to 5 minutes and 50 pages of printed output, are run during normal working hours.
Comment: Excellent computer reliability is reflected in the low machine maintenance times.



IBM 7044



IBM 1460

APPLICATION PROGRAM MAINTENANCE: The ORBIT system does not require much maintenance. A new atmospheric model is inserted each year and modification in support of particular satellite programs is very infrequent. Maintenance is done by the developers, the Martin Company.

Comment: The small requirement for program maintenance arises from the fact that the system has been operational for a relatively long period of time.

BENEFITS: Proposed: The primary benefit from ORBIT was planned to be an orbit determination and analysis capability, which had not existed in the past. This capability was to be available to any division within AFCRL, and therefore had to be general in nature. The basic analytic technique to be used in the orbit determination was the method of minimum variance.

Actual: ORBIT provides the orbit determination and analysis capability that was required. It may be assumed that a considerable saving in elapsed time and personnel costs (over manual procedures) was realized with the implementation of ORBIT.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk ☑

Actual: 49 [redacted]

Comment: An RFP was sent out in January 1964 with approval by the Technical Services Division at AFCRL. A "cost-plus" contract was awarded in May 1964 to Martin Co. for work to start 1 June 1964. There were no detailed task statements in the contract. The actual number of man-months shown here reflects what has been expended to date.

Months of Elapsed Development Time (Dev.)

Proposed: Unk ☑

Actual: 24 [redacted]

Comment: The initial contract awarded to Martin Co. was for 1 year. The contract was renewed for another year and is currently scheduled to end 1 June 1966. The actual number of months shown here reflects both contracts.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk ☑

Actual: 18,050 [redacted]

Comment: Program checkout has required to date 34 hours on the IBM 7090 and 33 hours on the IBM 7044. The actual cost shown here is for the hours used on both the IBM 7044 and the IBM 7090.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk ☑

Actual: 1 [redacted]

Comment: Reflects usage during March 1966 on the IBM 7044 computer. The IBM 1460 was not used for ORBIT.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk ☑

Actual: 0

Comment: Reflects usage during March 1966 on the IBM 7044 computer. The IBM 1460 was not used for ORBIT.

Number of Operations Personnel (Op.)

Proposed: Unk ☑

Actual: 0.1 [redacted]

Comment: The actual number of personnel is prorated from 12 operators and 6 managers on the basis of machine hours for ORBIT.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk ☑

Actual: 0

Comment: None.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk ☑

Actual: 140 [redacted]

Comment: None.

FUTURE PLANS: The Computer Processing Branch at AFCRL hopes to augment the present computer system to an IBM 7094/7044 coupled system to alleviate the overloaded condition now in existence. This will not affect the ORBIT system. There are no design changes contemplated for ORBIT system programs.

SYSTEM: Priority Distribution System--PDS (RCA 301)

DATA SYSTEM DESIGNATOR: D032A

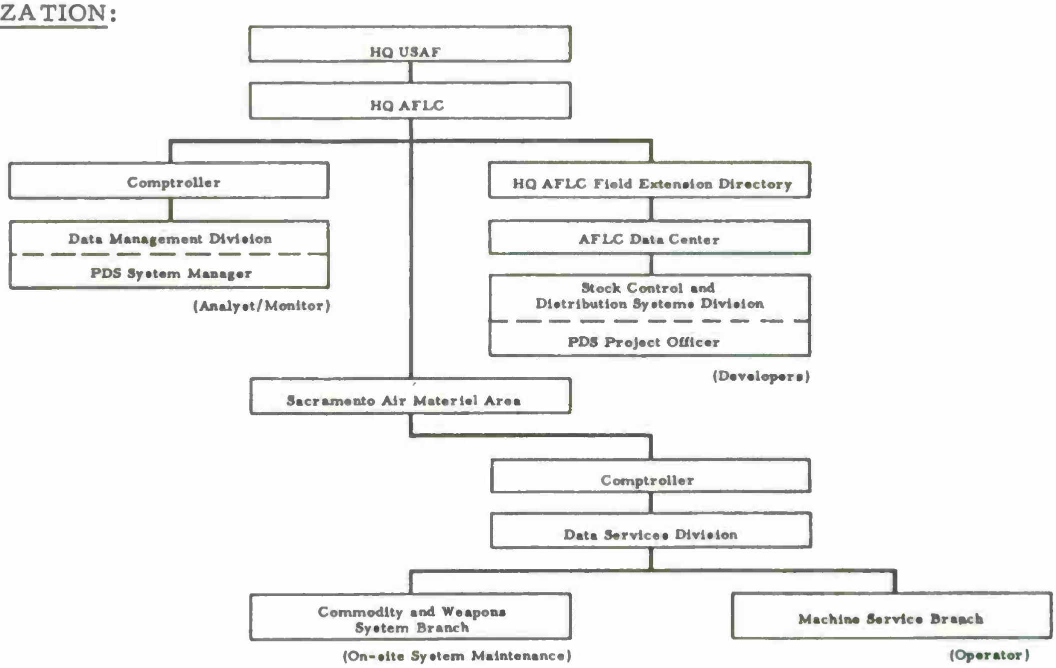
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Comptroller (Data Management Division) Headquarters, Air Force Logistics Cmd. Wright-Patterson Air Force Base Dayton, Ohio
Development	Headquarters, Air Force Logistics Cmd. Wright-Patterson Air Force Base Ohio
Maintenance	Headquarters, Air Force Logistics Cmd. Wright-Patterson Air Force Base Ohio
Pilot Installation	None
First Operational Installation	San Antonio Air Materiel Area Kelly Air Force Base Texas
Number of Operational Installations	7

FUNCTION: The users of PDS are seven AFLC Air Materiel Areas--SAAMA, SMAMA, OCAMA, MAAMA, OOAMA, WRAMA, and MOAMA. The mission of the users is logistic and system support management for specific weapon systems. PDS is a subsystem of the Inventory Management Stock Control and Distribution System and functions as a management support system to provide for the expeditious processing of high-priority requisitions and associated transactions received from Air Force bases, AFLC AMA's and contractors, Defense Supply Agency, Military Assistance Program, and other DOD and U.S. Government agencies.

ORGANIZATION:



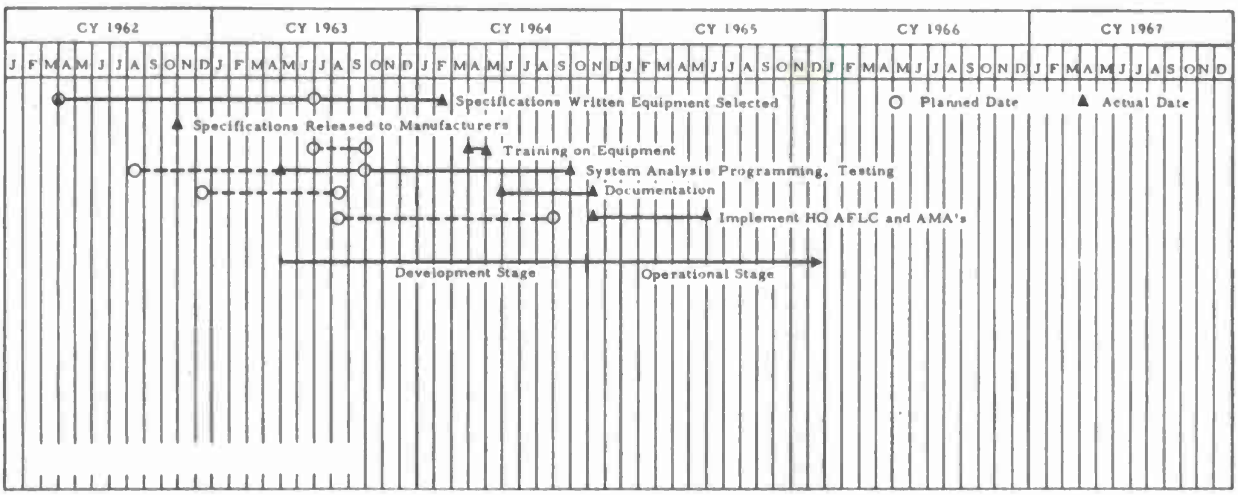
HISTORY: In 1960 the Air Force Logistics Command (AFLC) established the Inventory Management Stock Control and Distribution (IMSC&D) System for the stock control and distribution function at all AFLC depots on the IBM 7080. This system gave a 12- to 24-hour response to the customer's request, with emergencies handled manually. Changes in operational concepts and requirements, however, increased the demand for faster response. A Headquarters, USAF, task group recommended that AFLC formulate plans to implement a standard depot inventory management package with random access and rapid response for supply distribution data handling. AFLC proposed to acquire a small-scale random access computer to be used in conjunction with the IBM 7080 to process priority transactions as received, but later decided a separate priority processing system should be developed which would operate in conjunction with the present IMSC&D. The development of this system (PDS) could satisfy the desired processing time criteria with a minimum of cost. This concept was accepted by Headquarters USAF and approval was given for development and implementation of the system.

Program development of PDS took place at Headquarters, AFLC and was distributed as a package to the Air Materiel Areas using the system. Within the AFLC Data Center, a data systems project office directed the analysts and programmers in the PDS development. This office developed the detailed system design under the specifications set forth by the Data Management Division, AFLC. While the detailed system was being designed and approved by the Data Management Division, training was being conducted at Headquarters AFLC for analysts, programmers, and operators. During the development phase, relatively minor changes were required in the system design for MILSTAMP requirements. The PDS is currently undergoing system design modifications and a complete reprogramming effort in order to incorporate new processing requirements imposed by Department of Defense MILSTRAP procedures.

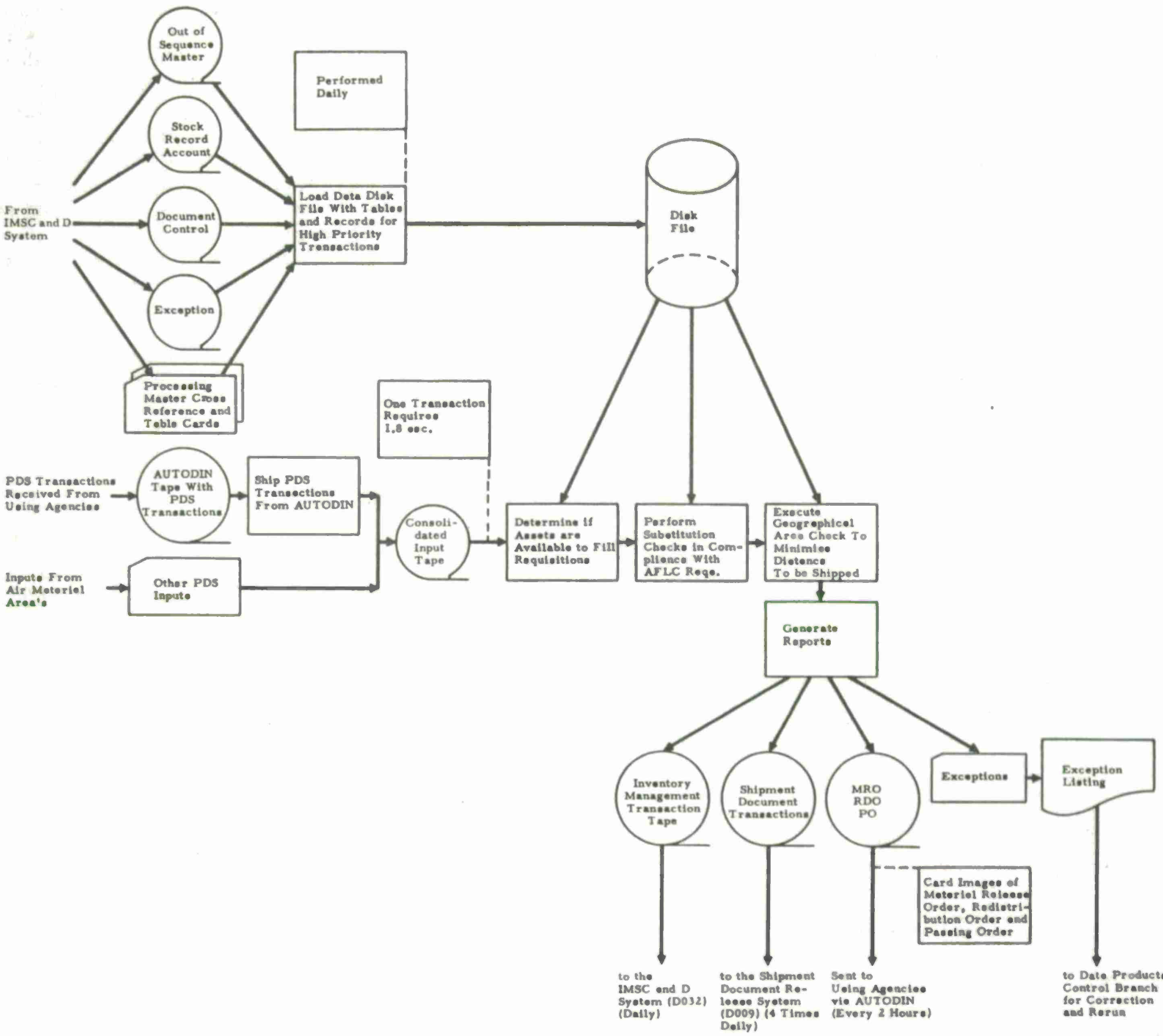
The documentation for the PDS is contained in one manual, AFM 300-20. There are no separate operator's, user's, or programmer's manual. The program maintenance function is carried on at the AFLC Data Center and any program changes or modifications require changes in AFM 300-20.

PDS is operational at the following seven sites: San Antonio AMA, Sacramento AMA, Oklahoma City AMA, Ogden AMA, Warner Robbins AMA, Mobile AMA, and Middletown AMA.

SCHEDULE:



DESCRIPTION: Each day the PDS loads, via punched cards and magnetic tape, the Data Disk File with the tables and records necessary to process high-priority supply transactions. Supply transactions are edited to validate elements of data. Those transactions which are valid are core memory transmitted to the other processor, where documents are prepared for output. At the completion of the daily run, the data records are retained on magnetic tape for the next cycle of the system.



WORKLOAD:

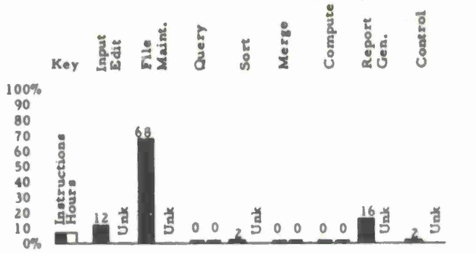
DATA BASE

Char. In Data Base:	116,400,000
Percent of Char. on D/A Storage:	100
Milliseconds of Access Time for D/A:	75
No. of Data Base Record Types:	8
No. of Data Base Records:	369,300
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	4,390,000

INPUTS

Char./Mo. of Input Volume:	4,390,000
No. of Input Transaction Types:	11
No. of Input Data Fields:	53
Percent of Input Rejects:	12.0

PROCESSING FUNCTIONS

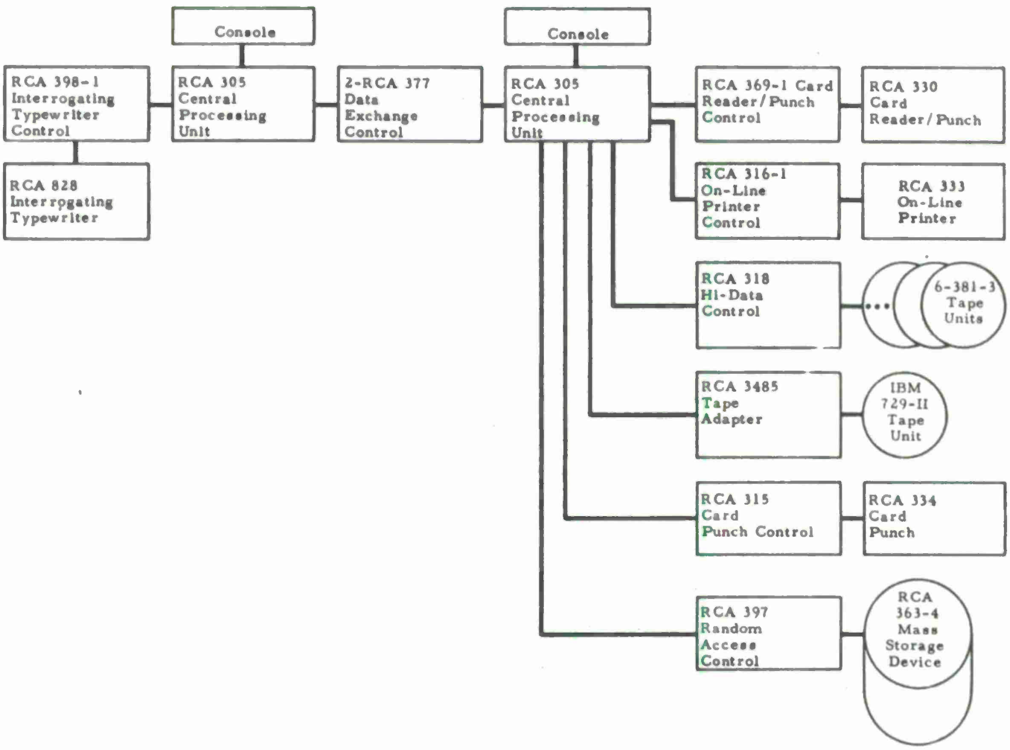


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	14,200	Unk
Total Object Instructions:	'4,200	Unk
Hrs./Mo. of Application Production:	. 270	Unk

OUTPUTS

Char./Mo. of Output Volume:	9,590,000
No. of Output Formats:	20
Response Time (seconds):	NA

HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (µs)	Internal Storage: Cycle Time (µs)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Devices: No. Mag Tapes	External Devices: Trans. Rate	External Devices, Disk: No. Disks	External Devices, Disk: Trans. Rate	External Devices, Disk: Capacity Chars.	External Devices, Disk: Access Time (µs)	Peripheral Devices(2), Card Reader/Punch: No.	Card Reader/Punch: Read Speed Cards/Min	Card Reader/Punch: Read Punch Cards/Min	Card Punch: No.	Card Punch: Speed Cards/Min	Printer: No.	Printer: Speed (lpm)
2-RCA(1) 301	2/61	Char.	67	4.8	6	40K	1-729II 6-381(3)	15K-41.6K 10K-66K	1-363-4	32K	66M	75	1-330	800	250	1-334	100	1-333	1,000

SOFTWARE: The only software for the RCA 301's supplied and required is the symbolic assembly language assembler which was developed specifically for this system due to the unusual hardware configuration.

Comment: Although other software is available for the standard RCA 301 configuration, this software will not operate on the dual processor PDS configuration. Sufficient need did not exist for this software to warrant conversion for the PDS configuration. A number of errors were detected in the assembler while checking out PDS application programs. These errors occurred primarily because the assembler was written concurrently with application program development.

APPLICATION PROGRAM DEVELOPMENT: A data systems project office was established within Hq. AFLC Data Center to direct programmers and analysts on the development of PDS. A detailed systems design was developed by this office and approved by the Data Management Division of AFLC, which had supplied the specifications. The programmers had continual access to the RCA 301 for the checkout of PDS. Many of the problems encountered during the development phase can be attributed to the fact that the programmers and RCA personnel, including 2 programmers, were inexperienced in the dual processor computer configuration. Program documentation was a joint effort of analysts and the responsible programmer. The 21 programs were written in RCA symbolic assembly language. Monthly progress reports on percentage of completion and man-hours expended were prepared by the project office and submitted to Hq. AFLC. The dual processor configuration necessitated the creation of an unusual programming technique to allow one processor to verify transactions while the other processor is formatting and producing the output products. System design changes during development, such as additional transaction types, did not significantly affect the implementation schedule.

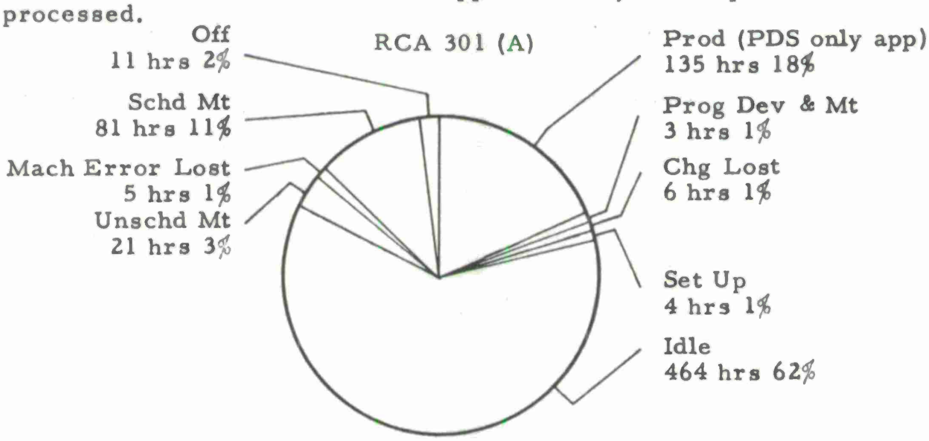
FILE CONVERSION: The IMSC and D records are used daily as input for creation of the priority distribution system records. There was no requirement, therefore, for a one-time conversion of any records or files.

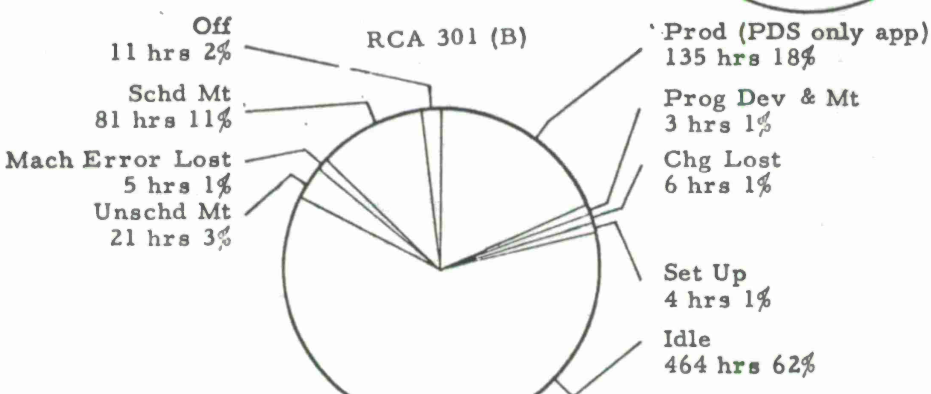
DOCUMENTATION: All system documentation is contained in Air Force Manual AFM300-20. There are no separate operator, user, and programming manuals.

PERSONNEL:

Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Logistics	Of College
Development	Manager	3	3	8.0	6.5	2.0
	Analyst	6	6	5.5	5.0	Unknown
	Programmer	9	9	7.0	1.5	Unknown
Operations	Manager	None	Unknown	Unknown	Unknown	Unknown
	Operator	6	10	Unknown	Unknown	

OPERATIONS: The computer operation at SMAMA is scheduled for processing and report generation 18 hours per day, 7 days per week. Three hours each per day are allotted to loading/unloading of PDS and to preventive maintenance. A daily schedule is utilized by SMAMA.
Comment: The excessive "idle time" is due to the fact that approximately three-quarters of the time no requests are being processed.





APPLICATION PROGRAM MAINTENANCE: There are currently seven programmers involved in full-time program maintenance at Headquarters AFLC and two programmers at SMAMA devoting 75 percent of their time to PDS. Information concerning the number of maintenance programmers at the other AMA's was not available. Because of disk problems, some of the programs are being rewritten to provide automatic restart/recovery procedures with more elaborate disk-read checks and edits. A second current program maintenance activity is reprogramming to include back orders on the PDS master file. Headquarters AFLC and SMAMA, together, have six system analysts working on PDS program maintenance. They are currently involved in system design modifications to incorporate new processing requirements imposed by DOD MILSTRAP procedures.

Comment: None.

BENEFITS: Proposed: PDS was proposed to handle the high-priority requests that could not be handled by the Inventory Management Stock Control and Distribution System. By 1963, approximately 40 percent of the total requests submitted required rapid response.

Actual: Through the use of direct access storage devices, PDS was able to provide the required response time at a minimum cost.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 267

Comment: No formal DAP was prepared for PDS. The system developed in response to the recommendation of a Hq. USAF task group which formulated detail plans and programs for the implementation of PDS.

Months of Elapsed Development Time (Dev.)

Proposed: 16

Actual: 18

Comment: The schedule slippage was due to a delay in equipment selection and the fact that neither the Air Force personnel nor the RCA personnel had previous experience on the RCA 301 dual processor configuration.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 151,780

Comment: Program and system checkout of PDS required 1,884 hours on the RCA 301 configuration.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 270

Comment: The actual number reflects the total hours used during March 1966 for PDS application production on both RCA 301 processors at SMAMA.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 6

Comment: The actual number reflects the total hours used for PDS program maintenance during March 1966 on both RCA 301 processors at SMAMA. All PDS program maintenance is done at Hq. AFLC. The operational site programmers only collect program error data to send to Hq. AFLC and install corrections from Hq. AFLC.

Number of Operations Personnel (Op.)

Proposed: 12

Actual: 10

Comment: The actual number of personnel represents operators at SMAMA. The PDS system is not operational at Hq. AFLC.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 8

Comment: The actual number of personnel is prorated from two programmers at SMAMA on the basis of time spent on PDS program maintenance and seven programmers at Hq. AFLC who devote full time to PDS program maintenance.

Dollars/Month of Hardware Cost (Op.)

Proposed: 17,960

Actual: 17,354

Comment: None.

FUTURE PLANS: This system is currently undergoing system design modifications and a complete reprogramming effort in order to incorporate new processing requirements imposed by DOD MILSTRAP procedures, to be implemented 1 July 1966. Further into the future, changes are anticipated to meet several new DOD MIL systems such as MILSTEP and MILSTAAD. The effects of these changes should be considerable although they cannot be fully determined at this time.

SYSTEM: Major Air Command Personnel Data System-Officers 65--PDSO/MAC (H800/H200)

DATA SYSTEM DESIGNATOR: E101A, E053, E517

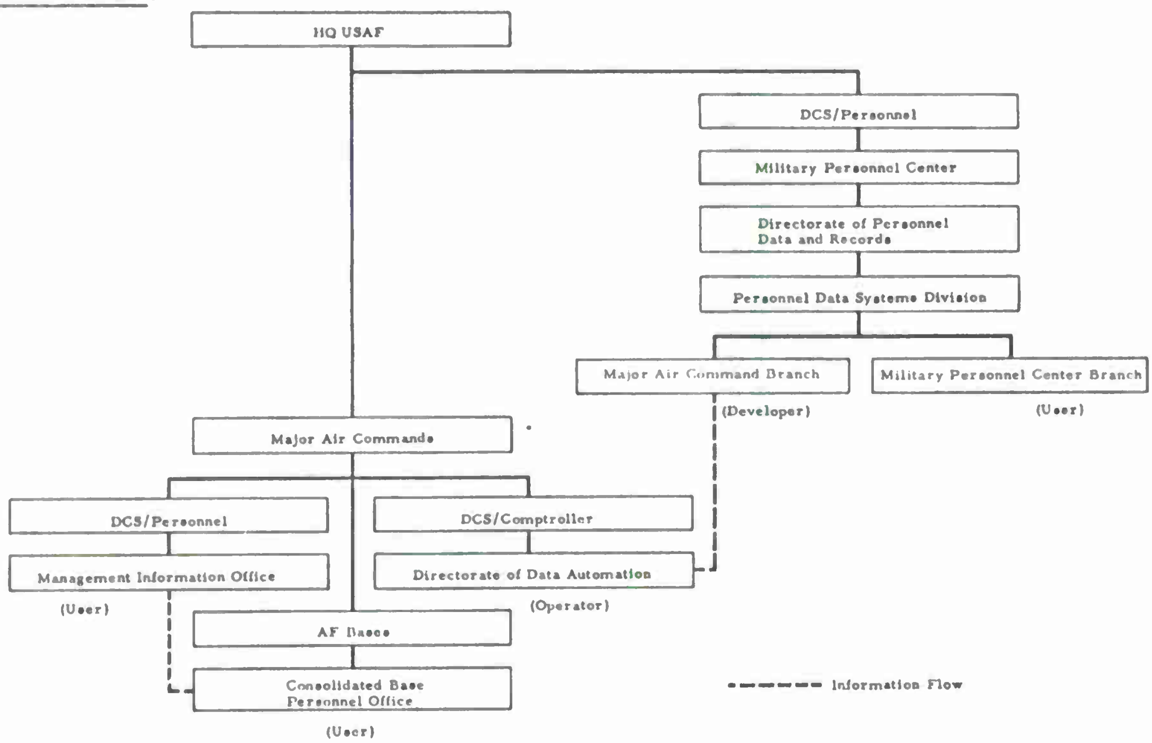
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Headquarters, Air Training Command Randolph Air Force Base San Antonio, Texas
Development	Headquarters, Air Training Command Randolph Air Force Base Texas
Maintenance	Headquarters, Air Training Command Randolph Air Force Base Texas
Pilot Installation	None
First Operational Installation	Headquarters, Air Training Command Randolph Air Force Base Texas
Number of Operational Installations	8

FUNCTION: The users of PDSO/MAC are the Management Information Offices of the major air commands and the Consolidated Base Personnel Offices of the various Air Force bases. The mission of the users is maintenance of personnel data, assignments, promotions, accessions, strengths, and planning. PDSO/MAC functions as a management support system to create, edit, control, retrieve, distribute and display active duty officer personnel data. The system integrates personnel information from the base to the major command level and then to USAF headquarters level.

ORGANIZATION:



HISTORY: MAC PDS-O 65 evolved from PDS-O 63. No formal DAP was prepared for MAC PDS-O 65, but its development was recognized and authorized as part of the overall vertically integrated personnel data system to be developed by the Military Personnel Center (MPC). MAC PDS-O 63 programs in COBOL for the Honeywell 800/200 computers were developed by the Air Training Command (ATC) at Randolph AFB for the Inquiry System and by HEDCOM at Bolling AFB for the Maintenance System. For MAC PDS-O 65, MPC integrated the Major Air Command (MAC) data base with the MPC and Consolidated Base Personnel Office (CBPO) data bases and completely rewrote the Maintenance System. For the Inquiry System, MPC adapted and modified in varying degrees the PDS-O 63 programs. Some of the inquiry programs proved to be rather inefficient in COBOL and were reprogrammed by Honeywell in assembly language.

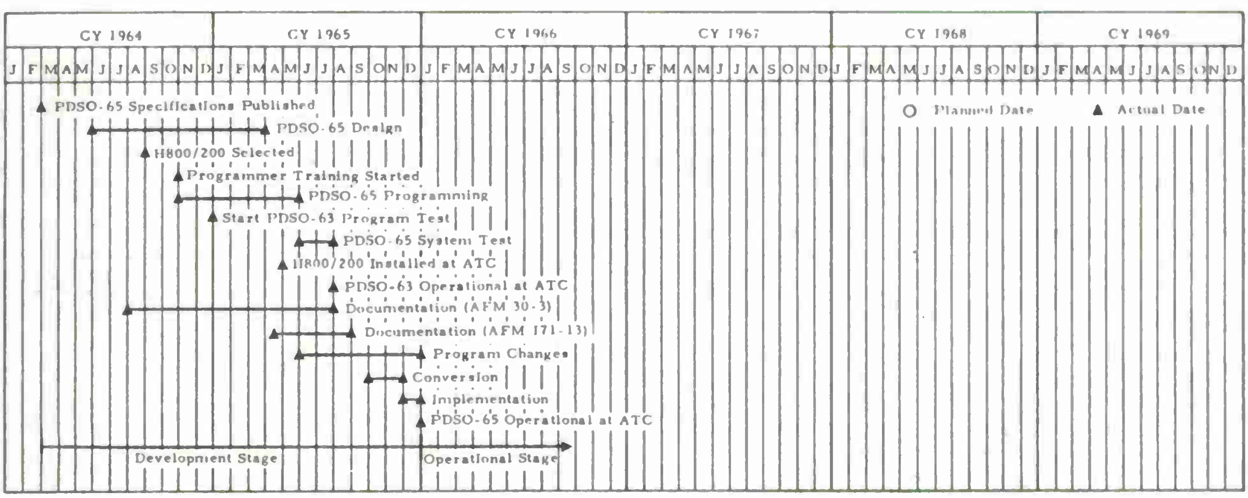
MAC PDS-O 65 was developed and is maintained by MPC and distributed to the MAC's for implementation. Since the MAC computers (Honeywell 800/200 system) may differ from one another in configuration, the personnel at each MAC retrofit the basic MAC PDS-O 65 to their own computer. Furthermore, the MAC's may develop command-unique "add-ons" to their PDS-O system. All maintenance and changes in the basic system must be done by MPC.

Two teams were formed at MPC. One developed the maintenance programs and the other developed the inquiry programs. Several of the inquiry programs were adaptations and modifications of PDS-O 63 programs. The personnel assigned were experienced programmers and performed both the systems analysis and programming function. The computer is in a secured area, but this has not been detrimental to implementation or operation.

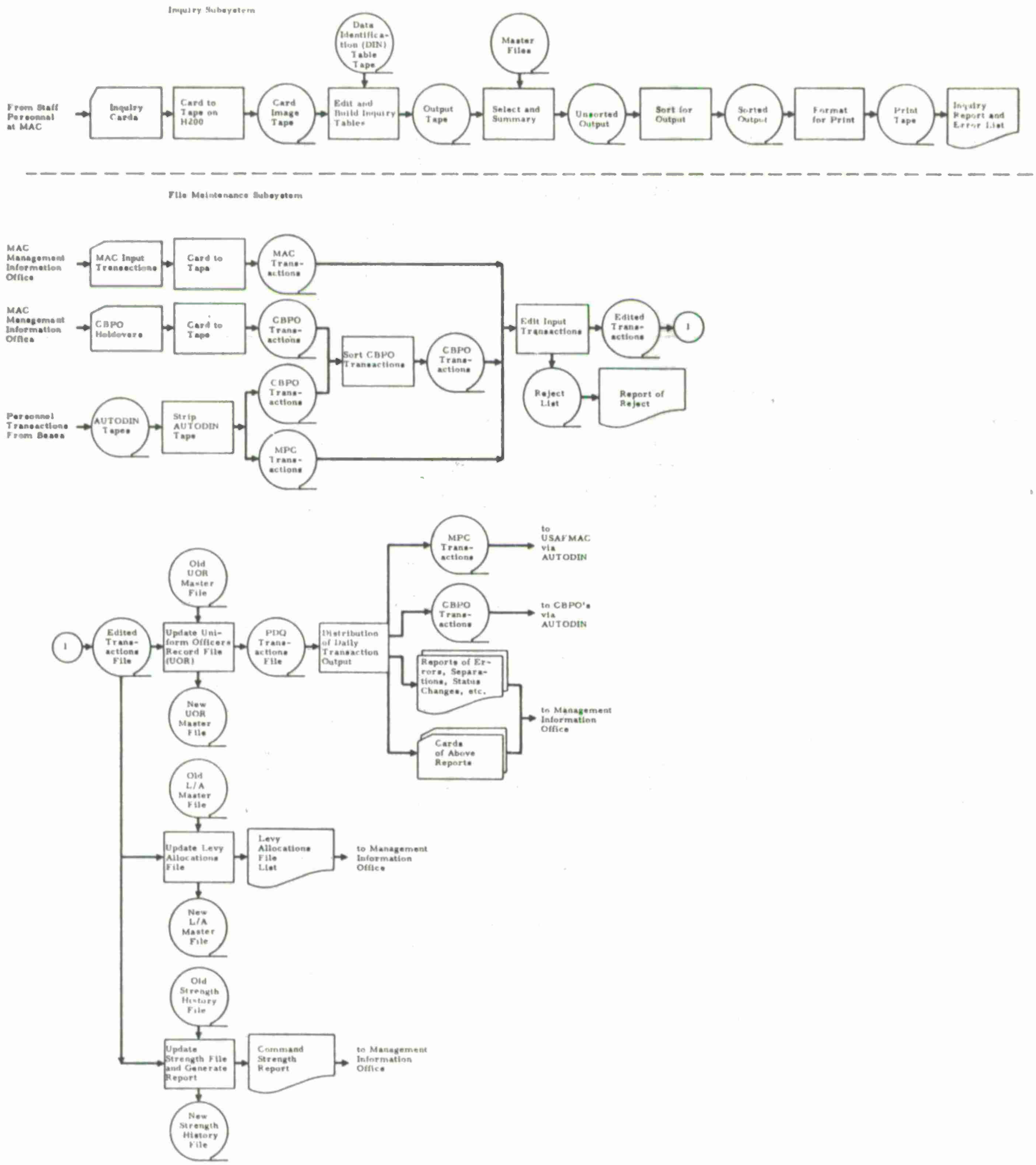
Standard Air Force documentation and program reporting procedures were employed during development as specified in AFM 171-10. The manual, AFM 30-3, specifying user procedures, was produced partially by the development effort.

MAC PDS-O 65 is operational at the following eight MAC Hqs.: SAC, TAC, ADC, ATC, PACAF, USAFSS, USAFE, and HEDCOM.

SCHEDULE:



DESCRIPTION: The system consists of a series of computer programs that create a merged manpower-personnel data file, which in turn is used as input to a library of computer sort applications for production of recurring reports. The sort programs have the ability to be altered on a one-time basis in order to provide inquiry of a selected portion of any or all of the recurring reports on an as-required basis.



WORKLOAD:

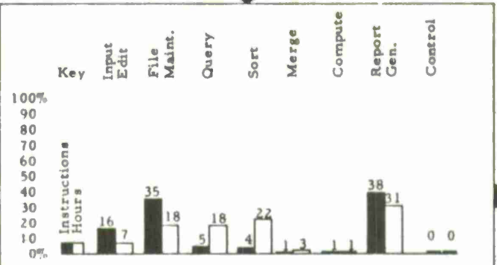
DATA BASE

Char. in Data Base:	11,570,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	5
No. of Data Base Records:	17,810
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	11,400,000

INPUTS

Char./Mo. of Input Volume:	11,400,000
No. of Input Transaction Types:	209
No. of Input Data Fields:	297
Percent of Input Rejects:	5.6

PROCESSING FUNCTIONS

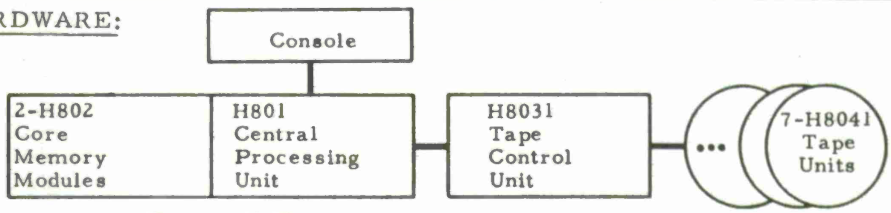


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	48,660	Unk
Total Object Instructions:	219,000	Unk
Hrs./Mo. of Application Production:	89	Unk

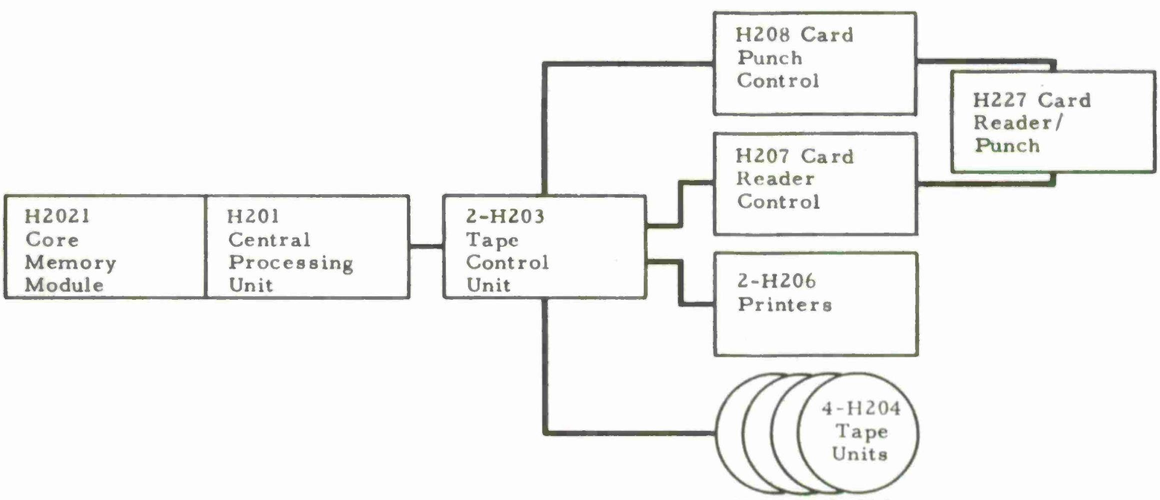
OUTPUTS

Char./Mo. of Output Volume:	69,210,000
No. of Output Formats:	21
Response Time (seconds):	NA

HARDWARE:



Honeywell 800



Honeywell 200

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (µs)	Internal Storage: Cycle Time (µs)	Internal Storage: Word Size (bits)	Internal Storage: Word Capacity	External Storage: No. Mag Tapes	External Storage: Trans. Rate	Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)
H800	12/60	Word (or Char.)	24	6	48	12K	7-8041	64K to 124K	None	---	---	None	---
H200	7/64	Word (or Char.)	44	2	48	8K	4-204	13K to 90K	1-227	800	100	2-206	900

Comment: Delivery of the hardware was 2 months late. The hardware has proved to be very reliable.

SOFTWARE: Software for the H800 consisted of a COBOL 61 compiler and an ARGUS assembler. The software was delivered by Honeywell with the equipment in April 1965--2 months late.

Comment: The use of COBOL 61 in the inquiry system proved to be inefficient, resulting in several programs being partially rewritten in ARGUS, the assembly and macro language. The COBOL 61 compiler also had some bugs which were corrected by Honeywell personnel. Honeywell is responsible for the maintenance of the software.

APPLICATION PROGRAM DEVELOPMENT: The Personnel Data Systems Division of the Military Personnel Center was responsible for the development of PDSO/MAC. Twenty experienced programmers were assigned the system analysis and programming tasks required for PDSO/MAC development. These personnel were divided into one team responsible for file maintenance programs and another team responsible for development of file inquiry programs.

System design of PDSO/MAC required close coordination with PDSO/MPC and the CBPO systems, since these systems are all part of the AF vertically integrated personnel data system. All three systems work with the same data elements and thus consistency in format and handling had to be maintained across development of these systems. PDSO/MAC system design commenced prior to the selection of the H800/200 computer hardware. The system designers had assumed a variable word length machine concept which required reorientation on the selection of the H800.

The system was programmed in COBOL 61; however, the inquiry system proved inefficient and parts of several programs were subsequently rewritten in ARGUS assembly language by Honeywell personnel. Program and system documentation conformed to standards specified in AFM 171-10. PDSO/MAC was given a thorough system test by simulating inputs typical of SAC, TAC, and ADC.

FILE CONVERSION: A separate organizational entity was created to plan the file conversion activities. The conversion consisted mainly of changing formats and codes to conform with the vertically integrated system. Much interfacing with MPC and CBPO existed. Media included both cards and tapes. A team of four was used for 12 months to do the planning, programming, and interfacing. Two thorough documents were produced specifying procedures for MAC's and CBPO's. These procedures spelled out in detail the flow of information, the changes in codes, the media used, the responsible organizations, pre- and post-conversion activities, the timing of conversion, and the audits and checks to be applied. In addition, the team oriented MAC and CBPO personnel on these procedures through personal visits to the sites. The conversion was accomplished very smoothly. The computer time used was not identifiable and is included in the checkout hours.

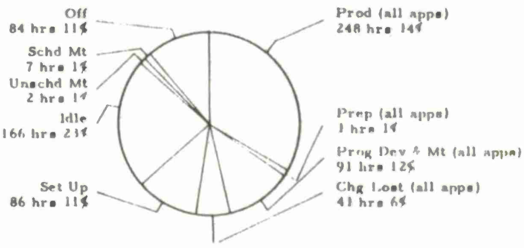
DOCUMENTATION: The system is documented in AFM 30-3 and according to standards specified in AFM 171-10.

PERSONNEL:

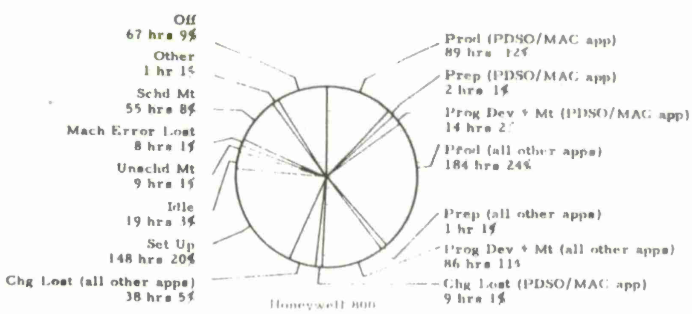
Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Personnel Systems	Of College
Development	Manager	3	3	11.0	7.5	3.5
	Analyst	7	7	8.0	14.5	Unknown
	Programmer	18	18	9.5	4.0	Unknown
Operations	Manager	None	2	Unknown	Unknown	Unknown
	Operator	54	7	6.0	2.0	

OPERATIONS: All scheduling for the computer operation is automated with monthly and daily schedules being updated and generated at fixed intervals by the H800/200 computers. The operation, a closed shop, is staffed as required by workload.

Comment: The H800 is currently overloaded at SAAMA. It is planned to augment the present computer configuration with another H800.



Honeywell 200



Honeywell 800

APPLICATION PROGRAM MAINTENANCE: All program maintenance of the basic PDSO system is done by the Personnel Data Systems Division at the Military Personnel Center. However, since the MAC computers (H800/200 system) may differ from one another in configuration, the personnel at each MAC retrofit the basic PDSO system to their own computer configuration. Furthermore, the MAC's may develop command-unique "add-ons" for their installation. All development programmers and analysts were phased into program maintenance. Maintenance consists of 60 percent program improvements and 40 percent corrections. Programmers receive from one checkout run per day to two or three per week. Bolling AFB is often used for program testing because of its light computer load.

Comment: None.

BENEFITS: Proposed: PDSO/MAC was proposed to be the major air command element of a three-level, vertically integrated personnel data system for officers. Specific benefits that PDSO/MAC was to provide include increased responsiveness to commanders and management in the creation, edit, control, retrieval, distribution, and display of active duty officer personnel data. Other benefits were to be the standardization of personnel systems across all major air commands and significant cost reduction in personnel data handling.

Actual: PDSO/MAC has provided increased responsiveness to commanders and management in the creation, edit, control, retrieval, distribution, and display of personnel data. Personnel systems were standardized across major air commands and standard data elements were adopted throughout the vertically integrated system.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk ☑

Actual: 489

Comment: No formal DAP was prepared for PDSO/MAC. Its development was recognized as a part of the overall vertically integrated PDSO.

Months of Elapsed Development Time (Dev.)

Proposed: Unk ☑

Actual: 22

Comment: PDSO/MAC system design commenced in March 1964. The system was declared operational at ATC on 1 December 1965.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk ☑

Actual: 84,700

Comment: 1,300 hours were used for program checkout. The number of hours includes an unknown number of hours required for file conversion. Approximately 100 of the 1,300 hours were used at locations other than ATC's H800.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk ☑

Actual: 89

Comment: The actual number reflects usage during March 1966 on the Honeywell 800 computer. PDSO/MAC application production usage is not known for the Honeywell 200 computer.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk ☑

Actual: 14

Comment: The actual number reflects usage during March 1966 on the Honeywell 800 computer. PDSO/MAC program maintenance usage is not known for the Honeywell 200 computer.

Number of Operations Personnel (Op.)

Proposed: Unk ☑

Actual: 7

Comment: The actual number of personnel is prorated from 21 operators allocating approximately 30 percent of their time to PDSO/MAC.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk ☑

Actual: 9

Comment: The actual number of personnel represents original development personnel.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk ☑

Actual: 10,457

Comment: None.

FUTURE PLANS: The current machine configuration is overloaded and does not supply the Military Personnel Center adequate checkout time for its function as centralized development and maintenance organization for PDS-O 65. It is planned to augment the present configuration with another H800. Sufficient H200 capacity is available to serve both processors.

SYSTEM: Personnel Data System-Officers, Military Personnel Center--PDSO/MPC (Burroughs 5500)

DATA SYSTEM DESIGNATOR: E053 and E101A

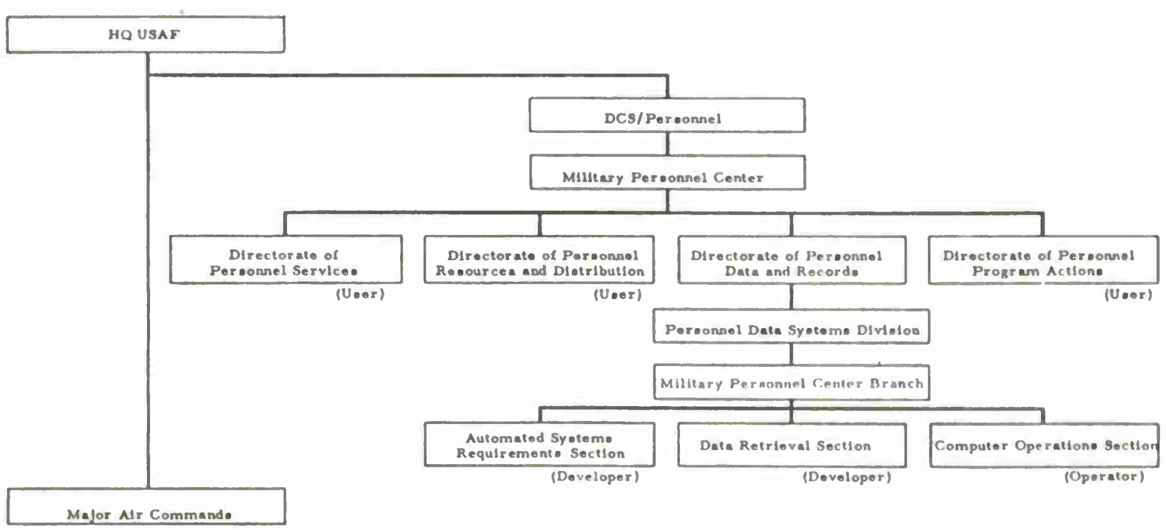
DATA COLLECTION DATE: March 1966

LOCATION:

Contact for Additional Information	Air Force Military Personnel Center Randolph Air Force Base San Antonio, Texas
Development	Air Force Military Personnel Center Randolph Air Force Base Texas
Maintenance	Air Force Military Personnel Center Randolph Air Force Base Texas
Pilot Installation	None
First Operational Installation	Air Force Military Personnel Center Randolph Air Force Base Texas
Number of Operational Installations	1

FUNCTION: The users of PDSO/MPC are the Directorates of Personnel Services, Personnel Resources and Distribution, and Personnel Program Action, USAF Military Personnel Center. A common mission of the users is the maintenance of personnel data such as assignments, accessions, separations, promotions, and integrations. PDSO/MPC functions as a management support system to maintain a central file of personnel data on all active Air Force officers. Other important functions of the system include maintaining manning data on Air Force organizations by grade and functional category, and Personnel Accounting Symbols for all Air Force units. An on-line inquiry capability enables the Military Personnel Center staff to have access to certain data within 90 seconds.

ORGANIZATION:



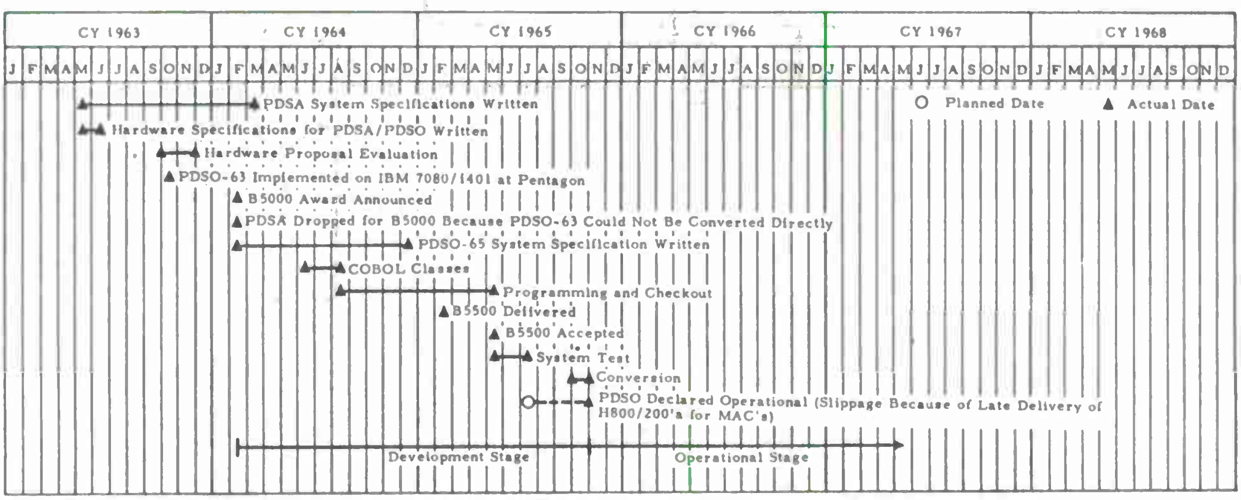
HISTORY: PDSO-65 evolved from PDSO-63, an automated personnel system operated at Headquarters, USAF. A need to integrate the personnel data systems vertically at Headquarters, USAF, the major air commands (MAC's) and consolidated base personnel offices (CBPO's) gave impetus to the development of the system. In addition, a direct inquiry capability was to be included in the new system. The hardware configuration was selected by the EDP Equipment Office (ESQ). All development work was done at the USAF Military Personnel Center (MPC).

A planning group of personnel from all major users of the system and other related systems was established to outline the areas of PDSO-63 requiring redesign. The development was broken down into two primary areas: (1) design and documentation of specifications, and (2) programming and system implementation. Both of these major areas were broken down into tasks and the responsibility for these tasks was delegated. Standards for programming, documentation, and management control were also specified.

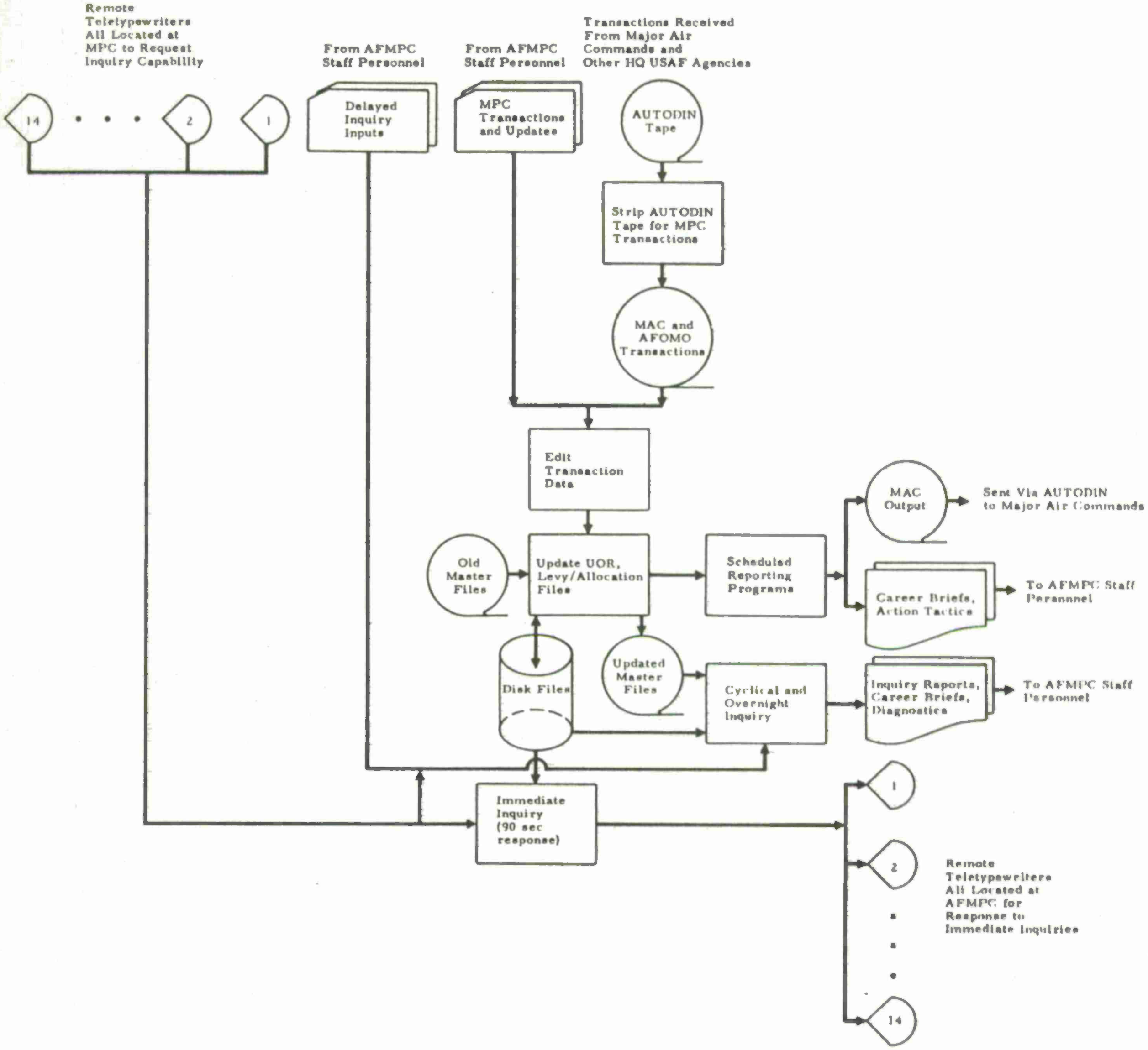
The Directorate of Personnel Systems had overall responsibility for the redesign of PDSO-63 and the implementation of PDSO-65 at the Military Personnel Center. The entire personnel resources of the CBPO Division, MAC Division, MPC Division, and the Plans and Administration Office were assigned to the effort. In addition, partial support was supplied by the Systems Development Division. Limited resources were available in other directorates of the USAF Military Personnel Center and directorates of Headquarters, USAF.

An extensive set of documents exist describing the system objectives, processing, and data element formats. The documentation is oriented toward the total vertical personnel system, since users (suppliers of input to PDSO/MPC) will be lower level subsystems in the vertical structure.

SCHEDULE:



DESCRIPTION: The primary function of PDSO/MPC is to maintain a central file of personnel data on all active Air Force officers. Assignments, accessions, separations, promotions, and integrations (received from Major Air Commands and the MPC staff) are all processed against the basic officer personnel file. Reports resulting from these transactions are distributed to the Major Air Commands and within MPC. Other important functions of the system include maintaining manning data on Air Force organizations by grade and functional category, and Personnel Accounting Symbols for all Air Force units. An on-line inquiry capability enables the MPC staff to have access to certain data within 90 seconds.



WORKLOAD:

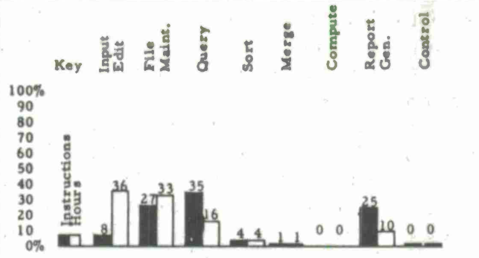
DATA BASE

Char. in Data Base:	276,700,000
Percent of Char. on D/A Storage:	86
Milliseconds of Access Time for D/A:	20
No. of Data Base Record Types:	6
No. of Data Base Records:	544,500
Percent Growth Rate/Mo.:	1.1
Char./Mo. of Update Input:	45,850,000

INPUTS

Char./Mo. of Input Volume:	46,460,000
No. of Input Transaction Types:	122
No. of Input Data Fields:	681
Percent of Input Rejects:	4.3

PROCESSING FUNCTIONS

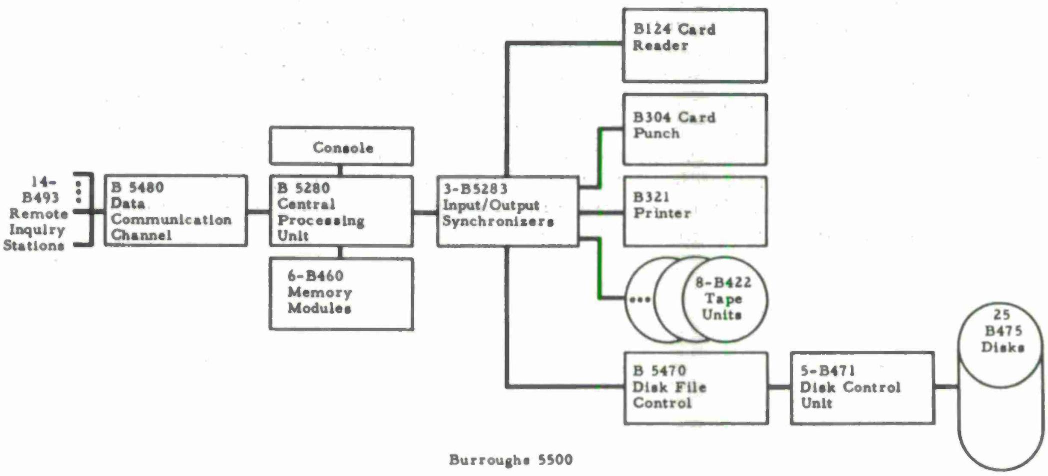


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	195,100	NA
Total Object Instructions:	780,500	NA
Hrs./Mo. of Application Production:	376	NA

OUTPUTS

Char./Mo. of Output Volume:	81,600,000
No. of Output Formats:	141
Response Time (seconds):	90.0

HARDWARE:



Burroughs 5500

				Internal Storage			External Storage						Peripheral Devices							
							Mag Tapes		Disk				Card Reader/Punch				Printer		Remote Consoles	
Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Cycle Time (μs)	Word Size (bits)	Word Capacity	No. Mag Tapes	Trans. Rate	No. Disks	Trans. Rate (char./sec)	Char. Capacity	Access Time (ms)	No.	Read Speed (cards/min)	No.	Punch Speed (cards/min)	No.	Speed (lpm)	No.	Speed (char./sec)
B5500	11/64	Word	2	4	48	32,768	8-B422	24K to 66K	25-B475	100K	9.6M	20	1-B124	800	1-B304	300	1-321	650	14-B493	10

SOFTWARE: Software for the Burroughs 5500 consisted of COBOL and ALGOL compilers, an ESPOL assembler, hardware diagnostic, debugging aids, and a Master Control Program (MCP). No utility routines were supplied by Burroughs, but some were obtained from the Burroughs user group. The software was delivered by Burroughs with the equipment in February 1965.

Comment: The initial COBOL compiler lacked many desired features (e.g., disk constructs, sort and merge verbs). A COBOL compiler with the disk constructs, the sort verb, and merge verb (which still gives problems) was delivered in May, 1965. Program checkout with COBOL was difficult because of no run time patching or modification capability and the absence of an intermediate or assembly language output to aid in the analysis of programs. The programmers also felt that more extensive diagnostic messages from the COBOL compiler would have assisted program development. ALGOL diagnostics were felt to be adequate. The compilers and assembler were on the whole highly successful and contributed to system development.

MCP was converted to operate with the disk construct in May, 1965. The users feel that checkpoint and restart capability should be on a controlled basis rather than periodic. The primary attribute of MCP that assists effective operation is the automatic scheduling of jobs and I/O assignments, which achieves efficient peripheral device utilization. The rigid structure of MCP does not allow easy modification for handling nonstandard formats, such as tapes of different labeling format. MCP is used to maintain the application program library and to call all functional programs from this library.

It was felt that the channels for dissemination of information on the software and correction of errors were generally not responsive to the requirements of the system users. The program documentation was usually delivered much later than the software itself and was sometimes inconsistent with the software.

Representatives of the manufacturer are maintained on site to assist with any problems in the support software. In addition, several AF personnel have been trained in the maintenance of the operating system and compilers. The systems programming people are also involved in making recommendations for modifications to improve the efficiency of the system operation.

APPLICATION PROGRAM DEVELOPMENT: A planning group of personnel from all major users of the PDSO-63 system outlined the redesign of PDSO-63. The same group also provided the design specification documentation, programming standards and system implementation of PDSO-65. The programming effort was divided into two areas: (1) file maintenance, and (2) file retrieval. There are 74 distinct file maintenance programs, which were written in COBOL. There are 80 file retrieval programs written in COBOL in addition to the on-line retrieval programs, which were written in ALGOL for efficiency of operation. Each program was checked out individually prior to the systems test. No program patching capability was available. This caused an inordinate amount of checkout time to be used for recompilation. The complete system test, designed to fully exercise the assignments, promotions, separations and integration of subsystems, was planned and completed on schedule.

FILE CONVERSION: The file conversion activity was documented and was planned for execution between 6 and 12 October 1965. A flow chart was drawn; all master files and intermediate work files of the PDSO system were specified and file formats and record contents indicated.

While 7080/1401 tapes were compatible with B5500 tapes, COBOL (B5500) would only process Burroughs tandard labels, and consequently tape labels on original tapes had to be modified accordingly before conversion. Necessary programs were prepared. A total of 29 files were converted. These were systematically analyzed and the volume indicated by the number of reels, records, blocks per record, and characters per block for each file.

Computer time used: approximately 60 hours.

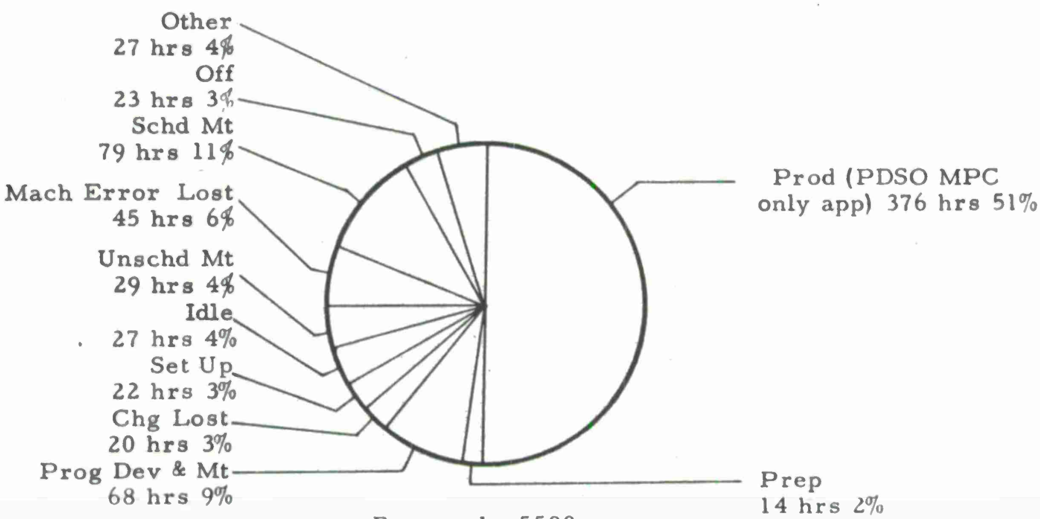
DOCUMENTATION: User documentation is aimed at those who supply input at the lower level in the vertical structure. Other documentation includes system design review notes, program changes, etc. A folder is maintained for each program containing listings, flow charts, and program specifications.

PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Personnel Systems	Number of Years: Of College
Development	Manager	15	15	8.5	7.0	3.5
	Analyst	7	7	4	11.5	Unknown
	Programmer	37	40	7.0	5.5	Unknown
Operations	Manager	3	3	12.0	2.5	2.0
	Operator	29	52	4.5	0.5	

OPERATIONS: The computer operation is staffed 24 hours a day, 7 days a week. It operates as a closed shop. PDSO/MPC is the only application on the Burroughs 5500 computer. Immediate queries are processed on-line during normal working hours 5 days per week in a multiprogramming mode with scheduled runs. Deferred inquiries and file maintenance are run at other times according to a master schedule.

Comment: Program development and maintenance time is somewhat large due to lack of program patching capabilities. A large percentage (21 percent) of time is taken for computer maintenance and machine error lost time, reflecting low hardware reliability.



Burroughs 5500

APPLICATION PROGRAM MAINTENANCE: There are currently 36 programmers and 14 system analysts involved in program maintenance for PDSO/MPC, all of whom were involved in the development efforts. The program maintenance activity is divided among corrections to programs, system documentation, system improvements, and program operational efficiency improvements.

Comment: The large amount of time devoted to the program maintenance effort is mainly due to the fact that a completely new system has not been operational very long and problems are still being encountered in the software.

BENEFITS: Proposed: The PDSO/MPC was established along with the USAF Military Personnel Center by direction of the Secretary of the Air Force. Prior to PDSO/MPC, Air Force Hq. personnel processing was performed on an IBM 7080 at the Pentagon. The PDSO/MPC system was to provide a number of new benefits, including (1) inclusion of significant additional data on each Air Force officer; (2) standardization of data codes and formats to enhance efficient communications of personnel data from one AF personnel system to another; and (3) immediate access to personnel data for personnel managers.

Actual: PDSO/MPC became operational in October 1965. It provided the additional officer data and standardization of data codes that was required. Communications with other AF personnel systems were enhanced, since PDSO/MPC was designed as the top component of a three-level, vertically integrated personnel system. Remote immediate access terminals were provided. However, due to the saturated computer utilization, updates could be run only three times weekly (compared with a proposed daily update), thereby causing personnel data to be less current than originally proposed. This problem is presently being alleviated by procurement of additional hardware modules for the system.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 1,443

Comment: No formal DAP was prepared for PDSO/MPC. An advanced design team began work in May 1963 to establish objectives and equipment requirements for PDSO 65. This effort evolved into the PDSO 65 system design begun in April 1964.

Months of Elapsed Development Time (Dev.)

Proposed: 16

Actual: 20

Comment: A proposed date for PDSO 65 implementation was established by the PDSO 65 design team as July 1965. Because of late delivery of the MAC Honeywell 800/200 computers, the implementation of PDSO 65 was delayed until November 1965.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: Unk

Comment: Computer time used before the acceptance of the computer on 1 May 1965 was not logged. After acceptance, it is known that at least 1,112 hours were used for program checkout between May and September 1965, costing approximately $266,880. Program checkout was lengthened because of the excessive recompilation required due to inadequate program-patching capabilities with COBOL.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 376

Comment: Reflects usage during February 1966 on the Burroughs B5500 computer.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 68

Comment: Reflects usage during February 1966 on the Burroughs B5500 computer.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 52

Comment: The actual number of personnel represents operators at the Military Personnel Center.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 50

Comment: The actual number of personnel consists of 14 analysts and 36 programmers.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 64,780

Comment: None.

FUTURE PLANS: Excessive workload on PDSO/MPC has resulted in degradation of system performance (master files are only updated three times weekly as opposed to a planned daily update). Proposed improvements in the hardware configuration to handle the workload include: (1) increase the number of modules from six to eight and increase memory speed from 6 µs to 4 µs; (2) add another central processing unit; (3) increase the number of tape drives from 8 to 14; and (4) increase the number of disk storage modules from 25 to 32, giving 307.2 million characters of disk storage instead of 240 million. At this time, there are no major design changes contemplated for PDSO/MPC system programs.

SYSTEM: Regional Accounting and Finance Test--RAFT (RCA 301)

DATA SYSTEM DESIGNATOR: H060

DATA COLLECTION DATE: April 1966

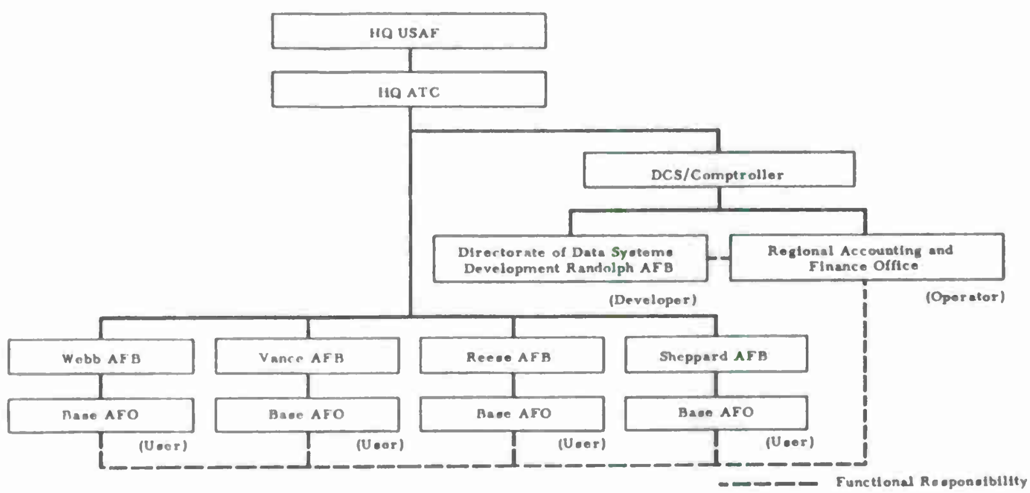
LOCATION:

Contact for Additional Information	ATAAF Accounting and Finance Dir. ATADC-DCS/Comptroller Randolph Air Force Base San Antonio, Texas
Development	Randolph Air Force Base, Texas Sheppard Air Force Base, Texas
Maintenance	Sheppard Air Force Base Texas
Pilot Installation(1)	Sheppard Air Force Base Texas
First Operational Installation(1)	Sheppard Air Force Base Texas
Number of Operational Installations	1

Note: (1) Entire system was a pilot system deactivated in June 1965.

FUNCTION: The users of RAFT are the Base Accounting and Finance Offices at Sheppard, Reese, Vance, and Webb Air Force Bases. The mission of the users is to perform the accounting and finance functions for their respective bases. RAFT functions as a research and development support system in that it is the result of a pilot project to design, develop, and test a standard USAF base level regional accounting and finance system (excluding military pay), utilizing electronic data processing equipment. RAFT was deactivated in June 1965.

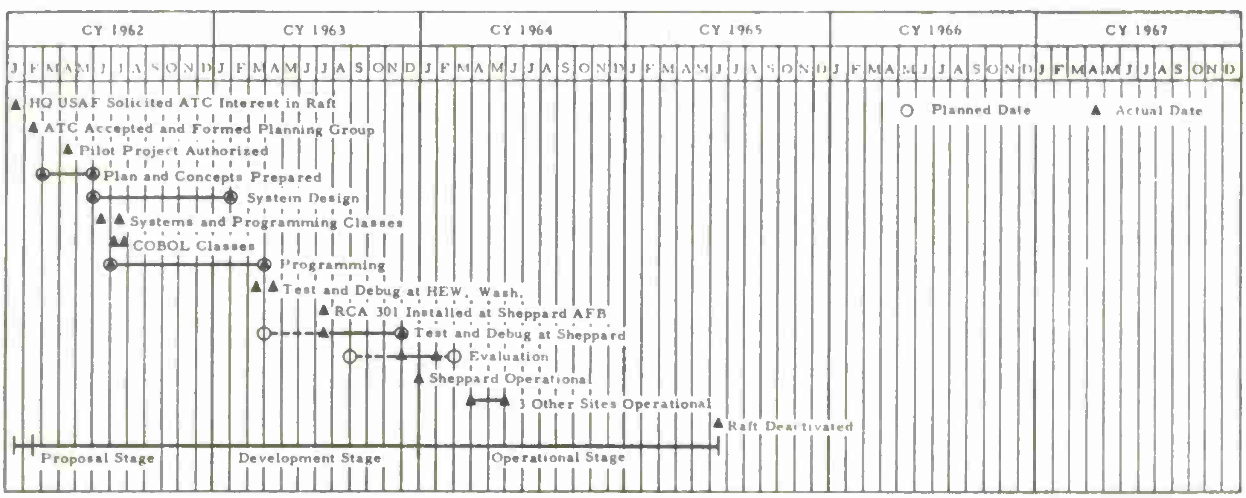
ORGANIZATION:



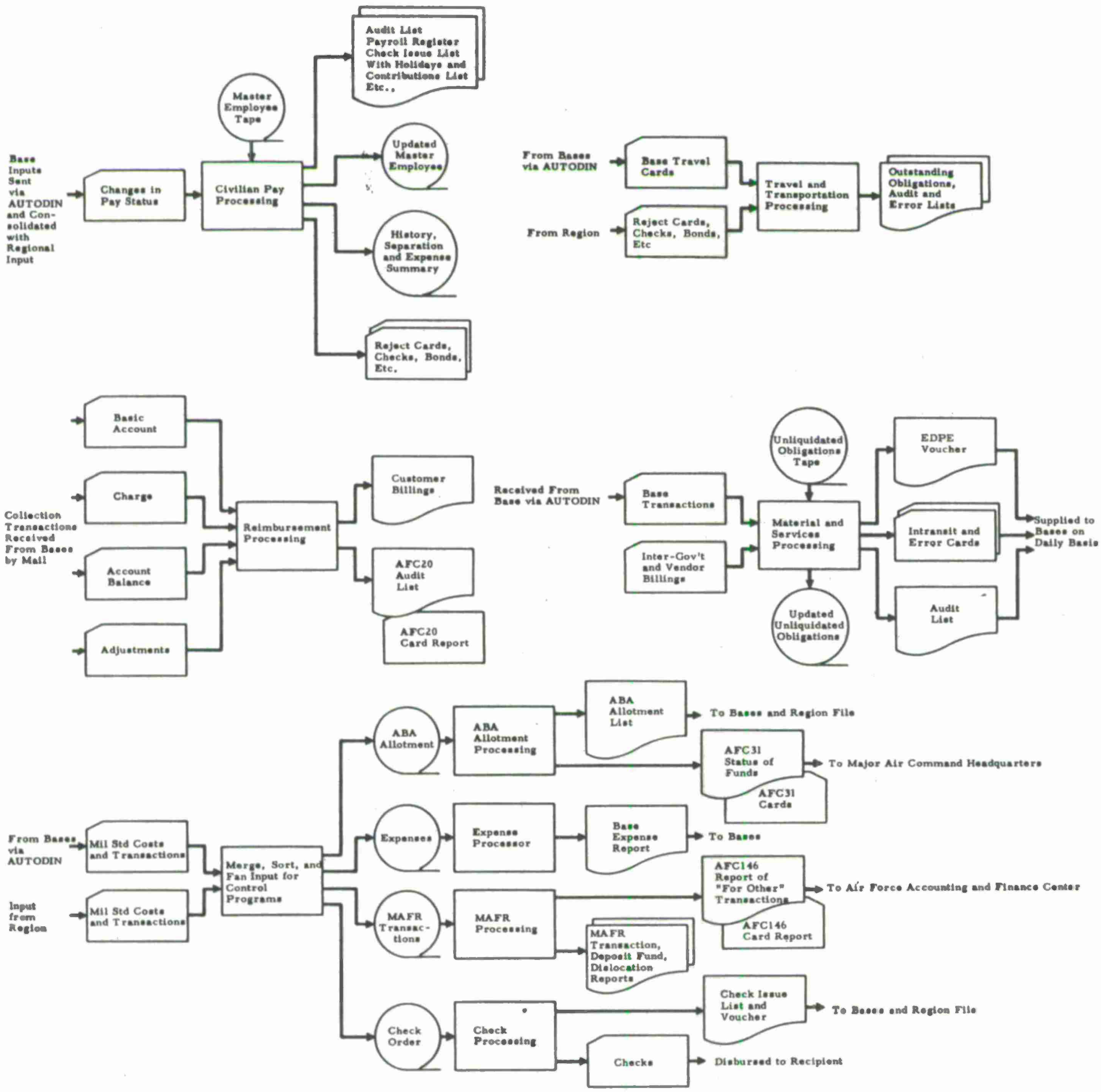
HISTORY: The Air Training Command (ATC) was requested by Headquarters USAF to investigate the development of a small regional accounting and finance system. An ATC planning group was formed that developed general project concepts and an agenda for a meeting with representatives of Headquarters USAF. This meeting was held in March 1962 and an action schedule was developed encompassing the concept preparation, system design, programming, testing, and evaluation. Development took place at Randolph AFB. RAFT became operational at Sheppard AFB in December 1963 and later at Reese AFB, Vance AFB, and Webb AFB. The system was designed as a test, and the test was successfully completed. RAFT was deactivated in June 1965 due to loss of computer support.

Data systems analysts assigned to the project had extensive background and training in accounting and finance, whereas their training in system design with EDP equipment was not as extensive. Data systems programmers assigned to the project had no previous programming experience or instruction in programming and were sent to RCA 301 programming school. The team concept was employed in development, with a team consisting of a functional expert in the accounting and finance area, an analyst, and a programmer. Critical path scheduling and progress reporting techniques were used throughout the development of RAFT.

SCHEDULE:



DESCRIPTION: The RAFT system functions are Civilian Payroll, Travel and Transportation (processing of open accounts on individual travelers), Commercial Services (processing of procurement functions), Reimbursements (maintenance of customer accounts), and Accounts Control (update of commitment and obligation, MAFR, check payment, and accountability records). Financial input information is sent to the regional office (Sheppard AFB), and the accounting and finance offices of the four bases (the users) receive in return products for base and employee use. These include payroll vouchers, payroll checks and bonds, printouts of status of open accounts, and various budget reports.



WORKLOAD:

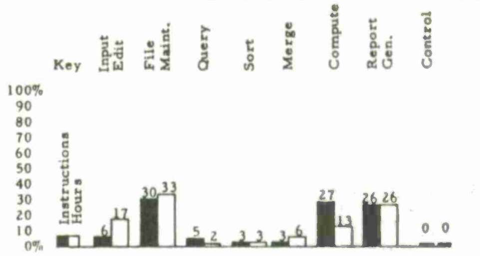
DATA BASE

Char. in Data Base:	17,510,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	8
No. of Data Base Records:	135,500
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	6,402,000

INPUTS

Char./Mo. of Input Volume:	6,402,000
No. of Input Transaction Types:	48
No. of Input Data Fields:	227
Percent of Input Rejects:	0.8

PROCESSING FUNCTIONS

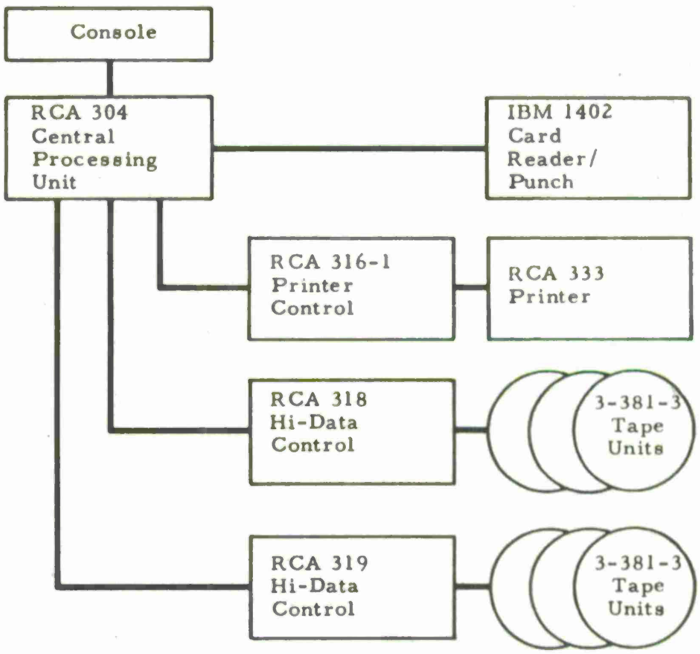


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	34,620	NA
Total Object Instructions:	34,620	NA
Hrs./Mo. of Application Production:	126	NA

OUTPUTS

Char./Mo. of Output Volume:	26,070,000
No. of Output Formats:	57
Response Time (seconds):	NA

HARDWARE:



RCA 301

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Internal Storage: Add Time (µs)	Internal Storage: Cycle Time (µs)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Storage: No. Mag. Tapes	External Storage: Trans. Rate	Peripheral Devices: Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)
RCA 301	2/61	Char.	98	7	6	20K	6-381(1)	10K to 66K	1-1402	800	250	1-333	1,000

Comment: (1) Housed in one cabinet.

SOFTWARE: Software for the RCA 301 consisted of the following: (1) a symbolic assembly language assembler; (2) a Utility Service Reference; (3) a "consolidate," (4) a Test Library Tape (TLT) and Program Library Tape (PLT); and (5) a sort program. The software was delivered by RCA with the equipment in June 1963.

Comment: "Consolidate" provides for selective dynamic memory dumps and traces. A routine was added by the Chief Programmer on the RAFT project to TLT and PLT to provide for run-to-run operating instructions. There have been no formal system programming activities. An RCA system representative provided software support.

APPLICATION PROGRAM DEVELOPMENT: The responsibility of RAFT was balanced between two USAF elements of the Accounting and Finance Directorate and the Data Automation Directorate. The former established policy and described output demands on the system. The latter designed and developed the ADP system. The system design phase included detailed flow charts, input/output requirements, stored data requirements, and transaction codes to be used in operations. The programs were written in COBOL by programmers trained at the RCA 301 programming school. Due to the 300-mile distance between the programming location and the checkout computer, the checkout was not begun until programming was virtually completed. RCA provided 90 hours of free test time during the 461-hour checkout, the amount of checkout time was high due to machine and tape malfunctions. Special input data was developed for program checkout. Computer time was supplied by open shop operations with programmers getting as many as five runs per day. System tests also consisted of parallel operations after completion of all program testing and debugging. Critical path scheduling using LESS (Least Cost Estimating and Scheduling) and weekly progress reporting using PROMT (Planning and Progress Measurement Techniques) were the management control methods used.

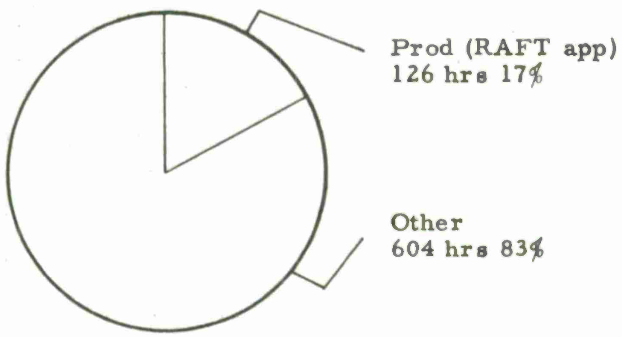
FILE CONVERSION: Conversion procedures to be used by the bases in converting their manual records to RAFT input formats were developed by RAFT project personnel within the applicable subject matter areas. During the conversion period, RAFT project and accounting and finance personnel visited each base and were on hand to assist them with any problems encountered in converting their records. The conversion was from manual records to punched cards. The punch card information was sent to the region via AUTODIN and received at the regional office in the form of punched cards. No major problems were encountered in base conversions. A problem did arise when it was discovered that the AUTODIN equipment at the bases could not send or receive credit zeros. This problem was eliminated by equipment modification. Each base was converted by functional area which reduced confusion and permitted an orderly flow of data into the region office. This gave region office personnel adequate time to load and audit the input data. No special programming was required.

DOCUMENTATION: User documents as well as system design specifications were produced by the system designers during the system design phase. Flow charts were produced prior to coding. All deviations from these flow charts are documented on program change forms during the coding, check, and maintenance phases. AFL 177-3, Terminal Documentation Part I contains the General Systems Specifications and Part II contains the Evaluation Schedules.

PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Accounting	Number of Years: Of College
Development	Manager	3	3	1.0	11.0	3.0
	Analyst	7	7	2.0	7.0	Unknown
	Programmer	14	14	1.5	0	Unknown
Operations	Manager	1	0.6	9.0	0	3.0
	Operator	4	2.4	5.0	0	

OPERATIONS: RAFT was run during the second shift at Sheppard AFB on an RCA 301. It was a closed shop operation. Since the RAFT system is no longer operational, current computer utilization figures do not exist. The figures in the pie chart are averages of utilization during RAFT's operational phase.
Comment: The "Other Time" could not be broken down for the only other application, the Base Supply System.



RCA 301

APPLICATION PROGRAM MAINTENANCE: There were three programmers involved with program maintenance. Their main function was to correct program errors and to link the various programs together into a smooth operating system. The ratio of program corrections to program improvements was 9 to 1. The programmers generally received two test runs per day during RAFT's operational phase.

Comment: The maintenance programmers also performed machine scheduling, production control, and maintenance of the tape library of 400 tapes.

BENEFITS: Proposed: RAFT was proposed as a pilot project to verify the regional accounting concept. A major air command accounting concept had been rejected by Hq. USAF, and RAFT was designed to determine the feasibility of a centralized system over a smaller number of bases. Benefits sought in RAFT included improved product design, elimination of unnessary items and reports, greater accuracy, and improved internal and external control.

Actual: RAFT became operational at four AF bases in June 1964, thus verifying that a regionalized accounting and finance system was feasible. Because of hardware availability problems and plans for an Air Force-wide standard accounting and finance system, RAFT was discontinued. Concepts developed in RAFT will be used in development of subsequent accounting and finance systems.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 381

Comment: No formal DAP was prepared for RAFT. At a meeting between Hq. USAF personnel and ATC personnel, Air Force letter 177-3 was drafted containing RAFT concepts and schedules.

Months of Elapsed Development Time (Dev.)

Proposed: 18

Actual: 23

Comment: RAFT system design began on schedule on 1 June 1962. RAFT programming also began on schedule on 1 July 1962. Both activities ended on schedule. The schedule slippage was due to a delayed start of program checkout, caused by a delay in the installation of the RCA 301 at Sheppard AFB, until 26 June 1963. Serious mechanical problems in the tape units hindered checkout from July to late October 1963, when they were overhauled.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 29,970

Comment: It was felt by the developers that program checkout hours would have been less if the equipment had been more reliable. Program checkout required 461 hours on the RCA 301 computer.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 126

Comment: The actual number represents the average monthly application production usage during RAFT's 18-month operational phase (January 1964 to June 1965) at Sheppard AFB. RAFT was usually run second shift after all other work on the Base Supply System had been completed.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: Unk

Comment: Since RAFT was deactivated in June 1965, current monthly usage figures do not exist. The program maintenance average monthly usage during the 18-month operational phase is unknown.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 3

Comment: The actual number of personnel was prorated from four operators and one EDP officer on the basis of time spent on RAFT during the 18-month operational phase at Sheppard AFB ending in June 1965.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual 4

Comment: The actual number of personnel was prorated from two analysts and four programmers on the basis of time devoted to RAFT program maintenance during the 18-month operational phase at Sheppard AFB ending in June 1965.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 8,775

Comment: The actual dollar amount is based on regular shift changes. However, the RAFT project allocated hardware costs on the basis of extra shift costs for those components that were shared with other applications, since RAFT used only second and third shift time. The cost of the six tape units used only by RAFT was borne completely by RAFT.

FUTURE PLANS: The region concept of base level accounting and finance was acceptably demonstrated by conducting a comprehensive test of the RAFT system. RAFT was deactivated in June 1965 upon completion of this test. This action was taken primarily because the RCA 301, which RAFT operated on, was replaced by the UNIVAC 1050 II in accordance with standardization of the Air Force's automated inventory control system at a base level. The majority of the accounting and finance functions that were performed by RAFT have been adapted to a card system on a Burroughs B263 at base level. A new accounting and finance system is currently in development using some of the concepts that were developed and tested in RAFT. There is some discussion that this new system should be usable either at one base or at several bases at a central location. The workload analyses for this new system were developed by RAFT personnel.

SYSTEM: Repair Requirement Computation--RRC (IBM 7080/1401)

DATA SYSTEM DESIGNATOR: D073

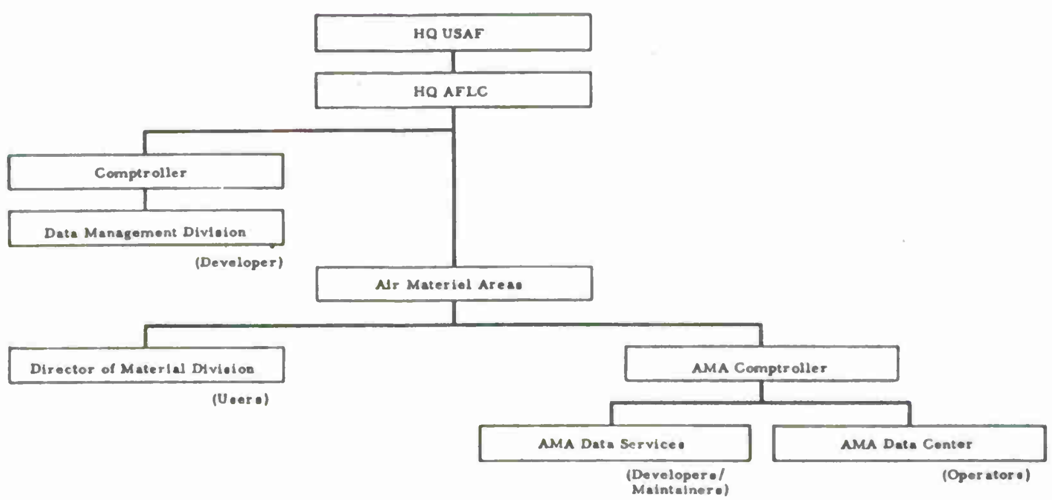
DATA COLLECTION DATE: July 1966

LOCATION:

Contact for Additional Information	SACS San Antonio Air Materiel Area Kelly Air Force Base San Antonio, Texas Comptroller (Data Management Division) Hq., Air Force Logistics Command Wright-Patterson Air Force Base Dayton, Ohio
Development	Hq., Air Force Logistics Command Wright-Patterson Air Force Base Ohio San Antonio Air Materiel Area Kelly Air Force Base Texas Warner-Robins Air Materiel Area Robins Air Force Base Georgia
Maintenance	Hq., Air Force Logistics Command Wright-Patterson Air Force Base Ohio
Pilot Installation	San Antonio Air Materiel Area Kelly Air Force Base Texas Oklahoma City Air Materiel Area Tinker Air Force Base Oklahoma
First Operational Installation	San Antonio Air Materiel Area Kelly Air Force Base Texas
Number of Operational Installations	7

FUNCTION: The users of RRC are the Directors of the Material Maintenance Divisions of the various AFLC Air Materiel Areas. The mission of the users is the management of the repair activity of Air Force materials. RRC functions as a management support system to identify the items, quantities, and urgency of need of those items to be repaired by the Specialized Repair Activity (SRA). The system functions on a biweekly frequency and produces a time phase statement of repair requirements in order of precedence and preference, to be accomplished by the SRA.

ORGANIZATION:



HISTORY: Investigations by various government agencies in 1964 uncovered two major problems in operations of the Air Force Logistics Command (AFLC). First, an ineffective inventory system existed, permitting one agency within the command to purchase items that were being discarded simultaneously by another agency within the command. Second, an inadequate repair system existed, resulting in some aircraft being inoperative for many months awaiting maintenance for lack of proper scheduling of parts, manpower, and facilities.

As a result of these findings, the Commander, Headquarters AFLC, ordered a review of the management of recoverable (repairable) items. This review concluded that AFLC did not have the managerial tools to fulfill this function effectively. Large-scale data processing systems were being planned for the distant future to solve this problem, but it was imperative that an interim solution be developed.

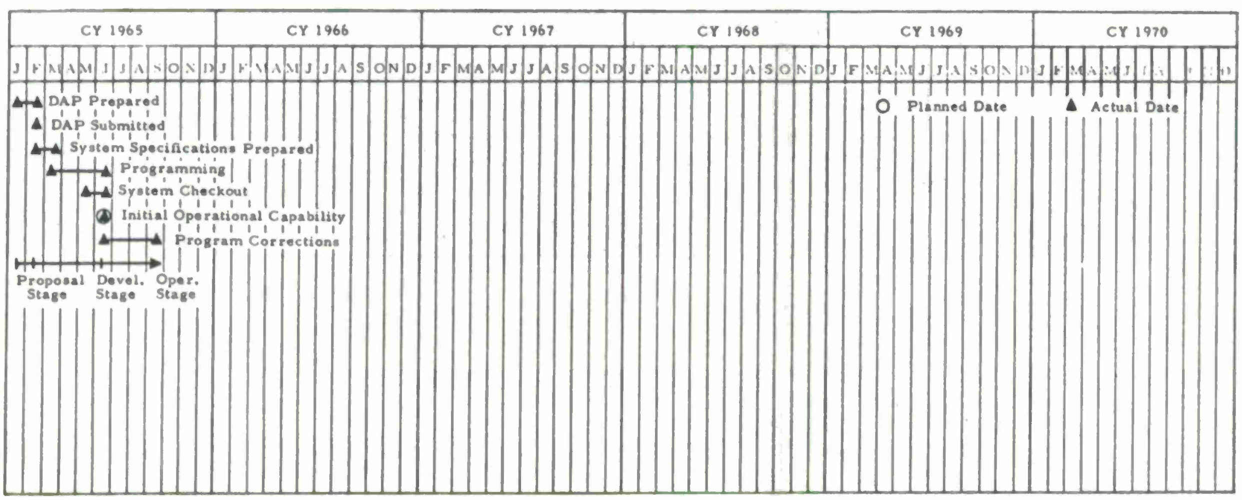
A six-man study group was formed from managerial level personnel of the Data Management Division of Headquarters AFLC. This group concluded that an automated system should be developed to permit the identification of items and quantities needing repair and to react in a short-range time period more closely aligned to the actual demand on AFLC. This group formed the nucleus of a special developmental task force that drew up specifications for the proposed system in March 1965. The programming effort began in April 1965 at Warner-Robbins Air Force Base as IBM 7080 computer time was available there. The Management of Items Subject to Repair (MISTR) system resulted from this effort. The Repair Requirement Computation System (RRC) is the portion of the MISTR system that computes the repair requirements for inventory maintenance.

System tests began in May 1965 at Warner-Robbins AMA and San Antonio AMA. Implementation began at all AMA's in June 1966. During system implementation, approximately 70 major problems requiring changes to the MISTR system were cataloged. The task group directed the extensive modifications to the system and completed their task in June 1966.

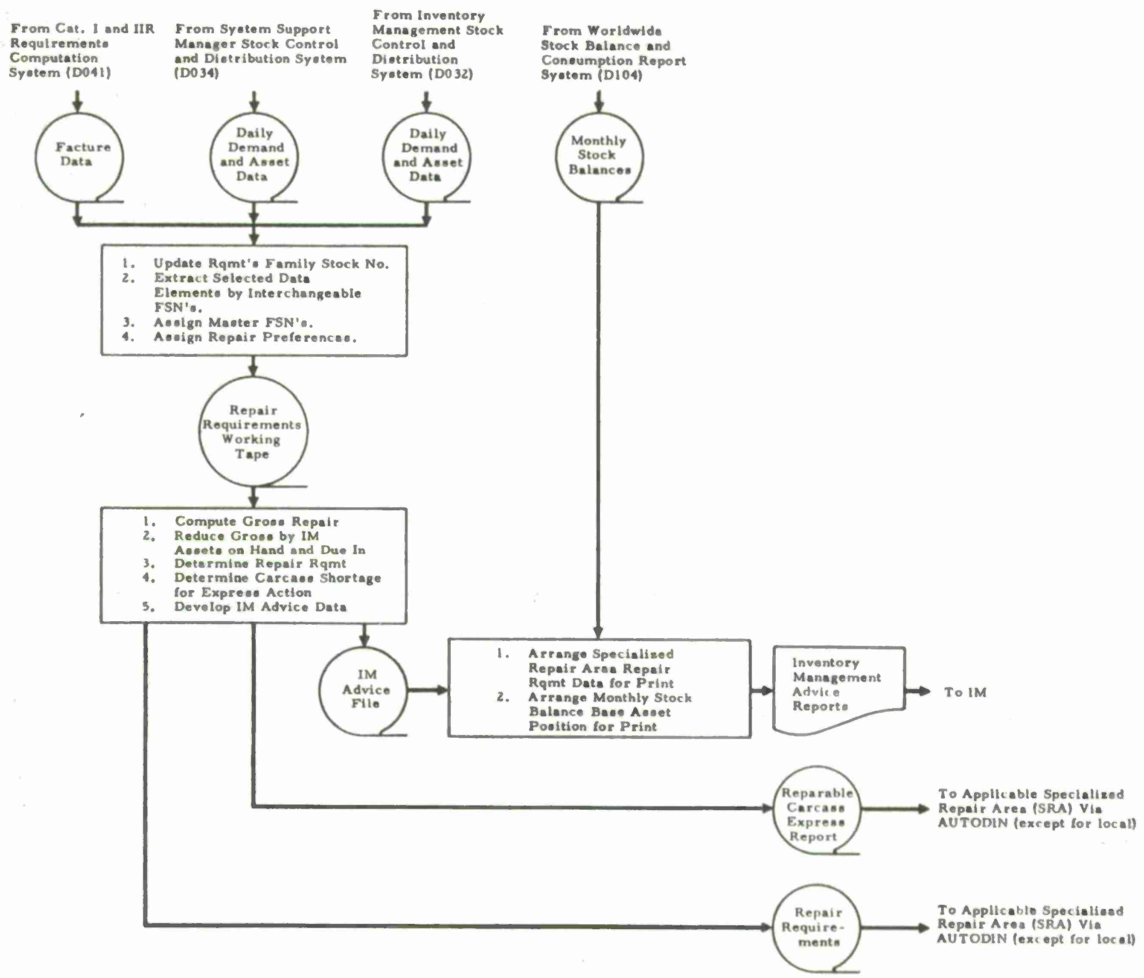
No special management techniques were used to control the development of the system. Progress reports on the development status were submitted to Headquarters AFLC on a monthly basis.

RRC is operational at the following seven sites: Rome AMA, Sacramento AMA, San Bernardino AMA, San Antonio AMA, Oklahoma City AMA, Ogden AMA, and Warner Robbins AMA.

SCHEDULE:



DESCRIPTION: The Repair Requirement Computation System identifies the items, quantities and urgency of items to be repaired by the Specialized Repair Activity (SRA). It operates on a biweekly frequency and produces time-phased statement of repair requirements in order of precedence and preference, to be accomplished by the SRA. Data for computing the requirement is extracted from the Inventory Manager Stock Control and Distribution System, the System Support Manager Stock Control and Distribution System, and the D041 World-Wide Category I and II R Requirements Computation System. The resultant computation produces levels of Safety, Repair Check Point, Repair Projection Point, and Maximum Repair Projection. All available wholesale assets and due-in quantities are then allocated to these levels. Deficiencies in each level become repair requirements by precedence. The above computation is made for each family of items, giving full consideration to the interchangeability of their parts, thereby establishing the preference for repair.



WORKLOAD:

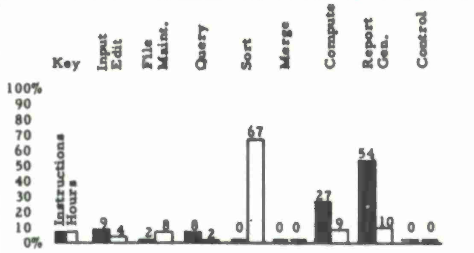
DATA BASE

Char. in Data Base:	627,500
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	2
No. of Data Base Records:	7,000
Percent Growth Rate/Mo.:	0.1
Char./Mo. of Update Input:	52,160

INPUTS

Char./Mo. of Input Volume:	79,570,000
No. of Input Transaction Types:	10
No. of Input Data Fields:	190
Percent of Input Rejects:	Unk

PROCESSING FUNCTIONS

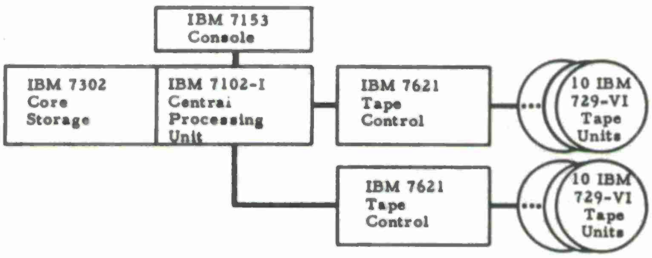


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	19,300	Unk
Total Object Instructions:	19,300	Unk
Hrs./Mo. of Application Production:	4	15

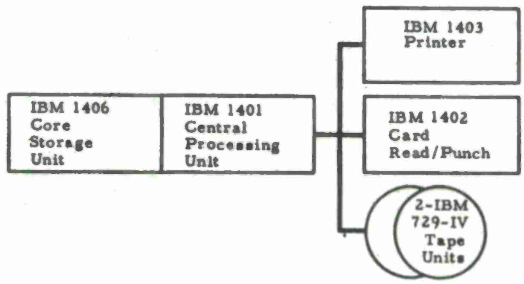
OUTPUTS

Char./Mo. of Output Volume:	10,310,000
No. of Output Formats:	11
Response Time (seconds):	NA

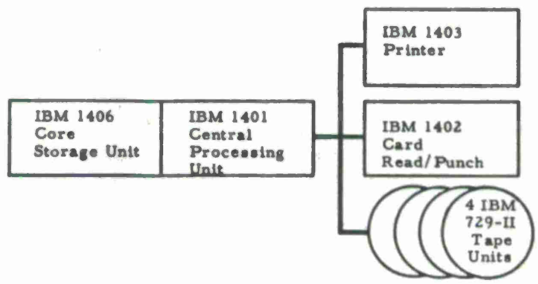
HARDWARE:



2-IBM 7080's



4-IBM 1401's



1-IBM 1401

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (μs)	Internal Storage			External Storage		Peripheral Devices				
									Card Reader/Punch			Printer	
				Cycle Time (μs)	Char. Size (bits)	Char. Capacity	No. Mag. Tapes	Trans. Rate	No.	Read Speed (cards/min)	Punch Speed (cards/min)	No.	Speed (lpm)
2-IBM 7080	9/61	Char.	11	2	6	160,000	20-729 VI	to 90K	None	---	---	None	---
4-IBM 1401	9/60	Char.	230	11.5	6	8,192	2-729 IV	22.5K-62.5K	1-1402	800	250	1-1403	600
IBM 1401	9/60	Char.	230	11.5	6	8,192	4-729 II	15K-41.6K	1-1402	800	250	1-1403	600

Comment: The equipment configuration varies with the installation, both between AMA's and Hq AFLC. The configuration depicted above is for the San Antonio AMA.

SOFTWARE: Software for both the IBM 7080 and IBM 1401 computers consisted of an Autocoder assembler and general input and output utility routines. The IBM 7080 also had a sort program available.

COMMENT: The software is maintained by IBM. Only canned programs are used on the IBM 1401 for RRC.

APPLICATION PROGRAM DEVELOPMENT: Due to the extreme importance of this effort, the development was assigned to a task group under the direction of the Data Management Division, Hq. AFLC. Maintenance, supply, and report management were the three functional areas using the system. Therefore, the task group assigned to development organized itself along lines responsible to these three areas. This put the developers in contact with the users to facilitate design. The analysts were then related directly to the mission groups. Personnel to staff the development group were brought in from five AMA's; also, one IBM programmer was used. Four categories of people were in the development group. First, there were the conceptual types who established the system policies and guidelines. Second, there were procedural people who specified operating instructions. Third, there were analysts who translated the policy and procedure requirements into specifications for programmers. Finally, there were programmers who coded the system. No special management techniques were used to control the development of the system. Status reporting to Headquarters was done on a monthly basis. The programs were written in Autocoder II to operate on hardware already existing at all the AMA's. All of the IBM 1401 software consisted of canned library routines. The programs were checked out individually at WRAMA or SAAMA with the system test following at SAAMA only for 4 months. Program test time was broken down into 223 hours for the IBM 1401 and 135 hours for the IBM 7080. System test time is unknown since system test was done with live data and considered to be production in some instances.

FILE CONVERSION: No file conversion was involved in RRC because the system was designed to operate on existing files.

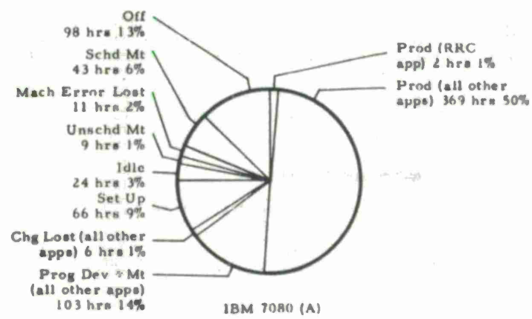
DOCUMENTATION: The principle documentation for this system is as follows: (1) AFLCL 300-11, App. 1 (a user's manual for D073 prepared by the repair agencies; and AFLCL 300-11, App. 2 (operating instructions for D073). This is a complete maintenance manual which includes flow charts and format layouts.

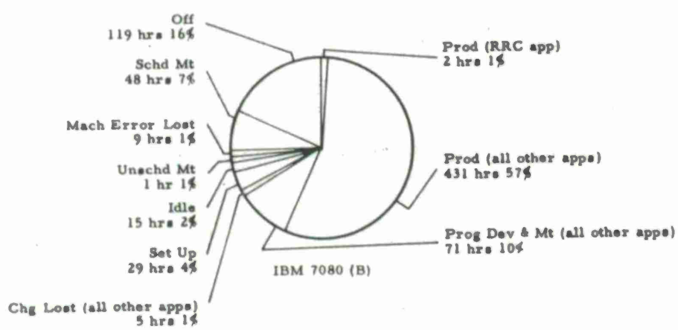
PERSONNEL:

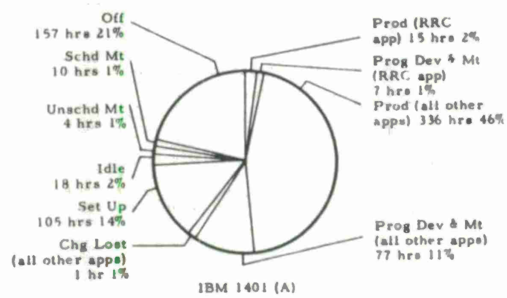
Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Area	Of College
Development	Manager	1	3	15	15	Unknown
	Analyst	1	3	10	10	Unknown
	Programmer	2	19	Unknown	Unknown	Unknown
Operations	Manager	4	0.1	Unknown	Unknown	Unknown
	Operator	89	0.4	2	Unknown	

OPERATIONS: The computer operation is staffed at SAAMA 24 hours a day, 7 days a week. It operates as a closed shop. RRC is one of many applications on the IBM 7080's and 1401's. A daily schedule is followed by the installation which is displayed on closed circuit TV. Five IBM 1401 computers are used to process RRC. The pie chart below reflects utilization as if one IBM 1401 did all of the RRC application processing, and not all five computers, which is actually the case.

Comment: None.







APPLICATION PROGRAM MAINTENANCE: Program maintenance for RRC is currently performed at Headquarters AFLC by three personnel of the Data Management Division. There are an analyst and a programmer at each AMA to monitor the operation of the system and to install program corrections received from Headquarters AFLC.

COMMENT: None.

BENEFITS: Proposed: RRC was to assist AFLC inventory management by identifying the items and quantities to be repaired in order to maintain inventory levels. An additional benefit from RRC was to be the production of a biweekly schedule of repair requirements to be accomplished by Specialized Repair Activities. Repairs were to be scheduled in order of precedence and preference to improve control and management of repairable carcasses.

Actual: RRC provided management tools to AFLC which had not formerly existed. It provided scheduling and control of repair activities not possible prior to RRC implementation.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 118

Comment: A DAP for RRC was submitted to AFADA in March 1965 and immediate verbal approval was given by AFADA for a 6-month effort. There was no estimate for man-months of development effort stated in the DAP.

Months of Elapsed Development Time (Dev.)

Proposed: 4

Actual: 4

Comment: The proposed initial operational capability date was June 1965.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 62,190

Comment: Program checkout required 135 hours on the IBM 7080 computer and 233 hours on the IBM 1401 computer.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: 20

Actual: 4

Comment: The actual number reflects usage during March 1966 on the IBM 7080 at SAAMA. Fifteen hours were used for RRC application production on the peripheral IBM 1401's. The DAP stated an estimate of 30 hours/month per AMA for RRC application production on the IBM 1401 computer.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 0

Comment: The actual number reflects usage during March 1966 on the IBM 7080 at SAAMA. Program Maintenance for RRC is done only at Hq. AFLC. The operational AMA's have monitor programmer/analysts who collect program error data to send to Hq. AFLC and install corrections from Hq. AFLC. Seven hours were used for RRC program maintenance on the peripheral IBM 1401's.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 1

Comment: The actual number of personnel is prorated from 89 operators at SAAMA on the basis of machine hours used by RRC.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 6

Comment: The actual number of personnel is prorated from programmers at SAAMA and Hq. AFLC on the basis of time devoted to RRC program maintenance.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 2,859

Comment: None.

FUTURE PLANS: A number of modifications and minor corrections are being incorporated in what is known as a "block change." A "block change" in a system is an extensive revision of the programs, procedures, and documentation reflecting an accumulation of minor errors and modifications. The modifications reflect efforts to be compatible with the "feeder" systems and changes of mission policies and operational environments. These changes are scheduled to be operational at all AMA's by September 1966. This "block change" procedure is common with the Air Force Logistics Command and this system will probably be modified in the future by this procedure.

SYSTEM: Appropriation Accounting Remote-Random Access System--SC/ACCT (IBM 1410)

DATA SYSTEM DESIGNATOR: H074

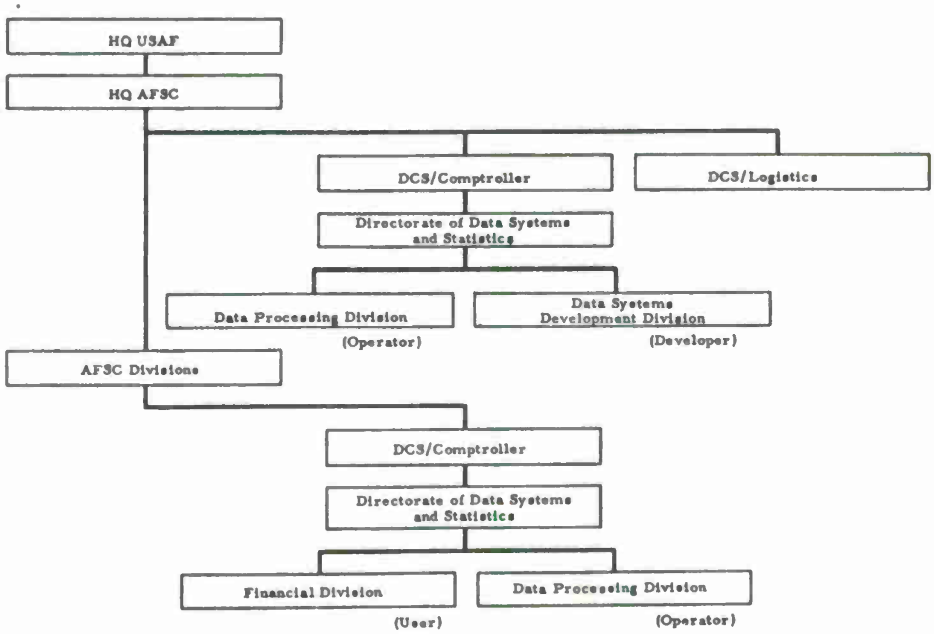
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Data Processing Division Directorate of Data Systems Air Force Systems Command Andrews Air Force Base, Maryland
Development	Air Force Systems Command Andrews Air Force Base Maryland
Maintenance	Air Force Systems Command Andrews Air Force Base Maryland
Pilot Installation	None
First Operational Installation	Air Force Systems Command Andrews Air Force Base Maryland
Number of Operational Installations	10

FUNCTION: The users of SC/ACCT are the Financial Divisions of the nine Air Force System Command (AFSC) Divisions and the Financial Division of AFSC Headquarters. The mission of these divisions is financial accounting and reporting the status of funds. SC/ACCT functions as a management support system in financial and accounting operations by permitting direct inquiry and maintenance of a division's current funding and listing periodic summaries of the finance file contents. In addition, accounting information required by the AFSC Headquarters and by other commands is provided by the divisions on punched cards and magnetic tape.

ORGANIZATION:



HISTORY: From August 1959 to January 1960, a study of the current posture of the Air Force Systems Command's (AFSC) data processing requirements was undertaken. This study resulted in the development of a data processing concept based on the principles of standardization and compatibility of data systems and equipment. The report was submitted in July 1960 to Headquarters USAF as a program concept of a total command package.

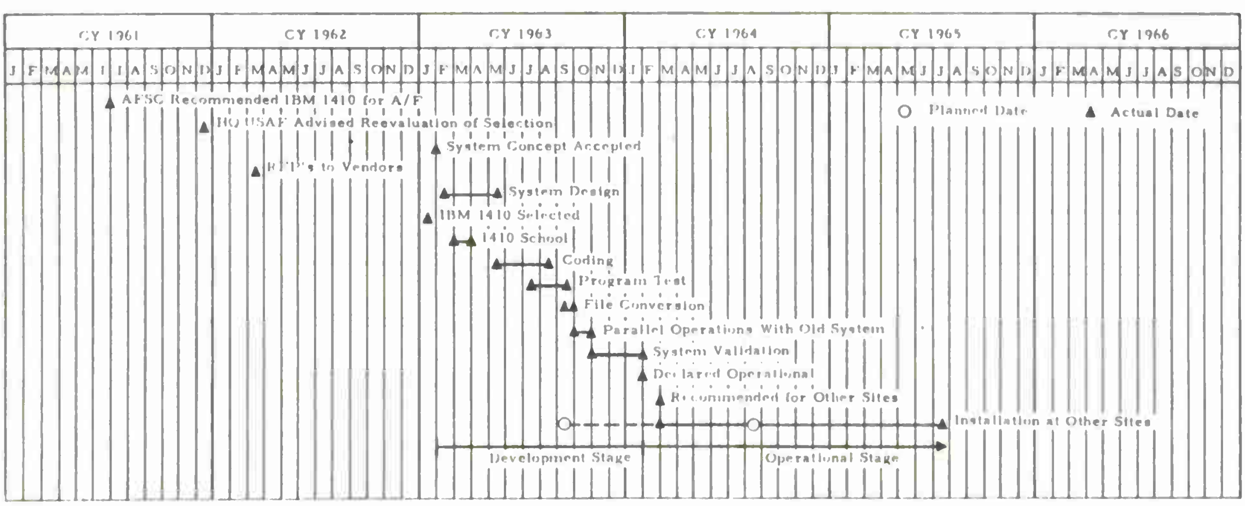
The report included the general identification of the data systems to be included in the development of the program and a detailed justification for the selection of an IBM 7070/1401 system for Headquarters AFSC and IBM 1410 systems for the divisions. Accounting and finance were among the functions selected for standardized automation and were to be part of a complete management system.

Headquarters USAF directed AFSC to make a reselection of the data processing equipment in accordance with a new computer selection policy. The Command ADP program was rewritten, approved by Headquarters USAF, and submitted to 16 manufacturers as an RFP in March 1962. Two proposals were received and the Headquarters AFSC ADP selection committee recommended the selection of the IBM 1410 to Headquarters USAF which approved the installation of one IBM 1410 to be installed at ESD as a pilot system. The 1410 was installed at ESD in August 1963, and the conversion of the accounting and finance system began in September. Following a Headquarters USAF evaluation of the pilot system, final approval was granted in February 1964 to retain the ESD system and to install eight additional 1410's at the AFSC divisions.

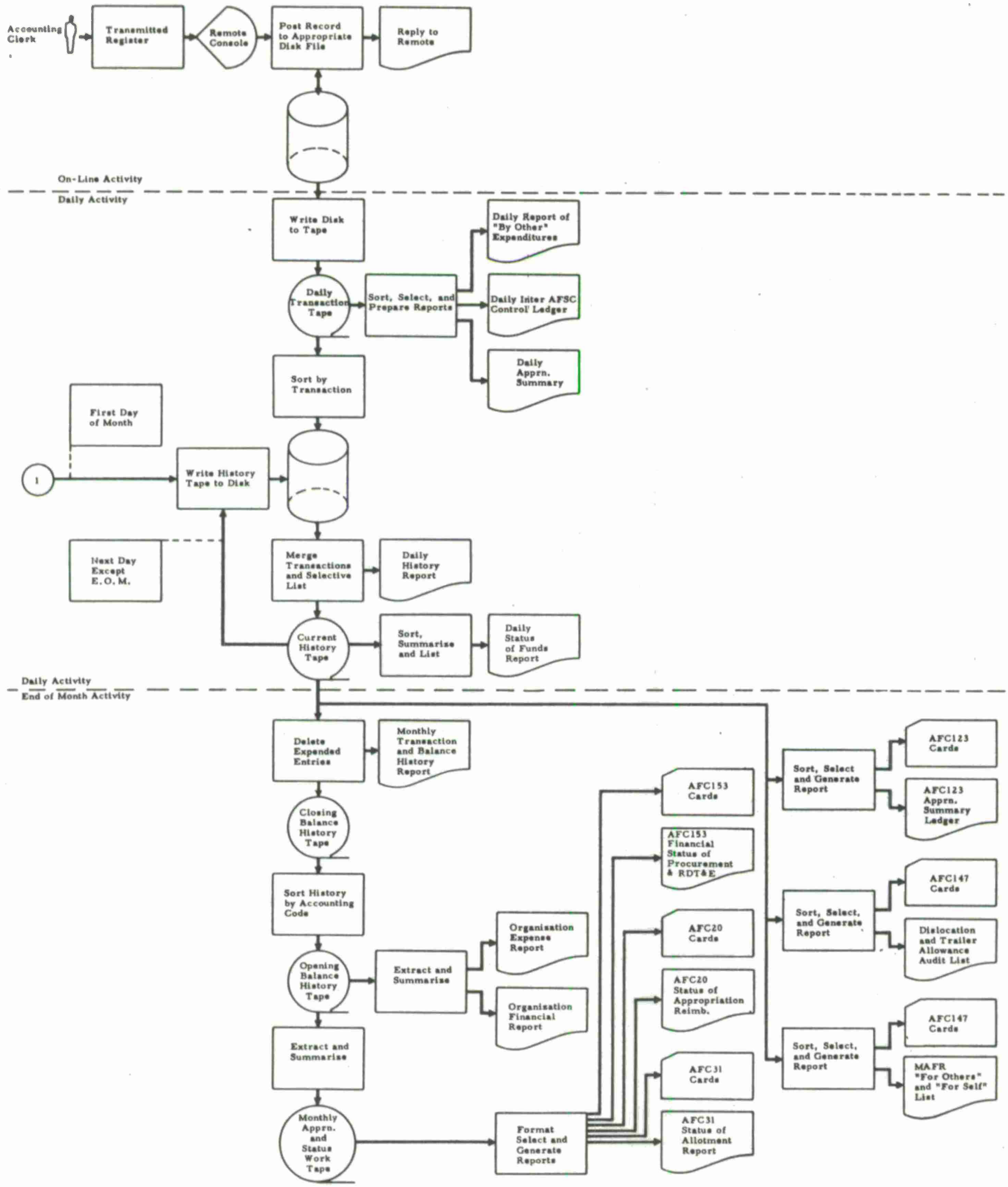
Early in 1962, a Data Development Division was established within the Directorate of Data Systems at AFSC for the exclusive purpose of developing the command management system. The Financial Management Branch's responsibility was to design, develop, and implement an ADP system for accounting and finance. The Standards Branch's responsibility was to define software in accordance with the system requirement. In addition to Air Force personnel, two IBM programmers provided programming support in the Financial Branch developing the inquiry system as well as test programs. Air Force personnel in the Standards Branch were supplemented by four IBM programmers in the development of the monitor system and various other software packages.

SC/ACCT is operational at Hq. AFSC, Andrews AFB, and at nine AFSC divisions.

SCHEDULE:



DESCRIPTION: The AFSC accounting and finance system provides a standard automated accounting system for each division within the command. The system permits direct inquiry and maintenance of the division's current financial funds, as well as listing of periodic summaries of the file contents. In addition, accounting information required by headquarters and by other commands is provided on punched cards or magnetic tapes.



WORKLOAD:

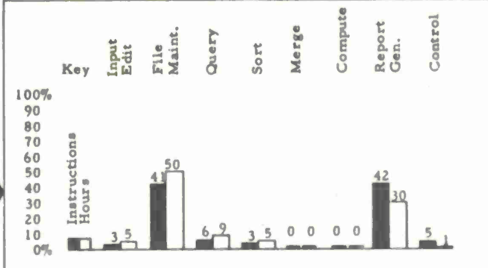
DATA BASE

Char. in Data Base:	3,800,000
Percent of Char. on D/A Storage:	100
Milliseconds of Access Time for D/A:	180
No. of Data Base Record Types:	6
No. of Data Base Records:	Unk
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	530,000

INPUTS

Char./Mo. of Input Volume:	576,000
No. of Input Transaction Types:	334
No. of Input Data Fields:	115
Percent of Input Rejects:	0.1

PROCESSING FUNCTIONS

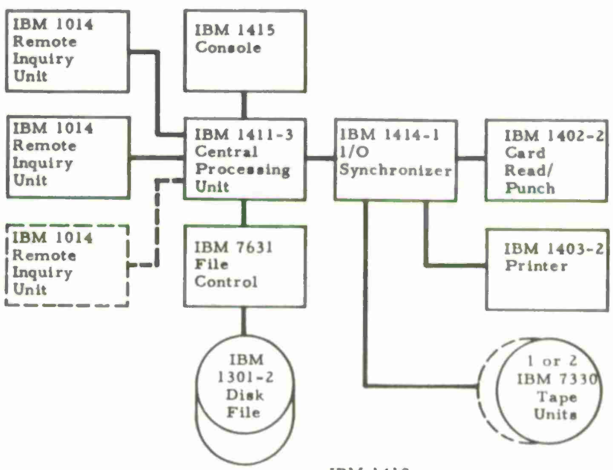


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	39,360	NA
Total Object Instructions:	66,000	NA
Hrs./Mo. of Application Production:	165	NA

OUTPUTS

Char./Mo. of Output Volume:	756,000
No. of Output Formats:	27
Response Time (seconds):	2

HARDWARE:



IBM 1410

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Internal Storage: Cycle Time (us)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Storage – Mag Tapes: No. Mag Tapes	Mag Tapes: Trans. Rate	Disk: No. Disks	Disk: Trans. Rate (char./sec)	Disk: Char. Capacity	Disk: Access Time (ms)	Peripheral Devices – Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)	Remote Consoles: No.	Remote Consoles: Speed (cpm)
IBM 1410	11/61	Char.	88	4.5	6	40,000	1 or 2(1) 7330	7.2K	1-1301-2 Model 2	90,100	55.9M	180	1-1402	800	250	1-1403	600	2 or 3(2) 1014	90

Comment:
(1) Six installations have two 7330 tape transports; four installations have one 7330 tape transport.

(2) Three installations have three 1014 remote consoles, seven installations have two 1014 remote consoles.

SOFTWARE: Software for the IBM 1410 consisted of the following: (1) a monitor program designed for this application; (2) a Processor Operating System (POS); (3) a maintainer program designed for this application; (4) a sort program; and (5) two utility program packages. The software was delivered by IBM with the machine in August 1963.

Comment: The monitor program resides in core storage at all times, controls the use of remotes, and establishes an interface between the analyzer program and the application programs stored on the disk. The POS provided AUTOCODER, COBOL, and FORTRAN capabilities. AFSC also developed macros for POS giving teleprocessing and monitor communication capabilities. The sort program has been modified for on-line use by the addition of routines to enable interrupt processing and call from another program. Both of the utility program packages were recompiled and relocated to convert from tape to the disk system.

APPLICATION PROGRAM DEVELOPMENT: A Data Development Division was established within the Hq. AFSC Directorate of Data Systems for the exclusive purpose of developing AFSC management systems for the IBM 1410. The Financial Management Branch's responsibility was the system design, programming, testing, and documentation of the Appropriation Accounting System. The branch chief and his assistant supplied the input formats, the output formats, the records formats, and the logical approach for the system design. The two sections of the Financial Management Branch then developed the detailed system design and wrote the required programs in AUTOCODER. The Standards Branch provided the software within which the system was to operate, including the monitor system and software to simulate remote terminals which were not available on the test computer. The final system test was done on a computer configuration with remote capabilities. Approximately 350 hours, out of a proposed 600 hours free test time bid by IBM in the proposal, were used for testing. The programmers were allowed to see their test run but they could not operate the computer. Turnaround time was normally 24 hours or less. (The system test included parallel operations for 1 month.)

FILE CONVERSION: There were three accounting and finance systems operating at the bases prior to the implementation of the 1410 system. One was a manual system, the second was an Air Force standard PCAM system, and the third was the Air Force Program Accounting System. Besides the three different programs, there were local codes used within each of the systems that made even the standard punch card system somewhat unique to each base. Those bases with punch card systems were directed by Headquarters AFSC to develop conversion programs to reformat the local card forms into the new formats used by the 1410 system, as well as to convert all local codes into standard codes. These cards were then entered into the system by use of the test simulator program to produce the master files. The computer time required to make the initial file development ran from 18 hours to a matter of days at some bases. Those bases that were on manual systems were required to enter all their transactions into the system via the remote keyboard. This required as much as a week in some instances.

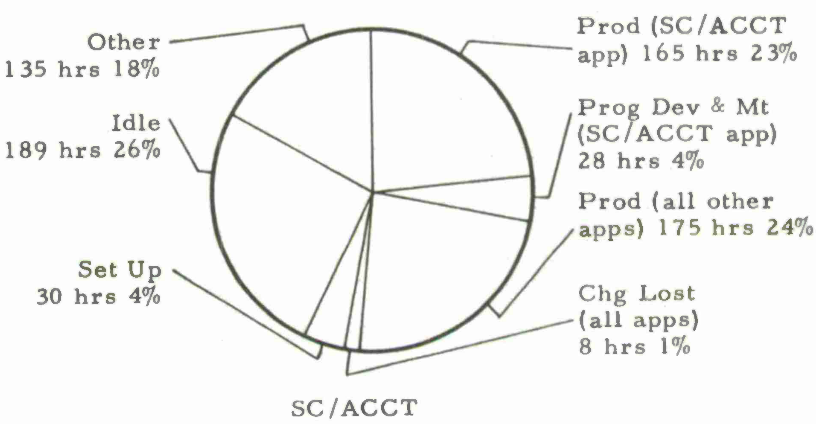
DOCUMENTATION: The documentation includes the narrative description of the system, operator instructions, system flow charts, logic charts, input and output layouts and program listings. This information is contained in one manual, AFSC Manual 171-4.

PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In Accounting	Number of Years: Of College
Development	Manager	4	2	7	1.5	0.5
	Analyst	3	3	17	17	Unknown
	Programmer	13	14	0.5	0.5	Unknown
Operations	Manager	None	Unknown	Unknown	Unknown	Unknown
	Operator	7	9	4	2	

OPERATIONS: The SC/ACCT system is run during regular business office hours. It operates as a closed shop. The SC/ACCT system is one of several applications on the IBM 1410 computer at Andrews AFB.

Comment: The program development and maintenance is done only at Headquarters, AFSC, Andrews AFB. The "Other Time" could not be defined. "All other application" program development and maintenance is included in application production in the pie chart.



APPLICATION PROGRAM MAINTENANCE: Two programmers are currently involved in program improvements and corrections at Andrews AFB where all program maintenance is done. More time is spent on improvement than on correction.

Comment: None

BENEFITS: Proposed: Prior to development of SC/ACCT, three accounting and finance systems were used at AFSC bases. These systems were either manual or on PCAM. The systems also used local codes, causing the systems to be unique to each base. Benefits that were to result from implementation of SC/ACCT indluded a standard accounting and finance system throughout AFSC and increased accuracy and timeliness through the use of state-of-the-art data processing equipment.

Actual: SC/ACCT was phased into operation at different AFSC divisions between February 1964 and July 1965. The system was standarized across all divisions, providing increased interchangeability of processing capability and personnel throughout AFSC, in addition to simplifying the production of command-wide reports. ADP provided more rapid access to accounting and financial data than the PCAM or manual systems.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk

Actual: 226

Comment: No DAP was prepared for the SC/ACCT system. Instead, a study group submitted a program concept to Hq. AFSC (at that time Air Research and Development Command). The study resulted in hardware recommendations and detailed system specifications.

Months of Elapsed Development Time (Dev.)

Proposed: 9

Actual: 12

Comment: Once the design was fixed, the system underwent little redesign or modification, either during or after development. It was felt by the developers that the planned operational date for the initial installation at Andrews AFB was overly optimistic.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: 28,525

Comment: IBM bid 600 hours free test time worth approximately $48,900 for entire system checkout, including system software. The remote query had to be simulated, since the test computer had no remotes. This caused no problems when actual checkout with remotes was begun. A total of 350 hours was actually used for program and system checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 165

Comment: The actual number reflects usage on the IBM 1410 during March 1966 at Andrews AFB.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: 28

Comment: The actual number reflects usage on the IBM 1410 during March 1966 at Andrews AFB.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: Unk

Comment: There are seven operators allocated to SC/ACCT at Andrews AFB. The number of managers allocated to SC/ACCT at Andrews AFB is unknown.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 2

Comment: The actual number represents full-time SC/ACCT maintenance programmers at Andrews AFB.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 15,730

Comment: None.

FUTURE PLANS: Plans for changes or refinements to SC/ACCT are indefinite, with the exception of the inclusion of DOD's MILCAP (Military Contract Administration Procedures). MILCAP is scheduled for implementation by 1 July 1968. In addition, the advisability of adding civilian payroll to the system and incorporating disk checks to improve disk reliability are under study.

SYSTEM: SPACETRACK--SPCTRK (Philco 2000)

DATA SYSTEM DESIGNATOR: A005

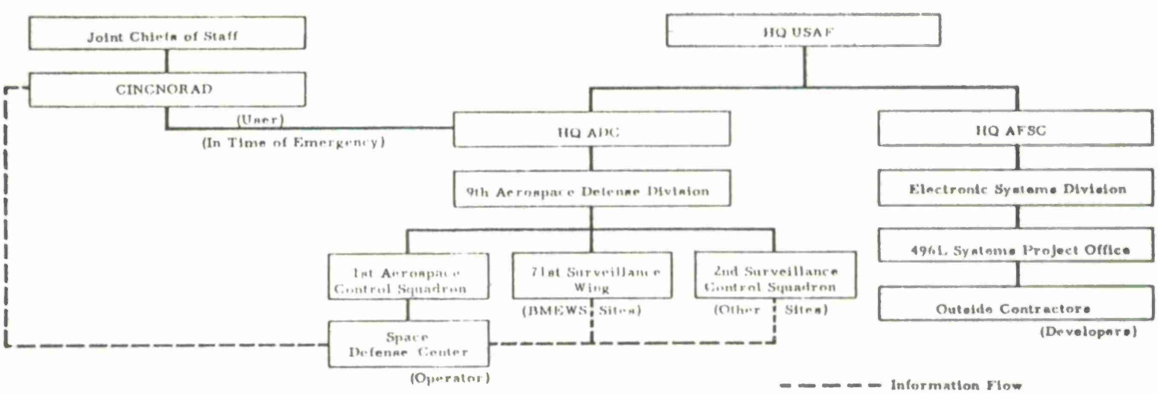
DATA COLLECTION DATE: April 1966

LOCATION:

Contact for Additional Information	Hq., Air Defense Command (ADOOP) Ent Air Force Base Colorado Springs, Colorado
Development	Laurence G. Hanscom Field Massachusetts
Maintenance	Ent Air Force Base Colorado
Pilot Installation	None
First Operational Installation	Ent Air Force Base Colorado
Number of Operational Installations	1

FUNCTION: The user of SPACETRACK is CINCNORAD. One of the most important missions of the user is the NORAD space surveillance program. SPACETRACK functions as an operational and intelligence support system to detect, track, and maintain a central catalog of all man-made objects in space and provide ephemerides on all such objects. In addition, SPACETRACK supplies CINCNORAD with information and data for threat evaluation and decision making and for the operation of SPADATS. SPACETRACK also has the responsibility for backup to the NORAD (425L) system for processing BMEWS display information.

ORGANIZATION:



HISTORY: In October 1957 the first man-made orbiting body, Sputnik I, was orbited around the earth by the U. S. S. R. At that time the United States capability for tracking orbital elements consisted of a private tracking system maintained by Dr. Arthur Leonard, an American astronomer. In early 1958, Leonard and two other astronomers, Wahl and Frieden, were brought together by the Advanced Research Projects Agency (ARPA) in a pilot project of space tracking. Late that year, ARPA formalized the project by issuance of order 50-59 establishing a "SPACETRACK" filter center at Bedford, Massachusetts. The order also generally defined the planning requirements of an operational system to locate, track, and catalog all man-made objects in space. In early 1959, the Air Research and Development Command (ARDC) was delegated the SPACETRACK mission and established a central data processing center at Laurence G. Hanscom Field, Massachusetts. The Air Force assumed responsibility for the system in October 1960 and the Air Defense Command (ADC) was designated user. The first contingent of ADC personnel began training in the techniques and methods of space detection at Hanscom Field in November 1960. The first or A system became operational at Ent AFB, Colorado, in June 1961. It was followed by the A-1, B-1, B-2, and B-3 systems. Each version replaced the previous one (with only partial recoding) and increased the capability of the SPACETRACK system.

The earliest SPACETRACK development was under the direction of the Cambridge Research Geophysics Laboratory until early 1961. The astrodynamics and operational programs were produced by several universities and by private industry under many small contracts.

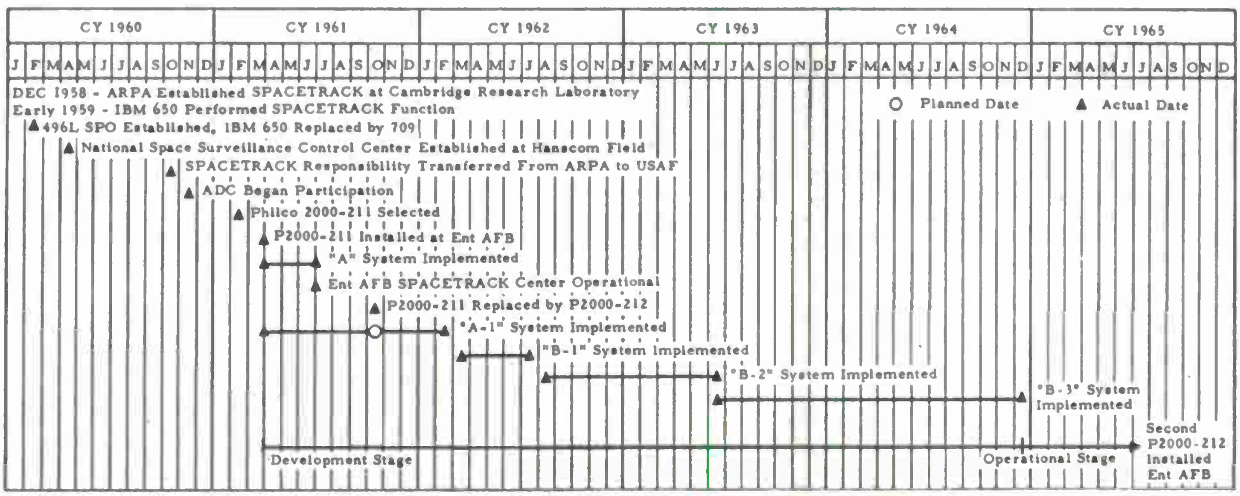
The two leading contractors were Aeronutronics and Wolf Research and Development. There was no system concept at this stage and these early efforts were of an R and D nature.

With the transfer of responsibility to the Air Force in 1960, Mitre Corporation was given the system engineering task including overall technical responsibility and development of future plans. During this period personnel from the Computer Division, Philco Corporation, were added to the programming effort, while both Aeronutronics and Wolf Research and Development maintained their existing contracts with the Air Force.

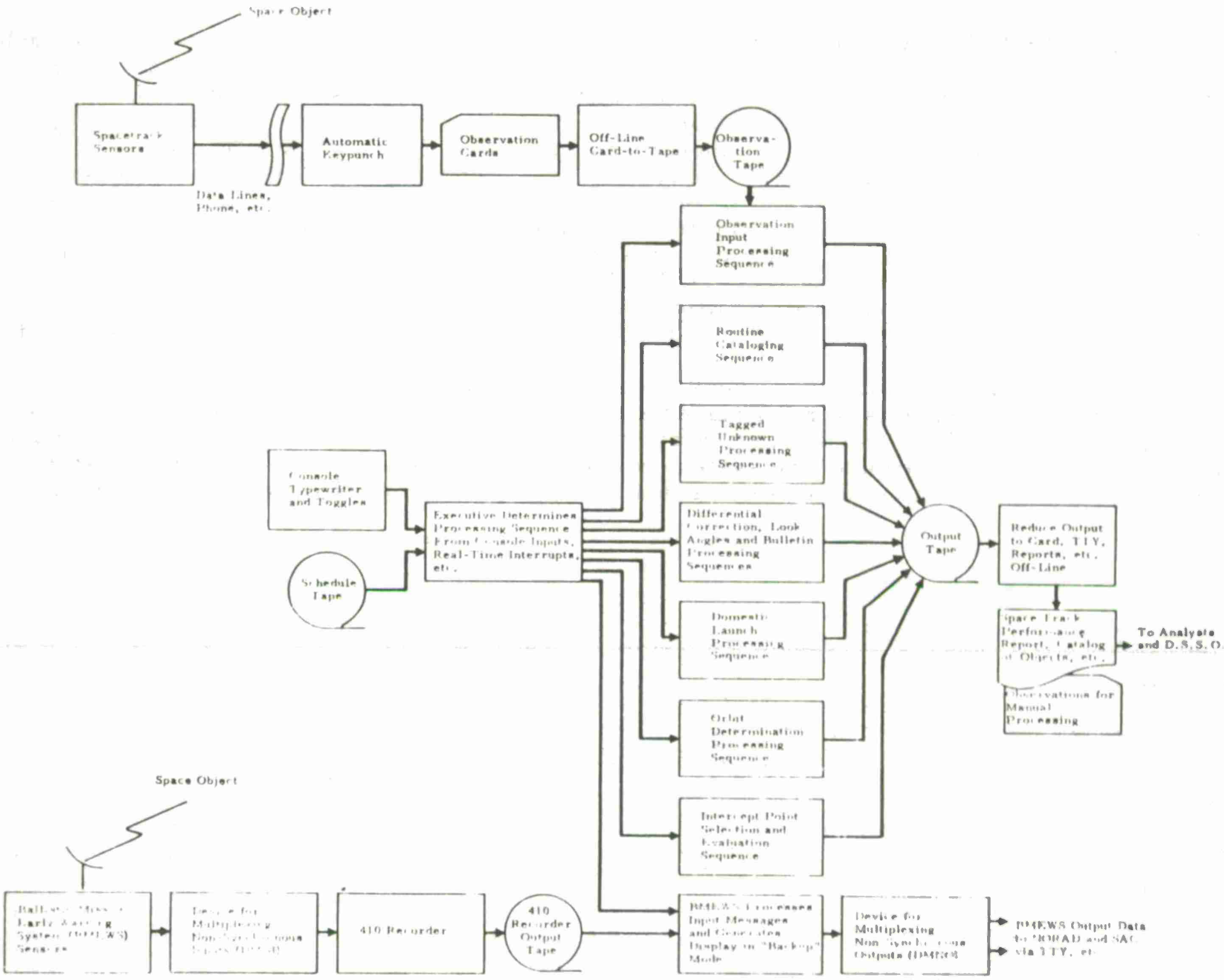
Continuing program additions and modifications have been made since 1961 by the above-mentioned contractors, in-house Air Force personnel, System Development Corporation, and TRW.

Before the B-2 system, uniform documentation did not exist for SPACETRACK, although system description documents were produced as well as a great deal of program documentation. Since implementation of the B-2 system, System Development Corporation has had the responsibility for total documentation of the system and its components. This has resulted in standardized documentation consisting of several volumes which are updated as the system evolves.

SCHEDULE:



DESCRIPTION: Observations are received via data link from forward sites. If supplying BMEWS Display Information Processor (DIP) backup, the data are transferred directly into the computer by a special input device (DMNI), BMEWS input data are recorded for later SPACETRACK usage. If display output is required, the messages are generated and output via a special output device (DMNO). For SPACETRACK functions, input is usually prepared by keypunch machines that automatically convert punched paper tape to cards. The processed observations are then compared with predicted positions of the orbital elements in the catalog and the orbital elements are updated. The corrected orbital elements, sensor acquisition data (look angles), and bulletins are prepared for sensors and users.



WORKLOAD:

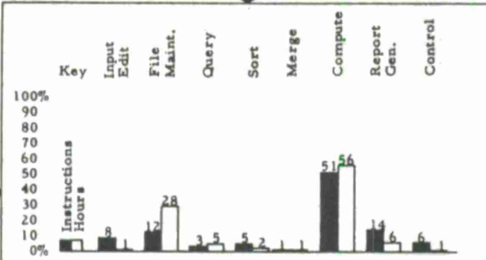
DATA BASE

Char. in Data Base:	44,420,000
Percent of Char. on D/A Storage:	NA
Milliseconds of Access Time for D/A:	NA
No. of Data Base Record Types:	6
No. of Data Base Records:	553,300
Percent Growth Rate/Mo.:	7
Char./Mo. of Update Input:	26,560,000

INPUTS

Char./Mo. of Input Volume:	26,560,000
No. of Input Transaction Types:	41
No. of Input Data Fields:	250
Percent of Input Rejects:	5.0

PROCESSING FUNCTIONS

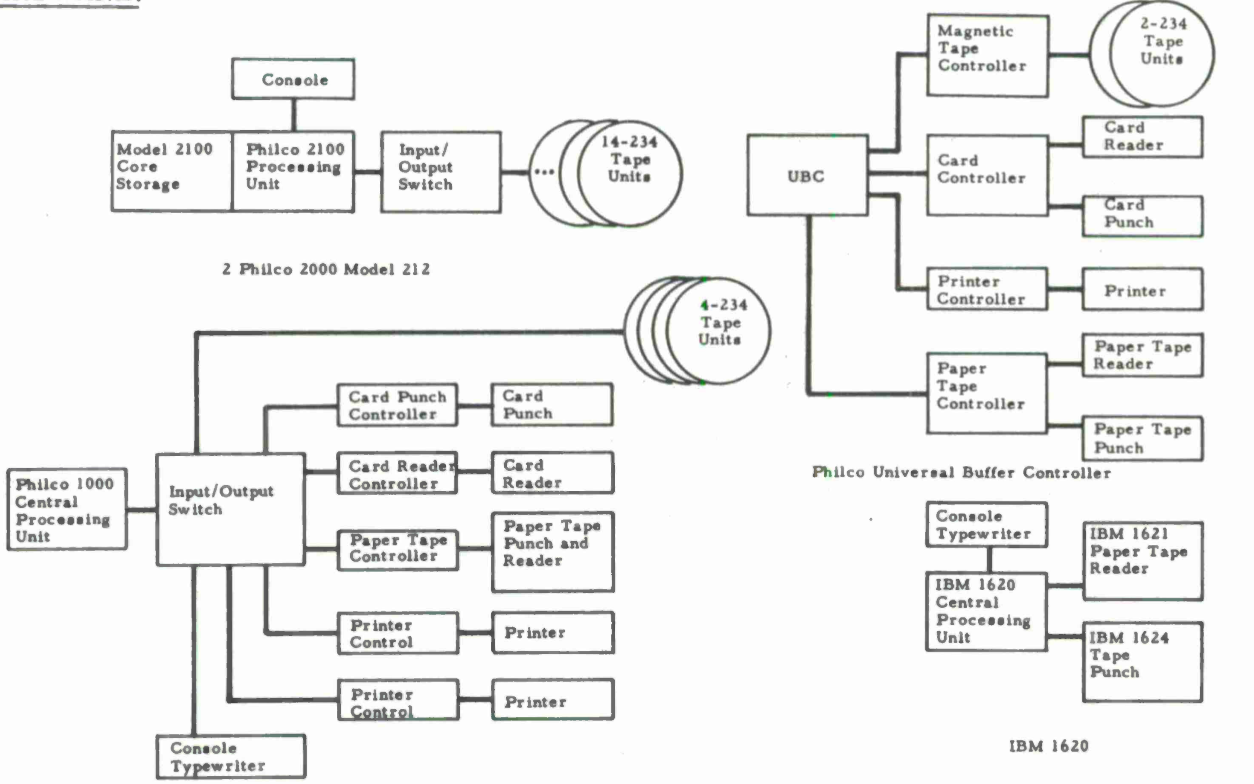


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	423,300	Unk
Total Object Instructions:	485,200	Unk
Hrs./Mo. of Application Production:	569	Unk

OUTPUTS

Char./Mo. of Output Volume:	1,240,000,000
No. of Output Formats:	70
Response Time (seconds):	NA

HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Internal Storage: Cycle Time (us)	Internal Storage: Word/Char. Size (bits)	Internal Storage: Word/Char. Capacity	External Storage: No. Mag Tapes	External Storage: Trans. Rate	Peripheral Devices – Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: Punch Speed (cards/min)	Printer: No.	Printer: Speed (lpm)	PT Reader/Punch: No.	PT Reader/Punch: Speed (char./sec)	PT Reader/Punch: Speed (char./sec)
2-P2000 212	2/63	Word	.6	1.5	48	32,768	14-234-2	90K to 240K	None	---	---	None	---	None	---	---
Philco UBC	11/58	Char.	N/A[(1)]	N/A[(1)]	6	1,024	2-234	90K to 240K	1-258	2,000	250	1-151	900	1-141	1,000	100
P1000	6/63	Char.	39	3.5	6	16,384	4-234	90K to 240K	1-258	2,000	100	2-151	900	1-141	1,000	100
IBM 1620	10/60	Char.	140	10	4	20K	None	---	None	---	---	None (2)	---	---	---	---

Comment: (1) Philco UBC is a "stand alone" I/O device which is not programmable.
(2) The IBM 1620 is equipped with a typewriter with and I/O rate of 10 characters/sec.

SOFTWARE: Software for the Philco 2000-212 consisted of a TAC assembler, an ALTAC compiler, and an SYS operating system. The software was delivered by Philco with the hardware in October 1964.

COMMENT: The ALTAC language is a FORTRAN-like language which includes the capability to intermix the TAC assembly language. The ALTAC compiler will accept either ALTAC or FORTRAN input statements. The executive system used by B-3 was developed by SDC, using segments of the SYS operating system. SPCTRK and BMEWS programs may occupy the computer simultaneously and be performing their functions over the same period of time in the interruptable mode of operation. In the noninterruptable mode, SPCTRK occupies the computer alone.

APPLICATION PROGRAM DEVELOPMENT: The first version of SPCTRK was programmed on an IBM 709 in a batched processing mode of operation. There was no BMEWS backup capability. The A system stems from the translation of programs from the IBM 709 to the Philco 2000. The machine language programs were coded in TAC by Aeronutronics Division of Ford Motor Company, and Wolf Research and Development Corporation under contract to Philco Corporation. The FORTRAN programs were modified to comply with ALTAC by Philco Corporation, Computer Division. Aeronutronics was contracted to produce an executive for the Philco 2000 which, when coupled with the A system, gave the A-1 system. The B-1 system included BMEWS backup capability and was developed by the System Development Corporation (SDC) to add this capability to the A-1 system, which was not reprogrammed. The B-2 system, developed by SDC with support from Aeronutronics and TRW Systems, was a major reprogramming effort. The A-1 programs were rewritten or modified along with the BMEWS backup modules, in order to be tied together under a single monitor. The B-2 system developers developed the B-3 system in which the B-2 system inputs were standardized and the file formats changed to contain sensor identification information. The object identification number was also increased from three to five digits. The Mitre Corporation served as system engineer and monitored the entire SPCTRK development. There are 100 application programs in the B-3 system, broken down by originators as follows: Aeronutronics, 31; Air Force (including Wolf), 31; Jet Propulsion Laboratories, 3; Philco Corporation (Computer Division) 16; SDC, 14; and TRW, 5. The programs were written in the following languages: TAC, 84 programs; ALTAC, 12 programs; and FORTRAN, 4 programs. SPCTRK was developed under 375 series AFR's. The system test conducted using these AFR's was in three phases: (1) the responsible contractor ran programs individually and as a system monitored by the System Programming Office (SPO); (2) the SPO ran the system; and (3) operational personnel ran the system monitored by the SPO. Records of the number of checkout hours do not exist but it is estimated that between 8,000 and 12,000 hours were required for development of all systems from A to B-3.

FILE CONVERSION: The only significant file conversion process in the SPACETRACK system took place during the switch from the B-2 to the B-3 system. This conversion was necessitated by new formats for the files. Among the changes were an increase of the object identification number from 3 to 5 digits, in order to be able to track over 999 objects, and increased information on the sensors in the Observation (R) File. The files which required conversion were the Sensor (S) file, the Observation(R) File, and the Element (E) File. The necessary programming of these conversion programs and the supervision of the conversion effort was performed by the Programming Division of the 1st Aerospace Control Squadron. Three hours of computer time on the Philco 2000-212 and 1.5 man-months of effort were required to perform this task.

DOCUMENTATION: System Development Corporation has the responsibility for complete documentation. The B-3 System documents have been organized into several series; e.g., Program User's Manual (TM-LX-193/000/00), Data Base Description (TM-LX-194/000/00), Computer Operator's Guide (TM-LX-192/000/00), etc.

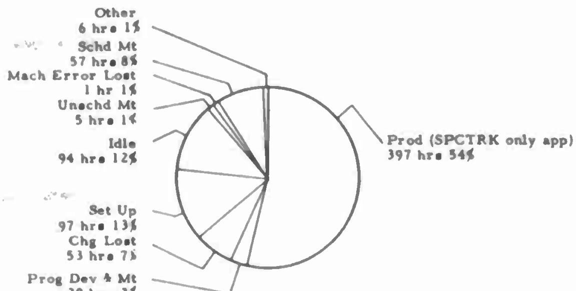
PERSONNEL:

Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In C and C	Of College
Development	Manager	None(1)	Unknown	8.0	4.0	5.0
	Analyst	None(1)	Unknown	5.0	4.0	4.5
	Programmer	20	Unknown	3.0	2.0	4.0
Operations	Manager	9	9	3.0	3.0	4.0
	Operator	None(1)	51	2.0	2.0	

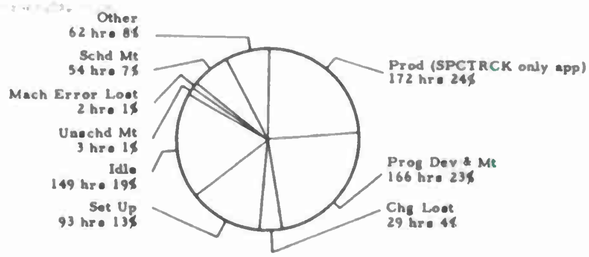
Note: (1) Years in ADP, C and C, and college were estimated.

OPERATIONS: The computer operation is staffed 24 hours a day, 7 days a week. It operates as an open shop. SPCTRK is the only application on the two Philco 2000 computers. The Philco 2000 (A) computer is owned, while the Philco 2000 (B) computer is rented. A daily schedule is strictly followed by the installation.

Comment: The chargeable lost time for the two computers was high, mainly because of tape defectiveness and maintenance (44 hours for both computers) of the high-speed Philco 234-2 tape drives. Programming and operator errors contributed another 16 hours to chargeable lost time hours. Computer utilization was not obtained for the following: Philco 1000, Philco 410, and IBM 1620.



Philco 2000 (A)



Philco 2000 (B)

APPLICATION PROGRAM MAINTENANCE: There are currently 17 programmers involved with program maintenance. Six of these programmers are civilians from Wolf Research and Development Corporation. None of these 17 people were involved in the original development of the system. It is estimated that they spend 85 percent of their maintenance effort in program improvement and 15 percent in program correction. They also act as liaison to those programmers at SDC doing major reprogramming (Delta I) and will act as integrators of the resultant new system. The turnaround time for checkout never exceeds 8 hours and averages 5 hours. Checkout is normal priority in this open shop environment. A serious program problem, however, usually allows the maintenance programmer almost immediate access to the computer.

COMMENT: None.

BENEFITS: The SPCTRK effort was initially established by the Advanced Research Project (ARPA) in 1958 to develop a system for cataloging space objects. Precise task requirements were not levied but the development effort was run as an R&D program. SPCTRK has evolved through a series of major modifications to provide the following benefits not available to the Air Force prior to SPCTRK: (1) ability to detect, track, and maintain a central catalog of all man-made objects in space and provide ephemerides on all such objects; and (2) ability to collect, process, analyze, and display information to CINCNORAD to enable threat evaluation and decision making. In addition to the SPCTRK benefits, backup capability is also provided to the BMEWS Display Information Processor.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk ☐

Actual: 2,424 [redacted]

Comment: No formal DAP was prepared for SPCTRK. The responsibility of SPCTRK resides with the Air Defense Command (ADC). The approach and tasks were modified several times during development. These modifications caused major system design changes, and, hence, the development of several new systems, each replacing the previous system.

Months of Elapsed Development Time (Dev.)

Proposed: Unk ☐

Actual: 45 [redacted]

Comment: The actual number of months represents the period from April 1961, when the P2000-211 was installed at Ent AFB and the A system development was begun, to December 1964, when the B-3 system was declared operational.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk ☐

Actual: Unk ■

Comment: Program checkout records from Hanscom AFB prior to June 1964 no longer exist. No records were kept on other Philco 2000 computers used at Ent AFB and at Aeronutronics. These factors make it impossible to determine the computer hours required for SPCTRK program checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk ☐

Actual: 569 [redacted]

Comment: The actual number reflects usage during March 1966 on both Philco 2000 computers.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk ☐

Actual: 186 [redacted]

Comment: The actual number reflects usage during March 1966 on both Philco 2000 computers.

Number of Operations Personnel (Op.)

Proposed: Unk ☐

Actual: 60 [redacted]

Comment: Approximately 2/3 of the actual number of personnel are military personnel.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk ☐

Actual: 20 [redacted]

Comment: The actual number consists of 13 military and 7 civilian personnel.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk ☐

Actual: 257,823 [redacted]

Comment: None.

FUTURE PLANS: The SPACETRACK Facility is being moved from Ent AFB, Colorado, to the Cheyenne Mountain Complex, Colorado. During the move, the SPACETRACK data is sent to Ent AFB from the new location via two full-duplex 1200-bit-per-second data links. The B-3 system will be replaced by a new system, Delta I, currently being developed by System Development Corporation and the Aeronutronics Division of Ford Motor Company. Delta I is basically the B-3 system with the following changes: (1) improved astrodynamic processes; (2) logic changes for near real-time operation of sequences which are manual or semiautomatic in B-3; (3) priority scheduling by executive control; and (4) new equipment which consists of the real-time system, drum storage, I/O data controller, on-line high speed printer, on-line analyst input typewriter, and an error detection and alarm device.

SYSTEM: TAC Command and Control System--TCC (IBM 1410)

DATA SYSTEM DESIGNATOR: A011D

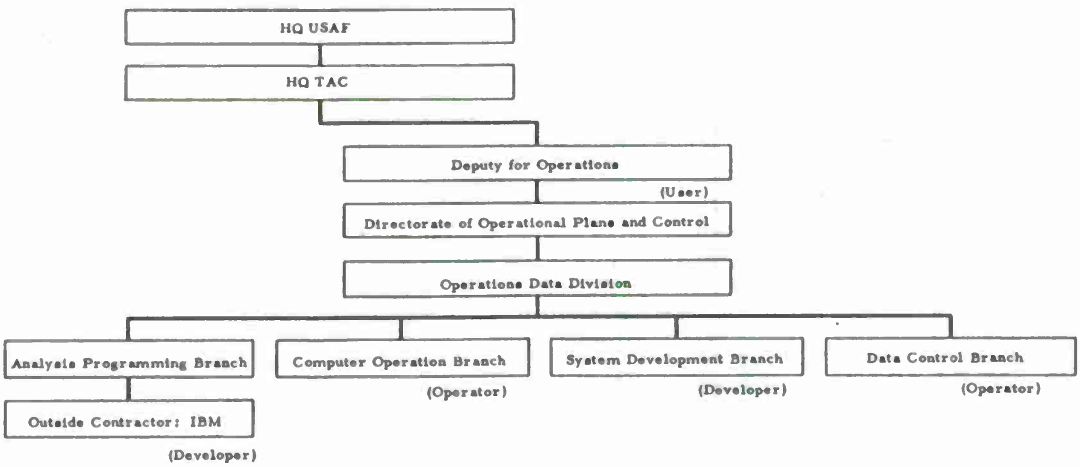
DATA COLLECTION DATE: May 1966 and July 1966

LOCATION:

Contact for Additional Information	Operations Data Division Directorate of Planning and Control Headquarters, Tactical Air Command Langley Air Force Base, Hampton, Va.
Development	Headquarters, Tactical Air Command Langley Air Force Base Virginia
Maintenance	Headquarters, Tactical Air Command Langley Air Force Base Virginia
Pilot Installation	None
First Operational Installation	Headquarters, Tactical Air Command Langley Air Force Base Virginia
Number of Operational Installations	1

FUNCTION: The user of TCC is Headquarters, Tactical Air Command. The mission of the user is the management of the Tactical Air Command's resources in training, exercising, evaluating, refining, improving, and maintaining a maximum combat readiness to meet any worldwide contingency requiring operational commitments. TCC functions as an operations support system providing the Commander TAC/CINCAFSTRIKE with automated command and control support to assist in the effective planning, managing, and controlling of TAC/CINCAFSTRIKE resources during normal and emergency situations.

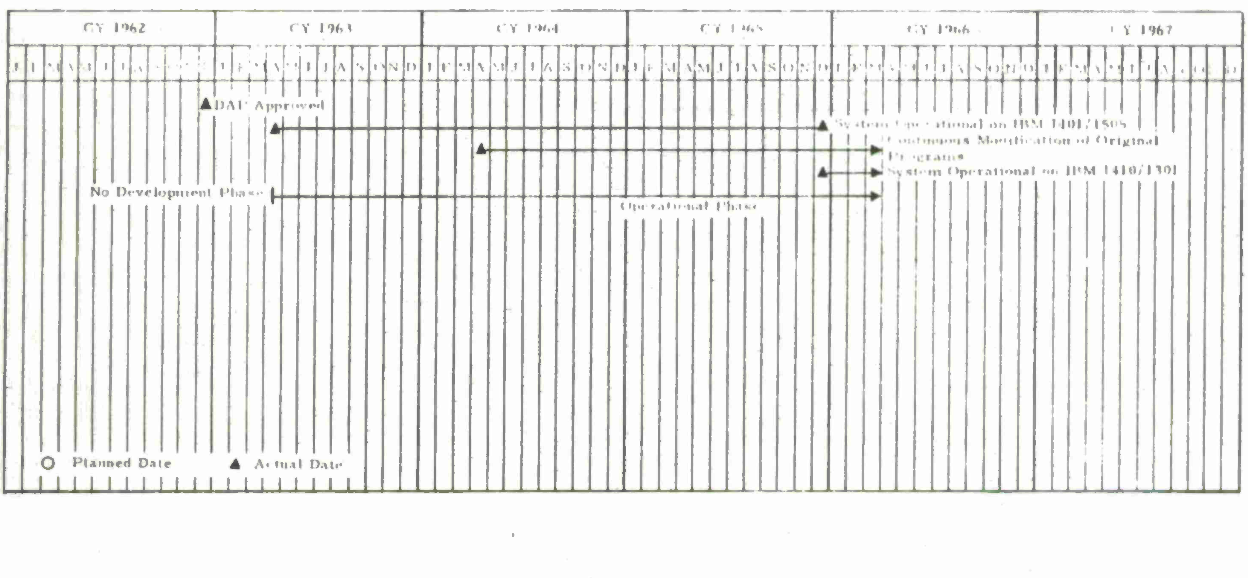
ORGANIZATION:



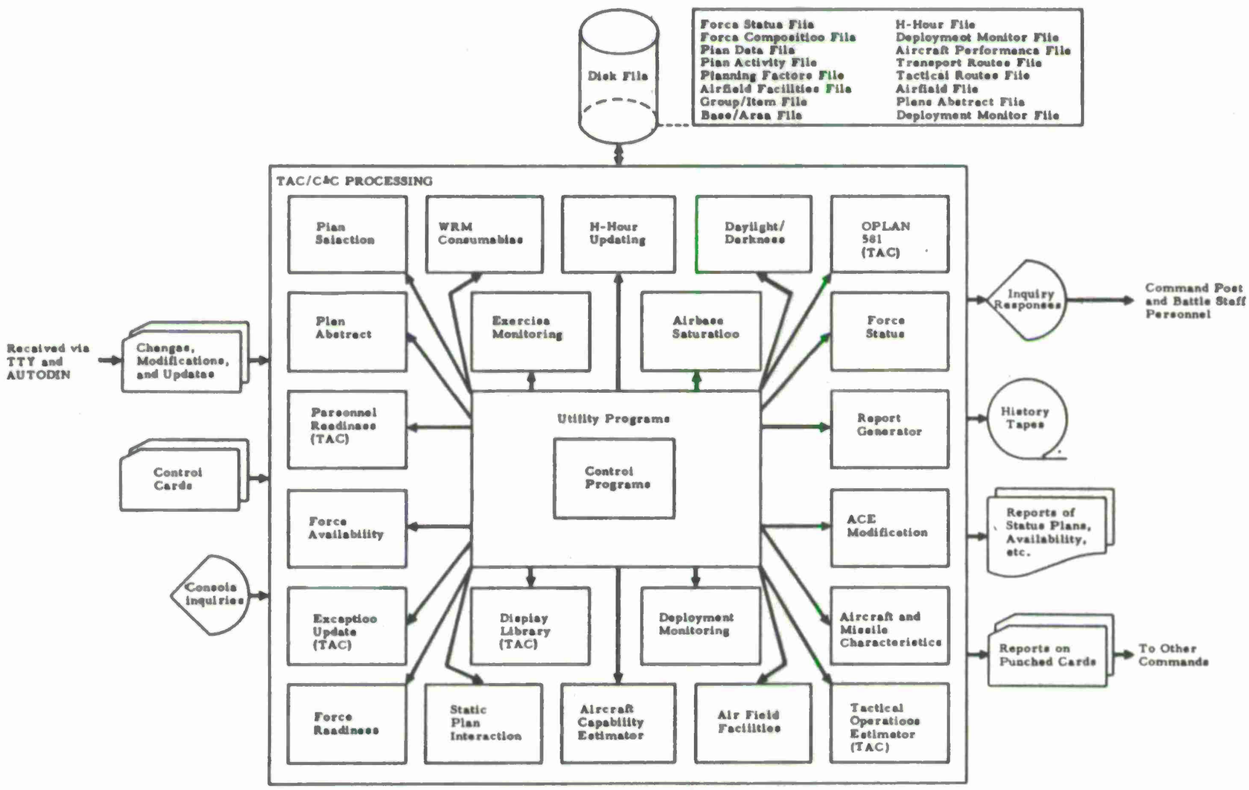
HISTORY: In December 1962, Headquarters USAF approved a proposal by the Tactical Air Command (TAC) for an IBM 1401/1405 system for use in conjunction with the Headquarters USAF 473L System. The equipment was installed and the 473L programs and data base were loaded in April 1963. An abbreviated Data Automation Proposal was approved by Headquarters USAF in December 1963 for contract programming to alter the 473L programs for greater responsiveness to the operational requirements of TAC. A request submitted by TAC was approved in June 1964 for an increase in number of personnel to develop an in-house capability to maintain, update, and develop programs in support of the TAC Automated Command and Control System. An increase in data processing capabilities was approved and the 1401/1405 system was replaced with a 1410/1301 system (operating in 1401 mode) which became operational in November 1965.

The developmental activity was contracted to IBM who has technical jurisdiction over Air Force personnel in this area. The contractor provides training to the military group in order to develop an in-house capability. Mixed IBM and Air Force teams are responsible for system analysis and program development. The same team carries through from system analysis to programming and checkout. Air Force personnel are responsible for the operational usage of the machine. Management control methods during development included the statement of work and monthly progress reports. The monthly progress reports contain program status and variances in man-months expended from that budgeted.

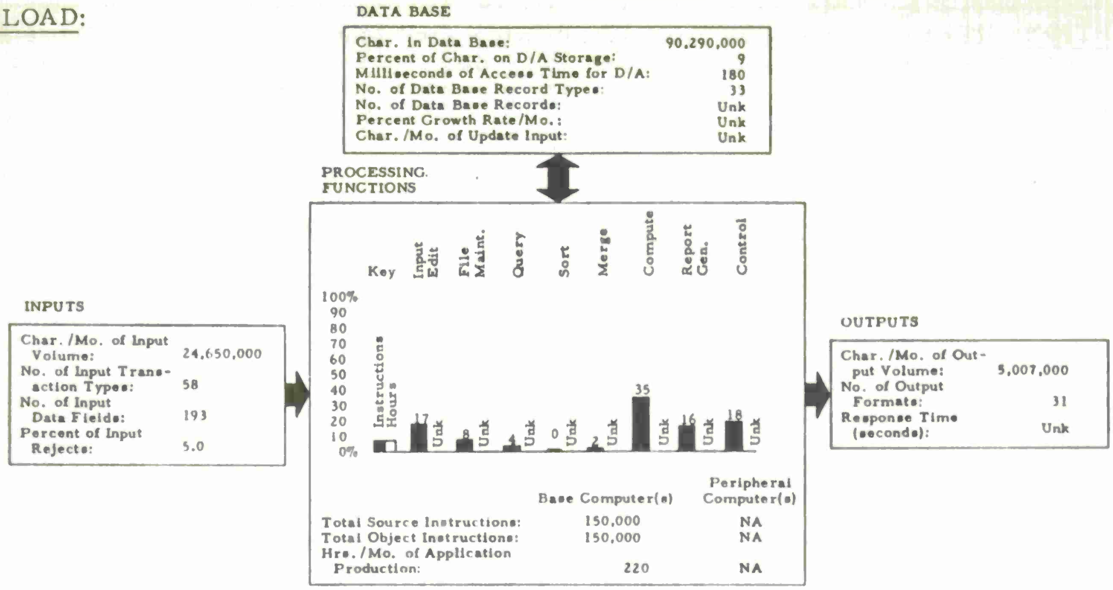
SCHEDULE:



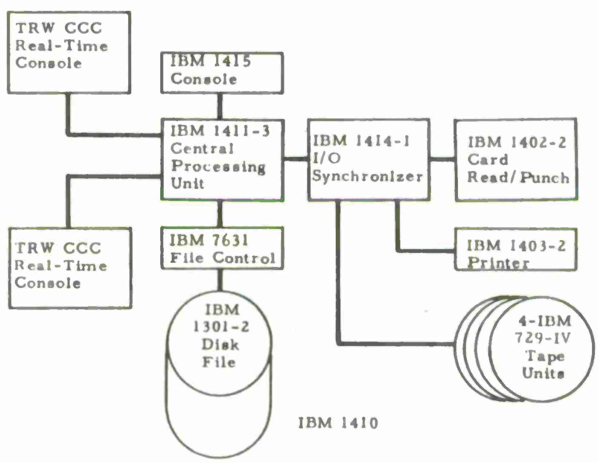
DESCRIPTION: The broad functions of the system are called "capabilities"; e.g., Force Status Capability, Airfield Facilities Capability. Each capability is a series of program modules used to extract information from the data base and produce reports. In addition, there is a semi-English language, called the Query Language, which is an alternate method for using the capabilities of the system. Programs reside on the disk. A small control program is loaded for each capability, which then automatically loads and reloads subroutines to process the request. Input data are received from TAC units and Hq. USAF and are used to update the data base periodically. Query Language requests may be used either via the computer console typewriter or via a TRW real-time console.



WORKLOAD:



HARDWARE:



Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Internal Storage			External Storage						Peripheral Devices				
							Mag Tapes		Disk				Card Reader/Punch			Printer	
				Cycle Time (us)	Char. Size (bits)	Char. Capacity	No. Mag Tapes	Trans. Rate	No. Disks	Trans. Rate	Char. Capacity	Access Time (ms)	No.	Read Speed (cards/min)	Punch Speed (cards/min)	No.	Speed (lpm)
IBM 1410	11/61	Char.	88	4.5	6	40K	4-729 IV	22.5K 62.5K	1-1301-2 Model 2	90,100	55.9M	180	1-1402	800	250	1-1403	600

Comment: Communications Control Console (CCC), built by TRW is used for real-time display and interogration. Hardware characteristics for this equipment are not available.

SOFTWARE: Software supplied by IBM consists of the 1401 and 1410 Autocoder assemblers and the 1400 series utility routines and software including a general sort/merge. Headquarters USAF supplied the executive system used by TCC.

Comment: None

APPLICATION PROGRAM DEVELOPMENT: Two branches in the Operations Data Division at Hq. TAC had the developmental responsibilities for the modified 473L system. The System Development Branch was mainly concerned with DAP's and future planning, while the Analysis Programming Branch aided IBM Federal Systems personnel in system analysis and program development. Because of IBM's experience and the Air Force's lack of experience in this area, IBM had technical jurisdiction over Air Force personnel. The programs are divided into three major areas: (1) control programs, which perform all disk operations; (2) utility programs, which perform the repetitive or common system functions; and (3) capability programs, which perform application functions such as file generation and maintenance, information retrieval and display, and report generation. The language used was IBM 1401 Autocoder. When the IBM 1410 was initially installed, the 1401 programs were run in the 1401 mode on the 1410. The executive, query language, and file formatting programs were rewritten for the 1410 and 1301 disk files by Hq. USAF and installed at TAC. Because of the magnitude of the system, the programs were highly segmented and connective control was provided by the executive control programs. The checkout computer was freely available during development on an open shop basis. A system test was performed by IBM to the satisfaction of TAC. No records were kept of development time used for checkout on the computer. Management control was in the form of work statements and monthly progress reports.

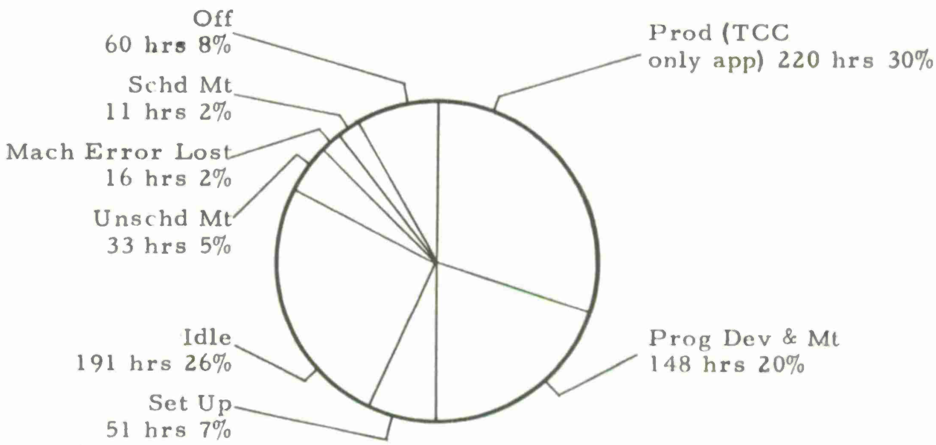
FILE CONVERSION: File conversion affects two types of data bases. The non-TAC-specific files were furnished by Hq. USAF, along with the 473L system. The TAC-specific files are being converted on an ongoing basis. This means that some functions are not completely automated. The reason for this is insufficient manpower to abstract all operational plans and other data from hard copy to punched cards. Consequently, only the high-priority plans and data are available to the computer. The function of file conversion rests with the Data Control Branch.

DOCUMENTATION: The documentation from the 473L system is used extensively. TAC-specific system and program documentation usually serves only to augment an existing 473L document.

PERSONNEL:

Activity	Function	Number of People: Sampled	Number of People: Allocated to System	Number of Years: In ADP	Number of Years: In C and C	Number of Years: Of College
Development	Manager	6	6	5.0	2.5	3.5
	Analyst	10	7	4.5	1.5	3.5
	Programmer	22	17	3.5	1.5	3.0
Operations	Manager	1	1	1.5	1.0	4.0
	Operator	7	11	7.0	2.5	

OPERATIONS: The computer operation at Langley AFB is staffed as required by workload. It operates during the prime time as an open shop. TCC is the only application on the IBM 1410 computer. A flexible master schedule is prepared each week.
Comment: None.



IBM 1410

APPLICATION PROGRAM MAINTENANCE: A total of 17 programmers maintain the TCC system. Headquarters USAF maintains the 473L programs, but TAC makes and maintains its own modifications and additions. Major corrections and improvements are handled by the contractor and developmental teams; minor maintenance runs are readily available with less than 24-hour turnaround time. Changes are not documented unless they affect the Operational Specifications or the Programming/Coding Specifications.

Comment: Program maintenance activity is characterized by the continual need for improvements and additions to the system. Continuity is achieved by the contractor whose personnel turnover has been low and Air Force personnel turnover has been relatively high.

BENEFITS: Proposed: TCC was proposed as an automated command and control support system to provide the commander TAC/CINCAFSTRIKE with an effective operational capability to plan, manage, and control TAC/CINCAFSTRIKE resources in the execution of its prescribed functions, during normal and emergency situations and in a compressed time/space environment.

Actual: TCC was developed as a major modification to the existing Headquarters, USAF, 473L Command and Control System. The system is operational and providing the proposed benefits; additional development is required to fully automate the command and control functions.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: Unk ☐

Actual: 748 [redacted]

Comment: The phase of development of the TCC system discussed here was completed in accordance with a DAP prepared on 30 August 1963 specifically for this development effort. This DAP proposed to alter the 473L programs, allowing them to be more responsive to the operational requirements of TAC. Hq. USAF approved the DAP on 9 December 1963.

Months of Elapsed Development Time (Dev.)

Proposed: Unk ☐

Actual: 25 [redacted]

Comment: The actual development period was from May 1964 to June 1966. It encompasses the replacement of the IBM 1401/1405 system with the IBM 1410/1301 system in accordance with a DAP prepared on 5 March 1965 and approved by Hq. USAF on 11 June 1965.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk ☐

Actual: Unk ■

Comment: No records were kept of computer use for the 473L program checkout.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk ☐

Actual: 220 [redacted]

Comment: The actual number reflects usage during March 1966 on the IBM 1410.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk ☐

Actual: 148 [redacted]

Comment: The actual number reflects usage during March 1966 on the IBM 1410.

Number of Operations Personnel (Op.)

Proposed: Unk ☐

Actual: 11 [redacted]

Comment: The actual number of personnel is for operators only.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk ☐

Actual: 17 [redacted]

Comment: The actual number of personnel represents programmers only. There are also 7 analysts and 6 managers allocated to TCC.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk ☐

Actual: 36,054 [redacted]

Comment: None.

FUTURE PLANS: In reply to a DAP dated 26 november 1965, Headquarters USAF proposes that the IBM 1410 ADP System will be used until December 1968 and not be replaced between July 1967 and January 1968 as currently scheduled by DOD. In FY 67 an automatic communications processing center, with an AUTODIN terminal which will initially be utilized for testing AUTODIN capability, will be installed at Headquarters TAC. I/O device testing is proposed throughout FY 67 to determine feasibility and desirability of placing I/O devices at USAF Headquarters and selected Division/Wing Command Posts. I/O devices, if approved by Headquarters USAF, will be purchased and installed at all TAC bases in FY 69, making the TAC bases capable of receiving information from the Headquarters TAC system. Subsequent to the installation of the USAF-designated standard computer to replace the interim IBM 1410, this system will be converted to the new computer, probably during the last half of FY 69. It is also proposed that the USAF-designated standard computer equipment and an automated communications terminal be installed at USAF Headquarters and selected Division/Wing Command Posts in FY 70.

SYSTEM: Standard Base Level Automated Inventory Control System--1050/BSS (UNIVAC 1050-II)

DATA SYSTEM DESIGNATOR: D002A

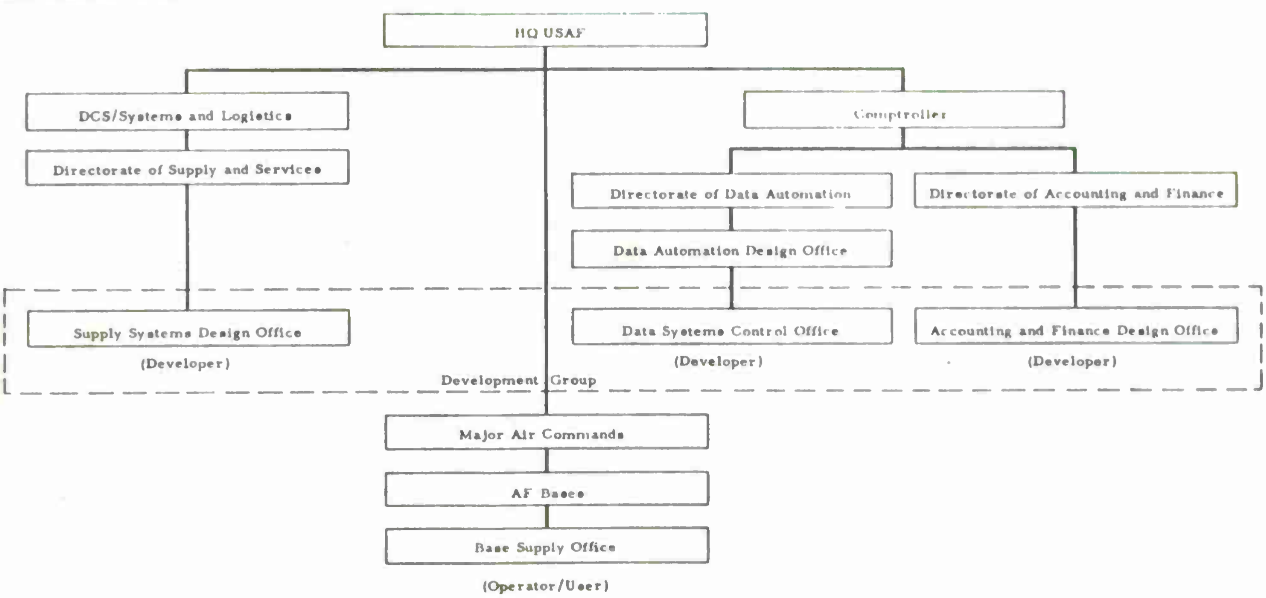
DATA COLLECTION DATE: May 1966

LOCATION:

Contact for Additional Information	Headquarters Command Bolling Air Force Base Washington, D. C.
Development	Bolling Air Force Base District of Columbia
Maintenance	Bolling Air Force Base District of Columbia
Pilot Installation	None
First Operational Installation	Bolling Air Force Base District of Columbia
Number of Operational Installations	150 planned, 75 currently in operation

FUNCTION: The users of 1050/BSS are the Base Supply offices at approximately 75 Air Force bases. The mission of the users is controlling the distribution, ordering, and inventory level for spare parts, equipment, and other supplies required by base activities. 1050/BSS functions as a management support system to establish a standard automated inventory control system at worldwide Air Force bases. The functions performed by the system include requisitioning, receipt, issue, stock control, turn-in, disposition, reporting, and accounting. The system responds immediately and fully to all transactions as they occur and provides standard, comparable reporting of data for use by all management levels.

ORGANIZATION:



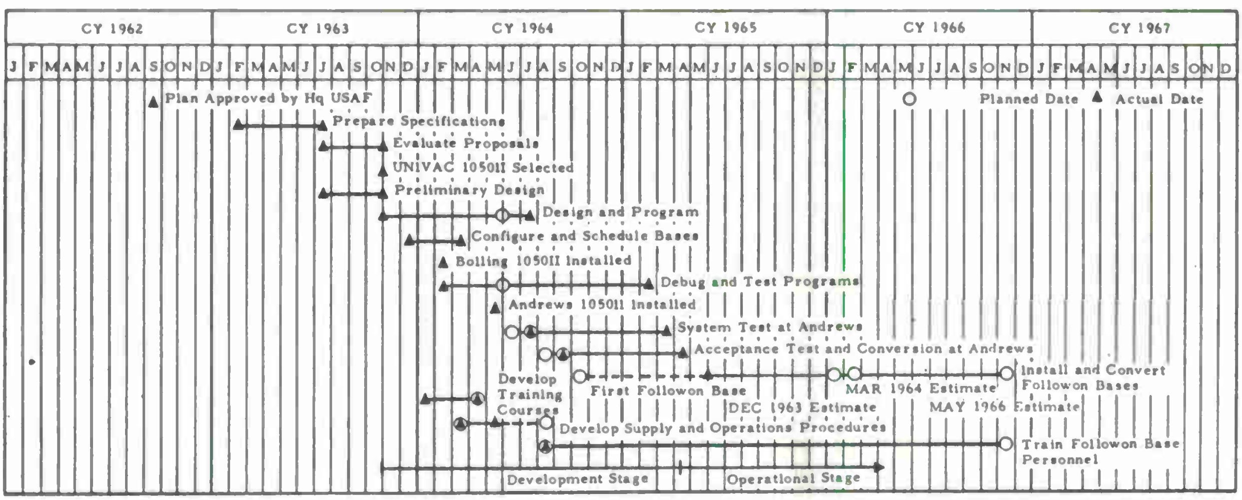
HISTORY: By 1962 each major air command had independently developed its own automated base supply system. It was apparent that the following problems existed: (1) Headquarters USAF could not determine the impact of supply policy changes throughout the Air Force; (2) standard supply management data were lacking; (3) personnel training was inefficient; (4) multiple-development efforts were wasteful. Supply procedures were standardized in an attempt to solve these problems, but it soon became apparent that equipment standardization was necessary for any significant improvement to be realized. In July 1962, a comprehensive plan was developed to establish a standard ADP program for base level material operations. The plan was approved in October 1962.

Systems specifications were developed by the Directorate of Supply and Services, Headquarters USAF assisted by personnel from Headquarters, Air Force Logistics Command (AFLC). In February 1963 the specifications were released to industry. Proposals were received and, in November 1963, the Air Force announced that Sperry-Rand Corporation had been selected to provide approximately 150 base-level supply activities with a standard configuration of data processing equipment.

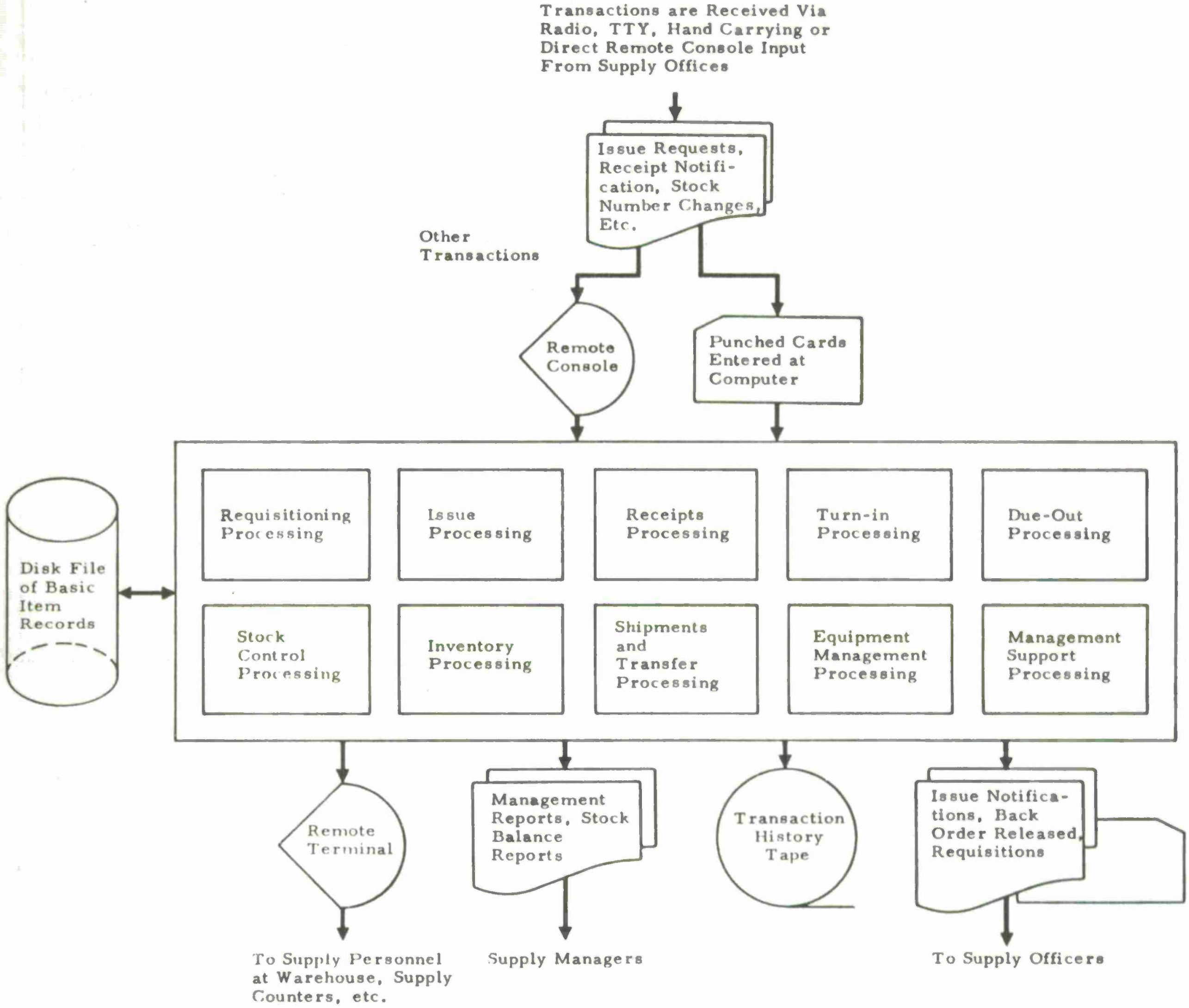
System design of the Standard Air Force Base Level Supply ADP System, which would be implemented Air Force-wide by March 1966, began in December 1963 at Andrews AFB.

A Central Development Group under Headquarters USAF was formed with the responsibility for program development, implementation, and maintenance. The group was comprised of a body of supply personnel under the direct control of the Director of Supply and Services, Headquarters, USAF, and of programmers under the Director of Data Automation. After the programs were written and tested, they were implemented at Andrews AFB. Simultaneously with the latter phases of writing, testing, and implementing at Andrews, training of Major Air Command personnel began. After a trial operational phase, the programs were evaluated and necessary changes and improvements were made. With the completion of the changes and improvements, the other bases became operational at the rate of 10 installations per month.

SCHEDULE:



DESCRIPTION: The 1050/BSS computer system is controlled by an executive routine which is always in memory. This routine examines the input request, either supply or accounting/finance, and calls the required processing programs and data from the disk. The programs are operated, the data file is accessed and modified if necessary, a history of the processing is recorded on magnetic tape, and the output response is sent. The inputs and outputs, except for the printer, are buffered and controlled by interrupts. In addition to normal processing, the system produces management reports and performs the accounting and finance functions associated with the supply system.



WORKLOAD:

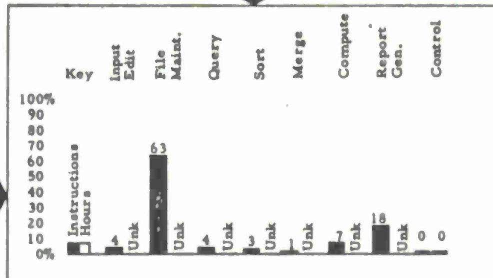
DATA BASE

Char. in Data Base:	3,981,000
Percent of Char. on D/A Storage:	100
Milliseconds of Access Time for D/A:	35
No. of Data Base Record Types:	115
No. of Data Base Records:	Unk
Percent Growth Rate/Mo.:	Unk
Char./Mo. of Update Input:	7,400,000

INPUTS

Char./Mo. of Input Volume:	7,400,000
No. of Input Transaction Types:	229
No. of Input Data Fields:	1,065
Percent of Input Rejects:	1.0

PROCESSING FUNCTIONS

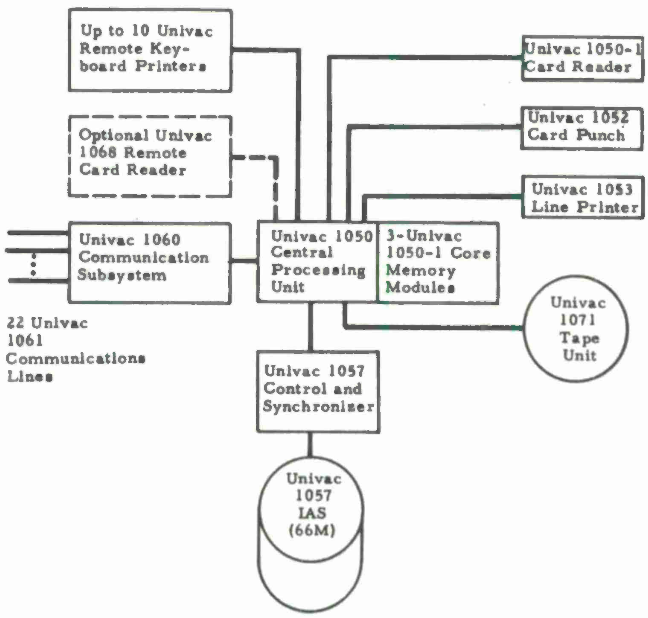


	Base Computer(s)	Peripheral Computer(s)
Total Source Instructions:	Unk	NA
Total Object Instructions:	340,000	NA
Hrs./Mo. of Application Production:	504	NA

OUTPUTS

Char./Mo. of Output Volume:	7,400,000
No. of Output Formats:	339
Response Time (seconds):	5.0

HARDWARE:



Univac 1050 (Configuration "B")

Computer	First Delivery Mo/Yr	Word or Char. Mach.	Add Time (us)	Internal Storage: Cycle Time (us)	Internal Storage: Char. Size (bits)	Internal Storage: Char. Capacity	External Storage, Mag Tapes: No. Mag Tapes	External Storage, Mag Tapes: Trans. Rate	External Storage, Drum: No. Drums	External Storage, Drum: Trans. Rate (char./sec)	External Storage, Drum: Char. Capacity	External Storage, Drum: Access Time (ms)	Peripheral Devices, Card Reader/Punch: No.	Card Reader/Punch: Read Speed (cards/min)	Card Reader/Punch: No.	Card Reader/Punch: Punch Speed (cards min)	Printer: No.	Printer: Speed (lpm)
Univac 1050	9/63	Char.	117	4.5	6	20,480[1]	1-1071	23K	1-1057-4	156	66M[2]	35	1-1051	400	1-1052	300	1-1053	900

Comments: (1) C configuration systems have 24,516 core storage.
(2) A configuration systems have 33M character drum storage.
(3) Three different configurations are used depending on workload at the installation:
A configuration has 33M character drum storage, 20,480 core storage.
B configuration has 66M character drum storage, 20,480 core storage.
C configuration has 6M character drum storage, 24,576 core storage.

SOFTWARE: Software for the UNIVAC 1050 consisted of the following: (1) PAL card and tape assembly language systems; (2) input and output utility programs; (3) library maintenance and sort programs; (4) FASTRAND tape utility programs; and (5) an executive control system. Portions of the software were delivered by UNIVAC at different times between February and July, 1964.

Comment: The executive system did not have adequate restart/backup/recovery capability nor did it provide automatic response to remotes. Considerable reprogramming of the executive system was required to provide these capabilities. The resultant system had many bugs and this hindered development considerably. The executive system was not considered acceptable until approximately one year after delivery. No major problems were experienced with any of the other software packages.

APPLICATION PROGRAM DEVELOPMENT: A Central Development Group was established by the Air Staff to operate under Hq. USAF at Bolling AFB. This group was responsible for program development, implementation and maintenance. The group was comprised of a permanent body of supply personnel under the direct control of the Directorate of Supply and Services, Hq. USAF, and of computer programmers under the Directorate of Data Automation. A short time later, it was decided to incorporate Accounting and Finance functions into the system, leading to the inclusion of permanent members to the group from the Directorate of Accounting and Finance. In view of the magnitude of the system, it was further decided to augment the group with vendor personnel and representatives from the Major Air Commands. A project manager was selected from the Directorate of Data Automation to direct the development and implementation at the first 10 bases. This project manager was scheduled to be replaced after the tenth base's implementation by a man from the Directorate of Supply and Services, but this has not occurred yet due to the many changes and corrections currently going on.

A test computer was available at Bolling AFB on a continuous 24-hour-a-day basis exclusively for this system's checkout. Each programmer was required to run his own tests for a period of six months in order to become sufficiently familiar with the computer operation to ensure successful field implementation. This policy resulted in console debugging which, coupled with the fact that no programmers had any UNIVAC 1050-II or disk file storage experience, led to extensive computer checkout time. There were no formal test procedures. Test decks were prepared to test the programs, which were all written in PAL assembly language. A team from the Central Programming Group at Bolling AFB was sent to the first base to be converted within each Command to aid in conversion. After receiving this support for the first base, the Command was responsible for aiding the remaining bases.

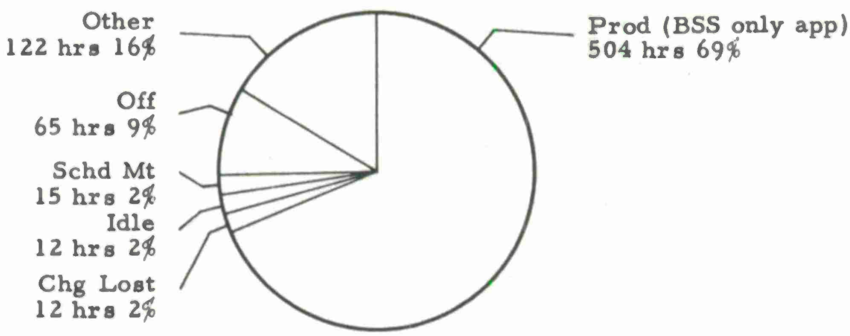
FILE CONVERSION: There were 16 different base level supply inventory systems in the Air Force prior to the UNIVAC 1050-II implementation. These included card systems (PCAM), three different RAMAC 305 systems, a 1401 card system, a 1401 tape system, GE 225, Burroughs 220, etc. All these systems, however, did have a common element in the punched card. The conversion process consisted of a download (preparation of a complete file of punched cards) and an upload (reading the punched cards into the 1050). There were over 160 different types of inputs which could be entered into the systems, which presented sufficient complexity to require 40 conversion programs to be written. UNIVAC was responsible for writing the majority of these conversion programs with the aid of three Air Force programmers (UNIVAC provided seven or eight). A team from the central programming group at Bolling was sent to the first base to be converted within each Command to aid in conversion. The Command was responsible for aiding the remaining bases.

DOCUMENTATION: The system is well documented in Air Force Manuals 77-206, and 67-1.

PERSONNEL:

Activity	Function	Number of People		Number of Years		
		Sampled	Allocated to System	In ADP	In Supply	Of College
Development	Manager	18	27	2.5	15.0	Unknown
	Analyst	35	40	0.5	4.0	Unknown
	Programmer	23	36	2.0	4.0	Unknown
Operations	Manager	None	Unknown	Unknown	Unknown	Unknown
	Operator	None	7.7	Unknown	Unknown	

OPERATIONS: All operational sites operate independently. The pie chart represents usage on a "B" computer configuration at Andrews AFB. All operational sites operate as closed shops, and are staffed as required by workload.
Comment: None.



UNIVAC 1050-II

APPLICATION PROGRAM MAINTENANCE: The program maintenance activity is carried on by 68 programmers in the Central Programming Group at Bolling AFB. There are no maintenance programmers at the operational bases. The operators, having attended a two-week programming course, locate problem areas when possible, and send details to Bolling. The operators are not allowed to change any program unless specifically directed by the Central Programming Group. Currently, it is estimated that 80 to 90 percent of the program maintenance activity is correction of existing programs with the remaining time spent on new programs.

Comment: None.

BENEFITS: Proposed: Benefits proposed to come from development and implementation of 1050/BSS include (1) standardization of automated inventory control systems at approved bases, (2) reduced need for system analysis and design through minimizing the number of authorized inventory control automation efforts; (3) greater discipline in enforcing supply policy; (4) development of standard training courses enabling supply personnel to be used immediately in any command; and (5) generation of standard comparable management data for use at all management levels.

Actual: The proposed benefits have been realized with the implementation of 1050/BSS. In the course of development, a number of additional features such as accounting for materiel resources were added to the system.

COST FACTORS:

Man-Months of Development Effort (Dev.)

Proposed: 300

Actual: 1,400

Comment: No DAP was prepared for the Base Level Supply System. Instead, in July 1962, a comprehensive plan was developed within the Material Automation Branch of Hq. USAF for the establishment of a standard ADP program for supply systems. This plan was approved by Hq. USAF and further development led to the purchase of the UNIVAC 1050 II computer for approximately 150 base level supply systems.

Months of Elapsed Development Time (Dev.)

Proposed: 10

Actual: 18

Comment: The system development began in November 1963 and ended in April 1965.

Dollars of Hardware Cost for Program Checkout (Dev.)

Proposed: Unk

Actual: Unk

Comment: The checkout computer was available on a continuous 24-hour a-day basis. The number of hours used for program checkout was not available.

Hours/Month of Hardware Use for Application Production (Op.)

Proposed: Unk

Actual: 504

Comment: The actual number reflects usage during a recent representative month on the "B" configuration of the UNIVAC 1050 II at Andrews AFB.

Hours/Month of Hardware Use for Program Maintenance (Op.)

Proposed: Unk

Actual: Unk

Comment: All program maintenance is done at Bolling AFB on a "C" configuration.

Number of Operations Personnel (Op.)

Proposed: Unk

Actual: 7.7

Comment: The actual number of personnel is prorated from operators at Andrews AFB on the basis of machine hours for 1050/BSS.

Number of Program Maintenance Personnel (Op.)

Proposed: Unk

Actual: 68

Comment: The actual number of personnel consists of 34 analysts and 34 programmers at Bolling AFB. All program maintenance is done by the Central Programming Group at Bolling AFB. There are no maintenance programmers at the other bases. The operators have been trained to insert program corrections from Bolling AFB.

Dollars/Month of Hardware Cost (Op.)

Proposed: Unk

Actual: 12,598

Comment: The actual dollar amount reflects the "B" configuration at Andrews AFB for production only.

FUTURE PLANS: The system is currently operational at about half of the approximately 150 bases projected. The implementation is expected to continue at about 10 bases per month. The expected system lifetime is six years. Future plans other than the completion of the implementation schedule are unknown at present.

IV. GLOSSARY

This glossary consists of two primary sections. The first section is a general glossary of Air Force and data processing terms. This section is based on the Bureau of the Budget (BOB) Glossary of Automatic Data Processing. Definitions have been freely modified to reflect the specific meaning of terms used throughout this project. A number of terms not defined in the BOB glossary are included here.

The second section is a glossary of cost factors and workload descriptors. Cost factors appear in the Cost Factors section of system descriptions and in the cost estimation iso-graphs, while workload de scriptors appear in the Workload section of the system descriptions and in the cost estimation iso-graphs.

A. Glossary of Air Force and Data Processing Terms

ADC	Air Defense Command
ADP	Automatic data processing; data processing performed by a system of electronic or electrical machines so interconnected and interacting as to reduce to a minimum the need for human assistance or intervention.
ADPS	Automatic data processing system. (See "System, Automatic Data Processing.")
AF	Air Force
AFADA	Air Force Director of Data Automation
AFAFC	Air Force Accounting and Finance Center
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFO	Accounting and Finance Office
AFR	Air Force Regulation
AFSC	Air Force Systems Command (formerly ARDC)
ALGOL	Algorithmic Oriented Language; an international procedure-oriented language.

Algorithm	A prescribed set of well-defined rules, or a process, for the solution of a problem in a finite number of steps; e.g., a full statement of an arithmetical procedure for evaluating sin X to a stated precision.
AMA	Air Materiel Area
Analyst, System	(See "System Analyst.")
Application	The system or problem to which a computer is applied.
Application Preparation	Any computer processing, such as file conversion, required to allow an application to be run.
Application Production	Any computer processing resulting in the generation of output to the application user(s).
ARDC	Air Research and Development Command (currently AFSC)
ASD	Aeronautical Systems Division of AFSC
Assemble	To prepare a machine language program from a symbolic language program by substituting absolute operation codes and addresses for symbolic operation codes and addresses on a one-for-one basis. Normally performed by a computer program called an assembler.
Assembly Language	The machine-oriented programming language (e.g., FAP, EASY) belonging to an assembly system.
ATC	Air Training Command
AUTODIN	Automatic Digital Information Network; a computer-based communication network primarily used by the Air Force, but also used by other agencies of the Federal Government.
Capacity, Storage	The amount of data that can be contained in a storage device.
Card, Master	A card containing fixed or indicative information for a group of cards. It is usually the first card of that group.

CBPO	Consolidated Base Personnel Office; Air Force organizational element responsible for base-level personnel functions.
Channel	(1) A path along which signals can be sent (e.g., data channel, output channel); (2) the portion of a storage medium that is accessible to a given reading station (e.g., track, band).
Character	One symbol of a set of elementary symbols, such as those corresponding to the keys on a typewriter. The symbols usually include the decimal digits 0 through 9, the letters A through Z, punctuation marks, operation symbols, and any other single symbols a computer may read, store, or write. A character will normally be represented by a combination of six bits.
Chart, Flow	A graphic representation of the major steps of work in process. The illustrative symbols may represent documents, machines, or actions taken during the process. The area of concentration is where or who does what rather than how it is to be done.
Chart, Logical Flow	A detailed solution of the work order in terms of the logic, or built-in operations and characteristics, of a specific machine. Concise symbolic notation is used to represent the information and describe the input, output, arithmetic, and logical operations involved. The chart indicates types of operations by use of a standard set of block symbols. A coding process normally follows the logical flow chart.
Chart, Systems Flow	A schematic representation of the flow of information through the components of a processing system.
Checkout	(1) A general term for a set of routines designed to provide the programmer with a complete evaluation of his program under operating conditions; (2) the process of checking out a program to ensure successful operation under all conceivable conditions.
Closed Shop	(See "Shop, Closed.")
COBOL	Common Business Oriented Language; a business data processing language.

Compile	To prepare a machine language program from a computer program written in another programming language by performing the usual functions of an assembler and also by making use of the overall logical structure of the program or generating more than one machine instruction for each symbolic statement or both.
Compute	A computer processing function that performs logical, arithmetic, and decisional operations on data.
Computer-Limited	Pertaining to a situation in which the time required for computation exceeds the time required to read inputs and write outputs.
Configuration	A group of machines that are interconnected and programmed to operate as an interacting assemblage.
Control	A computer processing function that expedites all other computer processing functions; e.g., job scheduling, priority handling, segment overlaying, data management, and hardware assignment.
Conversion	(1) The process of changing information from one form of representation to another, such as from the language of one type of machine to that of another or from magnetic tape to the printed page. (2) The process of changing from one data processing method to another or from one type of equipment to another; e.g., conversion from punch card equipment to magnetic tape equipment.
CPU	Central Processing Unit; that part of a computer system containing the arithmetic unit, execution control, and special register groups.
DAP	Data Automation Proposal; a document that must be prepared and submitted to AFADA for any proposed new data automation or major change to an existing automated system.
Data	A general term used to denote any or all facts, numbers, letters, and symbols, or facts that refer to or describe an object, idea, condition, situation, or other factors. It connotes basic

	elements of information that can be processed or produced by a computer.
Data, Test	A set of data developed specifically to test the adequacy of a computer program or system. The data may be actual data that have been taken from previous operations or artificial data created for this purpose.
Data, Transaction	A set of data in a data processing area, a record of occurrence of a new event or transaction, in which the incidence of the data is essentially random and unpredictable. Hours worked, quantities shipped, and amounts invoiced are examples from the areas of payroll, accounts receivable, and accounts payable, respectively.
Data Base	A collection of files containing unique information; these files are accessible to an ADPS. The files of a data base are normally referenced or updated with relatively high frequency. Reordered files are not included in the data base.
Data Base Growth Rate	The amount by which the size of the data base will increase over a specified period of time, normally measured in percentage of data base current size per month.
Date, Delivery	The date of physical delivery on site of the components of the computer configuration without regard to whether or not they have been unpacked, placed in final position, or interconnected. Delivery of equipment carries no connotation of operational status.
Date, Installation	The date new equipment is ready for use. The commencement of rental normally begins on the day following the date on which the contractor officially notifies the using organization that the equipment is installed and ready for use, subject to the acceptance and standard of performance provisions of the applicable contract.
Debug	To isolate and remove the mistakes from a routine in a program or malfunction from a computer.
Design, Functional	The specification of the working relations between the parts of a system in terms of their characteristic actions.

Development Phase	The period of time from the date system design for the ADPS is begun to the date the system is declared operational. During this phase, such activities as detailed system design, programming, checkout, and equipment installation are accomplished as required.
Device, Input	A machine that translates data to be processed from coded representations; e.g., punch cards or paper tape to electric impulses for use by a computer.
Device, Output	A machine that translates the electrical impulses representing data processed by the computer into permanent results, such as printed forms, punched cards, and magnetic writing on tape.
Device, Storage	A machine into which data can be inserted, in which data can be retained, and from which data can be retrieved.
Documentation	The group of techniques necessary for the orderly presentation, organization, and communication of recorded specialized knowledge in order to maintain a complete record of reasons for changes in variables. Documentation is necessary not so much to give maximum utility as to give an unquestionable historical reference record.
DOD	Department of Defense
DSAP	Data System Automation Program; the official data automation program of USAF. It provides a coordinated and common basis for planning, designing, and operation of USAF ADP systems. Each major data automation is assigned a four- or five-character DSAP designator. The first character of the designator is alphabetic and indicates the major functional area of the automation.
Element, Data	A specific item of information appearing in a set of data. For example, in the following set of data, each item is a data element: the quantity of a supply item issued, a unit rate, an amount, and the balance of stock items on hand.
Element Error Rate	The ratio of the number of elements incorrectly received to the total number of elements sent.

Equipment, Off-Line	The peripheral equipment or devices not in direct communication with the central processing unit of a computer. Synonymous with auxiliary equipment.
Equipment, On-Line	Descriptive of a computer system and of the peripheral equipment or devices in a computer system in which the operation of such equipment is under control of the central processing unit (CPU), and in which information reflecting current activity is introduced into the data processing system as soon as it occurs. Thus, directly in-line with the main flow of transaction processing. Related to on-line processing.
Error, Data	A deviation from correctness in data, usually an error, which occurred prior to processing the data.
Error, Machine	A deviation from correctness in data resulting from an equipment failure.
Executive	(See "Routine, Executive.")
Facsimile (FAX)	Transmission of pictures, maps, diagrams, etc., by wire. The image is scanned at the transmitter and reconstructed at the receiving station.
Field	A specified area of a record used for a particular category of data; e.g., a group of card columns used to represent a wage rate or a set of bit locations in a computer word used to express the address of the operand.
Field, Card	A set of card columns, either fixed as to number and position, or, if variable, then identifiable by position relative to other fields. Corresponding fields on successive cards are normally used to store similar information.
File	A collection of related records. For example, in inventory control, one line of an invoice containing data on the material, the quantity, and the price forms an item; a complete invoice forms a record; and the complete set of such records forms a file.

File Conversion	A process for preparing the data base of an ADPS to enable the ADPS to become operational. In file conversion all necessary files of the data base are converted from their present format (magnetic tape, punched cards, hard copy, etc.) to their required format in the ADPS about to become operational.
FORTRAN	Formula Translation; a programming language designed primarily for problems that can be expressed in algebraic notation. The original version of FORTRAN has been extended to include Boolean expressions, hierarchies of subroutines sharing common storage, and insertion of symbolic language sequences.
Functional Analysis	Application-oriented analysis and research required to support ADPS design and implementation. This effort usually takes place very early in the development phase and is independent of any particular implementation methodology.
Functional Area	Any one of the broad application categories such as payroll, accounting, inventory control, weather forecasting, etc.
Function, Processing	A set of computer instructions performing computational, decisional, or data manipulation operations. Processing functions may be categorized as input edit, sort, report generation, etc.
Hardware	The physical equipment or devices of a computer and peripheral equipment.
HEDCOM	Headquarters Command
Input	(1) Data supplied to a system from an external source for processing; (2) the process of transferring data from an external to an internal storage.
Input, Batched	(1) Any set of inputs collected together as a group before submittal for computer processing. The collected groups are called batches. (2) Any input that is not unbatched.
Input, Unbatched	Input that is entered directly into the computer as it is received via an on-line input device.

Input Edit	A computer processing function performed on input data to prepare them for the primary processing; e.g., limit and logic checking, field conversion, and data edit.
Instruction	An operation and the values or locations of all operands associated with the operation.
Instruction, Multiple Address	An instruction consisting of an operation code and two or more addresses. Usually specified as a two-address, three-address, or four-address instruction.
Instruction, Object	An instruction in the machine language of the computer on which the instruction is to be executed.
Instruction, One Address	An instruction consisting of an operation and exactly one address. The instruction code of a single address computer may include both zero- and multi-address instructions as special cases.
Iso-Graph	A planar diagram of a function of two variables, representing values of the function by lines of constant function value (iso-lines).
Iso-Line	A straight or curved line on an iso-graph along which there is a constant value.
Language, Source	A language in the form of written statements that is an input to a given translation process usually resulting in object instructions.
Language, Target	A language that is an output from a given translation process.
Library	(1) A collection of information available to a computer, usually on magnetic tapes; (2) location of the collection of magnetic tapes.
Library, Routine	A collection of standard proven routines and subroutines by which problems and parts of problems may be solved.
Logical Record	A set of logically related data fields independent of the physical manner of representation.

MAC	(1) Military Airlift Command, a major Air Force command, formerly MATS (Military Air Transport Service). (2) Major Air Command; any one of the Air Force commands such as SAC, TAC, PACAF, ATC, etc.
MAFR	Merged Accountability and Fund Reporting; an Air Force central accounting system.
Maintenance, File	A computer processing function for modification of a file to incorporate corrections, additions, and deletions.
Maintenance, Preventive	The maintenance of a set of hardware that attempts to keep equipment in top operating condition and to preclude failures during production runs.
Maintenance, Program	The process of improving, changing, and correcting programs of a system that is currently operational.
Maintenance, Remedial	The maintenance performed by the contractor following equipment failure; therefore, is performed as required, on an unscheduled basis.
Manager	An individual responsible for directing and coordinating all or part of the activities associated with an ADPS. Only managers devoting at least 10 percent of their time to a system are considered part of that system's personnel.
Merge	A computer processing function that combines items or records from two or more sequenced files with the same key into one sequenced file.
MILSTAMP	Military Standard Transportation and Movement Procedures; a DOD standard for worldwide shipment transportation activities.
MILSTRIP	Military Standard Requisitioning and Issue Procedures; a DOD standard for procurement and issuance of inventory items.
Module	(1) An interchangeable plug-in item containing components; (2) an incremental block of storage or other building block for expanding the computer capacity.

Multiplex	The process of transferring data from several storage devices operating at relatively low transfer rates to one storage device operating at a high transfer rate in such a manner that the high-speed device is not obliged to wait for the low-speed devices.
Multiprocessing	A mode of hardware operation where two or more instruction sequences may be executed simultaneously. The instruction sequences may be part of the same program or different programs. When the instruction sequences are from different programs, the hardware operation is also multiprogrammed.
Multiprogramming	The interleaved or simultaneous execution of two or more programs by interconnected hardware.
Off-Line	Pertaining to peripheral equipment or devices not in direct communication with the central processing unit (CPU) of a computer. Clarified by "Equipment, Off-Line."
OI	Office Instruction
On-Line	Pertaining to peripheral equipment or devices in direct communication with the central processing unit (CPU) of a computer. Clarified by "Equipment, On-Line"; synonymous with in-line processing and on-line processing.
Open Shop	See "Shop, Open."
Operand	A quantity entering or arising in an instruction. An operand may be an argument, a result, a parameter, or an indication of the location of the next instruction, as opposed to the operation code itself.
Operations, Computer	That part of ADP activity required for running production and/or development programs on ADP equipment.
Operator	(1) In the description of a process, that which indicates the action to be performed on operands; (2) a person who operates a machine.

Output	(1) Those data that have been processed as an ultimate system product; (2) the process of transferring data from an internal storage to an external storage.
Output, Direct	Data produced on an on-line output device while the user is in attendance.
Output, Indirect	Data disseminated to a user via manual handling subsequent to its production on an output device.
PCAM	Punched Card Accounting Machine; the set of conventional punch card equipment including sorters, collators, and tabulators.
PDSA	Personnel Data System--Airmen; a centralized Air Force data processing system to maintain airman personnel data.
PDSO	Personnel Data System--Officers; a centralized Air Force data processing system to maintain officer personnel data.
Preparation, Application	(See "Application Preparation.")
Programmer	A person who prepares problem-solving procedures and logical flow charts and who codes and debugs programs.
Production	Any computer processing resulting in the generation of output to users.
Production, Application	(See "Application Production.")
Query	A computer processing function acting on a demand input which specifies that data be accessed via file search and be displayed or output.
RAFT	Regional Accounting and Finance Test; a pilot Air Force data processing system for testing a USAF base-level regional accounting and finance system concept.
Ratio, Operating	The ratio of the number of hours of correct machine operation to the total hours of scheduled operation; e.g., on a 168-hour-week scheduled operation, if 12 hours of preventive maintenance

are required and 4.8 hours of unscheduled downtime occurs, then the operating ratio is (168 - 16.8)/168, which is equivalent to a 90 percent operating ratio.

Real-Time	(1) Pertaining to the actual time during which a physical process transpires; (2) pertaining to the performance of a computation during the actual time that the related physical process transpires so that results of the computations can be used in guiding the physical process.
Record	(1) A group of related fields of information treated as a unit; (2) to put data into a storage device.
Record, Unit	A separate record that is similar in form and content to other records; e.g., a summary of a particular employee's earnings to date.
Reliability	(1) A measure of the ability to function without failure; (2) the amount of credence placed in a result.
Relocate	In programming, to move a routine from one portion of storage to another and to adjust the necessary address references so that the routine can be executed in its new location.
Report Generation	A computer processing function that transforms results from the primary computation to outputs for the system user; e.g., data edit, formatting, and printing.
Response	The response of a device or system is a quantitative expression of the output as a function of the input under conditions that must be explicitly stated.
Routine	A set of coded instructions arranged in proper sequence to direct the computer to perform a desired operation or sequence of operations. A subdivision of a program consisting of two or more instructions that are functionally related; therefore, a program.
Routine, Debugging Aid	A routine to aid programmers in the debugging of their routines. Some typical routines are storage printout, tape printout, and drum printout routines.

Routine, Executive	A routine that controls loading and relocation of routines and in some cases makes use of instructions that are unknown to the general programmer. Effectively, an executive routine is part of the machine itself.
Routine, Service	A broad class of routines that are standardized at a particular installation for the purpose of assisting in maintenance and operation of the computer as well as in the preparation of programs, as opposed to routines for the actual solution of production problems. This class includes monitoring or supervisory routines, assemblers, compilers, diagnostics for computer malfunctions, simulation of peripheral equipment, general diagnostics, and input data. The distinguishing quality of service routines is that they are generally standardized to meet the servicing needs at a particular installation, independent of any specific production-type routine requiring such services.
Routine, Utility	A standard routine used to assist in the operation of the computer; e.g., a conversion routine, a sorting routine, a printout routine, or a tracing routine. Synonymous with utility program.
Run	The performance of one or more programs on a computer; thus, the performance of one routine or several routines linked so that they form an automatic operating unit, during which manual manipulations by the computer operator are zero, or at least minimal.
SAC	Strategic Air Command
Shop, Closed	The operation of a computer facility where programming service to the user is the responsibility of a group of specialists, thereby effectively separating the phase of task formation from that of computer implementation. The programmers are not allowed in the computer room to run or oversee the running of their programs. Contrasted with "Shop, Open."
Shop, Open	The operation of a computer facility where computer programming, coding, and operating can be performed by any qualified employee of the organization, not necessarily by the personnel

of the computing center itself; and where the programmer may assist in or oversee the running of his program on the computer. Contrasted with "Shop, Closed."

Software — The totality of programs and routines used to extend the capabilities of computers, such as compilers, assemblers, narrators, routines, and subroutines. Contrasted with "Hardware."

Sort — (1) To arrange items of information according to rules dependent upon a key or field contained in the items or records; (2) a computer processing function to arrange records of information according to rules operating upon key(s) contained in the records.

Statement, Source — In computer programming, a meaningful expression or generalized instruction in a source language.

Storage, Auxiliary — A storage device in addition to the main storage of a computer; e.g., magnetic tape, disk, or magnetic drum. Auxiliary storage usually holds much larger amounts of information than the main storage, and the information is less rapidly accessible.

Storage, Main — Usually the fastest storage device of a computer and the one from which instructions are executed.

System, Automatic Data Processing — The term descriptive of an interacting assembly of procedures, processes, methods, personnel, and automatic data processing equipment which performs a complex series of data processing operations.

System Analyst — A person skilled in the definition and development of techniques for solving a problem. System analysts are usually specialists in a particular class of problems such as inventory, accounting, command and control, etc.

TAC — Tactical Air Command

Terminal — (1) A point in a system or communication network at which data can either enter or leave; (2) a general term referring to the equipment at the end of a telegraph circuit; modems and associated equipment.

Test, Program	A system of checking before running any problem in which a sample problem of the same type with a known answer is run.
Test, System	(1) The running of the whole system against test data; (2) a complete simulation of the actual running system for purposes of testing the adequacy of the system; (3) a test of an entire interconnected set of components for the purpose of determining proper functioning and interconnection.
Throughput	Productivity based on all facets of an operation. For example, a computer with a capability of simultaneous operations (e.g., read/write/compute) would have a high throughput rating.
Time, Application Preparation	Any computer processing involved in initial file development and other one-time operations when converting an application, including parallel operations.
Time, Application Production	Any computer processing of an application resulting in the generation of output to the application user(s).
Time, Available	(1) The number of hours a computer is available for use; (2) the time during which a computer has the power turned on, is not under maintenance, and is known or believed to be operating correctly.
Time, Chargeable Lost	This time may be attributed to the following: (a) Programming Error: Rerun time as a result of program errors. (b) Operator Error: Rerun time as a result of computer operator errors. (c) Defective Tape: Rerun time as a result of magnetic tape defects when such time is not gratuitously provided. (d) Scheduling Error: Rerun time when a program run is processed out of sequence with incomplete data, etc., because of an erroneous schedule. (e) Defective Materials: Rerun time due to material defects other than magnetic tape; i.e., bad paper, card defects, poor printer ribbons, etc. (f) Incorrect Data: Rerun time caused by erroneous input data received from another organization or other data. (g) Site Environment Failures:

	Rerun time caused by an air conditioning failure, electric power failure, or other site phenomenon that interrupts processing. (h) Other Chargeable Rerun: Rerun time caused by factors other than above.
Time, Down	The period during which a computer is malfunctioning or not operating correctly because of mechanical or electronic failure, as opposed to available time, idle time, or standby time, during which the computer is functional. Contrasted with "Time, Up."
Time, Idle	That time, scheduled or unscheduled, which normally occurs between completing of one program run (end of tear down) and starting to set up for the next program run. Idle time may also occur during a run period. Idle time also includes that portion of time the computer system cannot be used because of site environment failure.
Time, Machine Error Lost	Rerun time provided by the vendor as a result of computer system failure.
Time, Off	Time when the computer system is not scheduled to operate. (Usually occurs on weekends, holidays, and late evening or early morning hours.)
Time, Operational Use	In Federal Government ADP contracts, the time during which the equipment is in operation, exclusive of idle time, setup time, maintenance time, or rerun time due to machine failure. Components not programmed for use in a specific computer run are not considered to be in use, even though connected into the computer system.
Time, Other	Time when no other classification of time is applicable or when the classification of time is not available or unknown.
Time, Program Development and Maintenance	The computer time for chargeable program development and maintenance, including assembly, compilation, test, and maintenance. (Maintenance refers to time spent in changing, improving, and patching of existing programs.)
Time, Program Testing	The machine time expended for program testing, debugging, and volume and compatibility testing.

Time, Search	The time required to locate a particular field of data in storage. Searching requires a comparison of each field with a predetermined standard until an identity is obtained. This is contrasted with access time, which is based on locating data by means of the address of its storage location.
Time, Scheduled Maintenance	Time during which the computer system is placed at the disposal of the engineer for scheduled preventive maintenance and during which maintenance is actually performed.
Time, Setup	Time required to load and unload tape drives and card readers, to insert printer forms, etc., when the CPU is not processing. Such time may occur at the beginning of, during, or at the end of, a processing run and includes temporary delays, such as correcting card and paper jams.
Time-Sharing	(1) The use of a device for two or more purposes during the same overall interval, accomplished by interspersing component actions in time; (2) pertaining to the interleaved use of the time of a device.
Time, System Improvement	The machine downtime needed for the installation and testing of new components, large or small, and machine downtime necessary for modification of existing components. This includes all programmed tests following the above actions to prove the machine is operating properly.
Time, Turnaround	The average time required by a computer operations unit to complete a program compilation or test, including time waiting in queue of jobs to be run.
Time, Unscheduled Maintenance	Time during which the computer system is down due to a machine malfunction. The computer system is considered down when it is not used because one or more components are down. Remedial maintenance is performed during this time.
Time, Up	The time during which equipment is either producing work or is available for productive work.
Trace	An interpretive diagnostic technique that provides an analysis of each executed instruction.

Transport, Tape	The mechanism that moves magnetic or paper tape past sensing and recording heads; usually associated with data processing equipment. Sometimes called tape drive.
Update	To put into a file changes required by current information or transactions.
USAF	United States Air Force
Workload	The external aspects of information flow associated with an ADPS. Workload is broken into the following major areas: inputs, outputs, data base, and processing functions. Each major area is further broken into components such as input volume, output volume, and data base size.
Workload Descriptor	A measurable numeric quantity defining the magnitude of workload components such as input volume, output variety, and data base size.

B. Glossary of Cost Factors and Workload Descriptors

Average Number of Years of ADP Experience for Analysts	Average number of years in ADP for analysts, who are persons skilled in the definition and development of techniques for solving a problem.
Average Number of Years of ADP Experience for Development Managers	Average number of years in the field of automatic data processing (ADP) for development managers.
Average Number of Years of ADP Experience for Operations Personnel	Average number of years in ADP for operations personnel, including operators, schedulers, data edit personnel, magnetic type librarians, report binders, and managers.
Average Number of Years of ADP Experience for Programmers	Average number of years in ADP for programmers, who are persons who prepare problem-solving procedures and logical flow charts, and code and debug programs.
Average number of Years of College Education for Development Managers	Development managers' college education, measured in average number of years, where development managers are the individuals responsible for directing and coordinating all or part of the activities associated with an ADPS during the development phase. Only managers devoting at least 10 percent of their time to the system are considered.
Average Number of Years of Functional Area Experience for Analysts	Average number of years of experience in a field of application for analysts, who are persons skilled in the definition and development of techniques for solving a problem.
Average Number of Years of Functional Area Experience for Development Managers	Average number of years of experience in a field of application such as accounting, inventory control, weather forecasting, etc., for development managers, where development managers are the individuals responsible for directing and coordinating all or part of the activities associated with an ADPS during the development phase. Only managers devoting at least 10 percent of their time to the system are considered.

Average Number of Years of Functional Area Experience for Operations Personnel	Average number of years of experience in a field of application for operations personnel, including operators, schedulers, data edit personnel, magnetic tape librarians, report binders, and managers.
Average Number of Years of Functional Area Experience for Programmers	Average number of years of experience in a field of application for programmers, who are persons who prepare problem-solving procedures and flow charts, and code and debug programs.
Characters in Data Base	The expected number of characters in the data base where the data base is a collection of files that contain unique information, are accessible to the ADPS, and are normally referenced or updated with relatively high frequency. Intermediate files are not counted.
Characters Per Month of Input Volume	The expected amount of ADPS input originating outside the ADPS, measured in characters per month. Intermediate inputs of the ADPS should not be included. On unit record input, only character positions used for data are counted.
Characters Per Month of Output Volume	The expected amount of ADPS output destined to users, measured in characters per month. Intermediate outputs of the ADPS are not included. Only nonblank characters are counted.
Dollars of Hardware Cost for Program Checkout	The hardware cost for computer hours used for program checkout during the development phase of the ADPS.
Dollars Per Month of Hardware Cost for Application Production	The hardware cost for monthly computer hours charged to the user of the ADPS for processing that is not of a developmental or corrective nature.
Dollars Per Month of Hardware Cost for Program Maintenance	The hardware cost for the monthly computer hours used for processing improvements, changes, and corrections to programs of an operational ADPS.

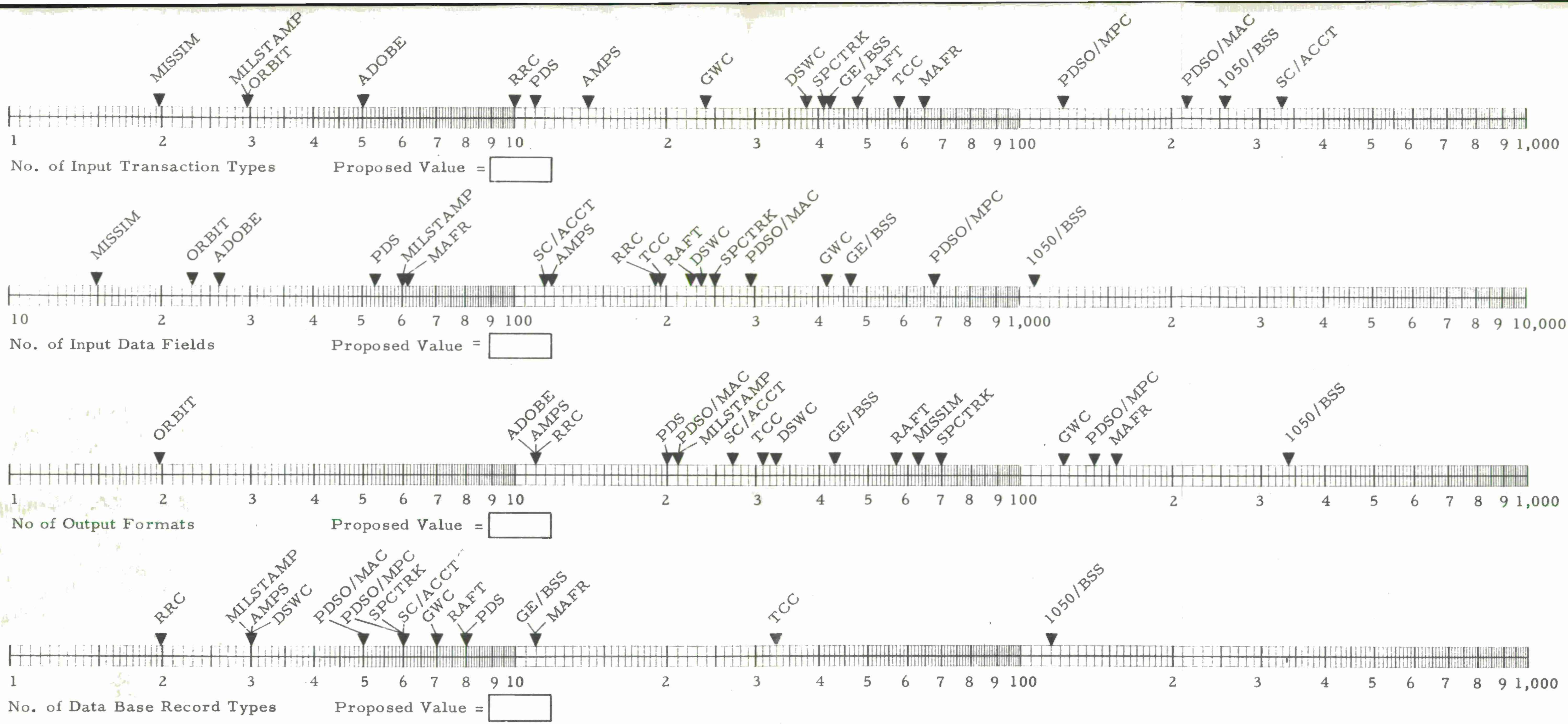
Man-Months of Development Effort	The number of man-months expended by all relevant personnel, including managers, analysts, programmers, and operators, to develop the ADPS during the development phase, which begins with the start of system design and ends when the system is declared operational. During this development phase such activities as detailed system design, programming, checkout, and equipment installation are accomplished.
Months of Elapsed Development Time	The number of calendar months elapsed from the date system design for the ADPS is begun to the date it is declared operational.
Number of Data Base Record Types	The number of logical record types in the data base where a logical record is a set of logically related data fields independent of the physical manner of storage.
Number of Input Data Fields	A count of data fields from the ADPS input that are unique in content and/or format; e.g., if there is a data field for name on six different card formats, the number of <u>unique</u> data fields is one.
Number of Input Transaction Types	A count of different transaction types of ADPS input that normally are identified by a unique transaction code and/or a unique input format.
Number of Object Instructions	The number of instructions generated by the compiler or assembler for the ADPS. This is the number of machine-format instructions in an object program deck that can be processed directly by the computer.
Number of Output Formats	The number of different types and formats of ADPS outputs.
Number of Operations Personnel	The number of personnel, including operators, schedulers, data edit personnel, magnetic tape librarians, report binders, and managers, etc., used to process the ADPS programs on the computer during the operations phase.
Number of Program Maintenance Personnel	The number of personnel, including managers, analysts, and programmers, involved in improving, changing, and correcting programs of a system during the operations phase.

Number of Source Statements	The number of lines of code written by the programmer in any source language for the ADPS. This may be the same as the number of instructions in machine language.
Percent of Input Rejects	Input data error rate, measured by the ratio of the number of rejected records to the number of expected records per month multiplied by 100.
Percent of Production Hours for Compute	The percent of production hours per month for compute, where compute is the performance of logical, arithmetic, and decisional operations on data.
Percent of Production Hours for Control	The percent of production hours per month for control, where control is a computer processing function that expedites all other computer processing functions; e.g., job scheduling, priority handling, segment overlaying, data management, and hardware assignment, etc.
Percent of Production Hours for File Maintenance	The percent of production computer hours per month for file maintenance, where file maintenance is the modification of a file to incorporate corrections, additions, and deletions.
Percent of Production Hours for Input Edit	The percent of production computer hours per month for input edit, where input edit is performed on input data to prepare it for the primary processing; e.g., limit and logic checking, field conversion, and data edit.
Percent of Production Hours for Merge	The percent of production computer hours per month for merge, where merge is the combining of items or records from two or more sequenced files with the same key into one sequenced file.
Percent of Production Hours for Query	The percent of production hours per month for query, where query is action on a demand input which specifies that data be accessed via file search and displayed or output.
Percent of Production Hours for Report Generation	The percent of production computer hours per month for report generation, where report generation is the transformation

	of results from primary computations to outputs for the system user.
Percent of Production Hours for Sort	The percent of production hours per month for sort, where sort is the arranging of records of information according to rules operating upon key(s) contained in the records.
Percent of Source Statements for Compute	The percent of source statements for compute, where compute is the performance of logical, arithmetic, and decisional operations on data.
Percent of Source Statements for Control	The percent of source statements for control, where control is a computer processing function that expedites all other computer processing functions; e.g., job scheduling, priority handling, segment overlaying, data management, and hardware assignment.
Percent of Source Statements for File Maintenance	The percent of source statements for file maintenance, where file maintenance is the modification of a file to incorporate corrections, additions, and deletions.
Percent of Source Statements for Input Edit	The percent of source statements for input edit, where input edit is performed on input data to prepare it for the primary processing; e. g., limit and logic checking, field conversion, and data edit.
Percent of Source Statements for Merge	The percent of source statements for merge, where merge is the combining of items or records from two or more sequenced files with the same key into one sequenced file.
Percent of Source Statements for Query	The percent of source statements for query, where query is action on a demand input which specifies that data be accessed via file search and displayed or output.
Percent of Source Statements for Report Generation	The percent of source statements for report generation, where report generation is the transformation of results from primary computations to outputs for the system user.

Percent of Source Statements for Sort	The percent of source statements for sort, where sort is the arranging of records of information according to rules operating upon key(s) contained in the record.

V. INDEXES



<u>Use of the Development Experience Index</u>

The development experience index is used to retrieve relevant development experience from the system descriptions. Retrieval is based on the following workload descriptors:

Number of Input Transaction Types
Number of Input Data Fields
Number of Output Formats
Number of Data Base Record Types

Proposed values of these workload descriptors must be known for the ADPS under evaluation. The type of development experience and problems retrieved by this index will be related to the magnitude of the development effort. Sections of system descriptions which will be of greatest interest include:

Application Program Development
Application Program Maintenance
Schedule

Other sections of interest include:

Organization
History
Software
File Conversion
Documentation
Personnel
Benefits
Cost Factors
Description

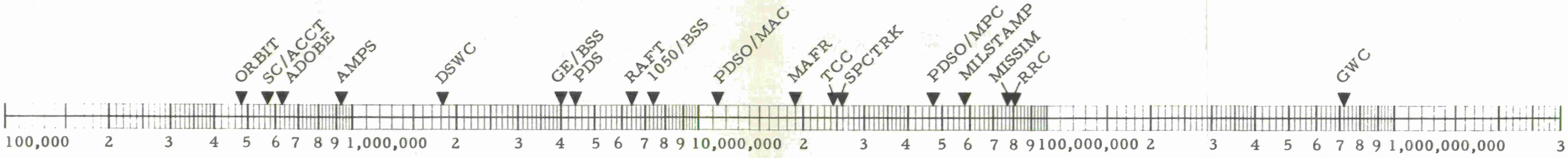
<u>Procedure</u>

1. Enter the proposed values for No. of Input Transaction Types, No. of Input Data Fields, No. of Output Formats, and No. of Data Base Record Types in box below the corresponding scale.
2. Remove the index card from the pocket in the Air Force ADP Experience Handbook (Pilot Version) and position the center arrow of the Development Slide at the proposed value on the No. of Input Transaction Types scale.
3. For all systems bounded by the Development Slide, enter the number from the tolerance band in the No. of Input Transaction Types row of the Ranking Table beneath the corresponding system name.
4. Repeat steps 2 and 3 for No. of Input Data Fields, and No. of Output Formats.
5. Repeat steps 2 and 3 for No. of Data Base Record Types if the proposed value is not zero. If the proposed No. of Data Base Record Types is zero, enter the number 3 in the Data Base row of the Ranking Table beneath ADOBE, MISSIM, and ORBIT.
6. Enter the Total Rank in the bottom row of the Ranking Table. Total Rank is computed by adding the numeric entries in each each column of the Ranking Table.
7. The system with the largest Total Rank is the most relevant system in developmental aspects to the proposed system. Relevancy of other systems is in order of Total Rank. Systems with Total Rank equal to or greater than 7 are highly relevant to the proposed automation. Systems with Total Rank less than 7 but greater than 3 have less relevance, but may still be used, while developmental experience data from systems with Total Rank less than or equal to 3 should not be used.

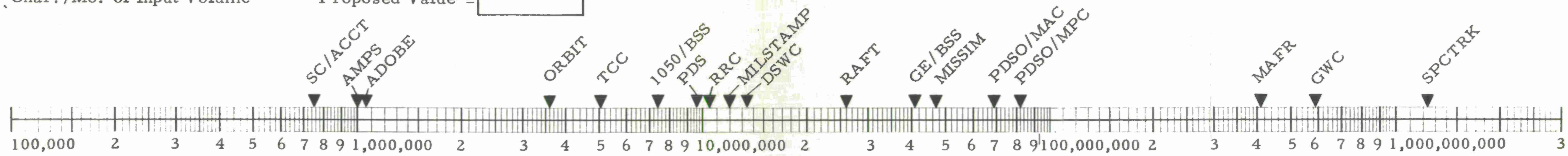
<u>Ranking Table</u>

	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
Page No.	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
No. of Input Trans. Type Rank																		
No. of Input Data Fields Rank																		
No. of Output Formats Rank																		
No. of Data Base Record Types Rank																		
Total Rank																		

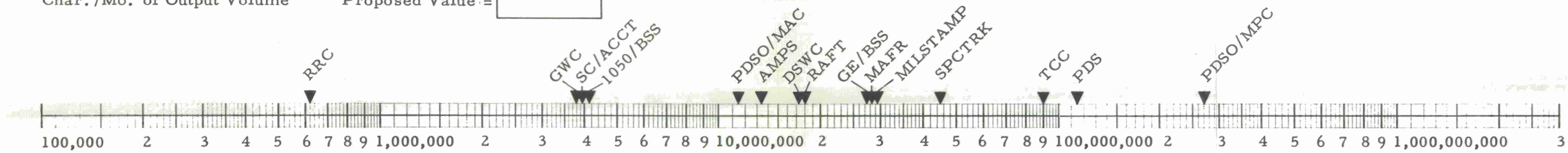
A. WORKSHEET FOR DEVELOPMENT EXPERIENCE INDEX



Char. /Mo. of Input Volume Proposed Value = ☐



Char. /Mo. of Output Volume Proposed Value = ☐



Char. in Data Base Proposed Value = ☐

Use of the Operations Experience Index

The operations experience index is used to retrieve relevant operations experience from the system descriptions. Retrieval is based on the following workload descriptors:

- Char. /Mo. of Input Volume
- Char. /Mo. of Output Volume
- Char. in Data Base

Proposed values of these workload descriptors must be known for the ADPS under evaluation. The type of operations experience and problems retrieved by this index will be related to the magnitude of the operations. Sections of the system descriptions which will be of greatest interest include:

- Operations
- Hardware

Other sections of interest include:

Organization	Documentation	Cost Factors
Software	Personnel	Description
File Conversion	Benefits	

Procedure

1. Enter the proposed values for Char. /Mo. of Input Volume, Char. /Mo. of Output Volume, and Char. in Data Base in the box below the corresponding scale.
2. Remove the index card from the pocket in the Air Force ADP Experience Handbook (Pilot Version) and position the center arrow of the Operations Slide at the proposed value of the Char. /Mo of Input Volume scale.
3. For all systems bounded by the Operations Slide, enter the number from the tolerance band in the Char. /Mo. of Input Volume row of the Ranking Table beneath the corresponding system name.
4. Repeat steps 2 and 3 for Char. /Mo. of Output Volume.
5. Repeat steps 2 and 3 for Char. in Data Base, if the proposed value is not zero. If the proposed Char. in Data Base is zero, enter the number 3 in the Data Base row of the Ranking Table beneath ADOBE, MISSIM, and ORBIT.
6. Enter the Total Rank in the bottom row of the Ranking Table. Total Rank is computed by adding the numeric entries in each column of the Ranking Table.
7. The system with the largest Total Rank is the most relevant system in operational aspects to the proposed system. Relevancy of other systems is in order of Total Rank. Systems with Total Rank equal to or greater than 5 are highly relevant to the proposed system. Systems with Total Rank less than 5 but greater than 2 have less relevance, but may still be used, while operational experience data from systems with Total Rank less than or equal to 2 should not be used.

Ranking Table	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
Page No.	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
Input Vol. Rank																		
Output Vol. Rank																		
Data Base Size Rank																		
Total Rank																		

B. WORKSHEET FOR OPERATIONS EXPERIENCE INDEX

C. Functional Area Index

System / Functional Area	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
Operations Supporting																X	X	
Research and Development	X							X	X									
Materiel Management				X						X				X				X
Personnel/ Manpower											X	X						
Financial and Accounting		X				X							X		X			
Weather					X													
Transportation Management							X											
Miscellaneous			X															

Use: To use this index, find the row of the Functional Area Index Table with the same functional area as the proposed ADPS. Systems selected with the same functional area as the proposed ADPS are designated by an "X" in this row under the system acronym. System description sections of the selected systems of greatest interest are

Function
Description

Other system description sections of interest are

Application Program Development
File Conversion
Personnel
Application Program Maintenance
Benefits

D. Decentralized Operations Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Number of Installations	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
Single Installation	X				X	X	X	X	X			X	X			X	X	
2 to 7 Installations				X						X				X				
8 to 100 Installations			X								X				X			
More than 100 Installations		X																X

Use: To use this index, find the row of the Decentralized Operations Index Table corresponding to the number of operational installations for the proposed ADPS. Systems selected with the number of operational installations in the same range as the proposed ADPS are designated by an "X" in this row under the system acronym. System description sections of the selected systems of greatest interest are

Location
History
Schedule
Application Program Development
Application Program Maintenance

Other system description sections of interest are

Organization
Description
Hardware
Documentation
Personnel
Benefits
Cost Factors

E. Multiple Application Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Number of Applications	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
Single Application		X		X						X		X				X	X	X
2 to 10 Applications					X	X	X						X					
More than 10 Applications	X		X					X	X		X			X	X			

Use: To use this index, find the row of the Multiple Applications Index Table corresponding to the number of applications at an installation for the proposed ADPS. Systems selected with the number of applications in the same range as the proposed ADPS are designated by an "X" in this row under the system acronym. The system description section of the selected systems of greatest interest is

Operations

Other system description sections of interest are

Organization
Software

F. <u>Programming Language</u>

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Languages	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
COBOL						X	X				X	X	X					
FORTRAN	X				X			X	X							X		
ALGOL												X						
ALTAC																X		
Autocoder			X											X	X		X	
GAP				X														
FAP					X			X	X									
ARGUS											X							
RCA Assembly Language										X								
TAC																X		
PAL																	X	
Machine Language		X																

<u>Use</u>: To use this index, find the row of Programming Language Index Table with the same programming language specified for the proposed ADPS. Systems selected with the same programming language as the proposed ADPS are designated by an "X" in this row under the system acronym. The system description sections of the selected systems of greatest interest are

Software
Application Program Development
Application Program Maintenance

Other system description sections of interest are

Description
Hardware
Personnel
Benefits

G. Processing Type Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Processing	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1051/BSS
Real-Time Data Collection	X				X			X								X	X	
On-Line Inquiry Processing				X								X			X		X	X
Batched Under Executive Control	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Batched With No Executive		X																

Use: To use this index, find the row of the Processing Type Index Table corresponding to the processing type of the proposed ADPS. Systems selected with the same type of processing as the proposed ADPS are designated by an "X" in this row under the system acronym. System description sections of the selected systems of greatest interest are

Description
Hardware
Software

Other system description sections of interest are

Workload
Application Program Development
Operations
Cost Factors

H. File Conversion Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Type of File Conversion	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
No. File Conversion	X				X		X	X	X	X				X				
Manual to ADP System		X	X										X		X			X
PCAM to ADP System															X			X
ADP System to ADP System				X		X					X	X				X	X	X

Use: To use this index, find the row of the File Conversion Index Table corresponding to the type of file conversion for the proposed ADPS. Systems selected with the same type of file conversion as the proposed ADPS are designated by an "X" in this row under the system acronym. The system description section of the selected systems of greatest interest is

File Conversion

Other system description sections of interest are

History
Schedule
Workload
Hardware
Cost Factors

I. <u>Direct Access Storage Index</u>

Page Number	39	46	53	60	67	74	81	88	95	[illegible]	109	116	123	130	137	144	151	158
System / Amount	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
No Direct Access Storage	X	X	X		X	X	X	X	X		X		X	X		X		
1 to 10M Char.															X		X	X
10M to 50M Char.				X														
Greater than 50M Char.										X		X						

<u>Use</u>: To use this index, find the row of the Direct Access Storage Index Table corresponding to the amount of direct access storage for the proposed ADPS. Systems selected with amount of direct access storage in the same range as the proposed ADPS are designated by an "X" in this row under the system acronym. The system description section of the selected systems of greatest interest is

Hardware

Other system description sections of interest are

Description
Software
Application Program Development
Operations
Application Program Maintenance

J. Computer Cost Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
Basic Computer Rental \ System	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
85,825								X										
75,390																X		
72,430					X													
69,945			X											X				
60,390							X											
48,065												X						
31,315									X									
19,633					X													
18,295	X																	
17,640																	X	
17,060																X		
16,151						X												
15,319										X								
14,345															X			
13,033											X							
11,422													X					
9,400				X														
9,284																		X
8,940	X																	
8,364						X												
8,130						X												
7,615							X											
7,490									X									
7,330								X										

(continued on next page)

J. (Continued)

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Basic Computer Rental	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PPS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
6,833					X													
6,590											X							
6,421			X											X				
5,540																X		
1,986		X																
1,375																X		

<u>Use</u>: To use this index, find the row of the Computer Cost Index Table with closest basic monthly rental of an individual computer in the proposed ADPS. Systems selected are designated by an "X" in this row under the system acronym. System descriptions sections of the selected systems of greatest interest are

Hardware
Operations

Other system description sections of interest are

History
Schedule
Workload
Software
Cost Factors

K. Computer Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Computer	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1051/BSS
IBM 7094II								X										
P2000-212																X		
IBM 7094I					X													
IBM 7080			X											X				
UNIVAC 1107							X											
Burroughs B5500												X						
IBM 7044									X									
ITT 7300					X													
IBM 7040	X																	
IBM 1410																	X	
Philco 1000																X		
RCA 501						X												
Dual RCA 301										X								
IBM 1410															X			
Honeywell 800											X							
RCA 301													X					
GE 225				X														
UNIVAC 1050						X												X
IBM 1401	X		X		X	X		X						X				
RCA 301						X												
IBM 1460									X									
Honeywell 200											X							
Philco 410																X		

(continued on next page)

K. (Continued)

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Computer	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1051/BSS
NCR 390		X																
IBM 1620																X		

Use: To use this index, find the row of the Computer Index Table with the same computer as the proposed ADPS. Systems selected using the same computer as the proposed ADPS are designated by an "X" in this row under the system acronym. System description sections of the selected systems of greatest interest are

Hardware
Operations

Other system description sections of interest are

History
Schedule
Workload
Software
Application Program Development
File Conversion
Application Program Maintenance
Cost Factors

L. Security Index

Page Number	39	46	53	60	67	74	81	88	95	102	109	116	123	130	137	144	151	158
System / Classification	ADOBE	AMPS	DSWC	GE/BSS	GWC	MAFR	MILSTAMP	MISSIM	ORBIT	PDS	PDSO/MAC	PDSO/MPC	RAFT	RRC	SC/ACCT	SPCTRK	TCC	1050/BSS
No. Aspect of System Is Classified		X	X	X		X	X		X	X	X	X	X	X	X			X
Some Aspect of System Is Confidential	X																	
Some Aspect of System Is Secret								X								X		
Some Aspect of System Is Top Secret					X												X	

Use: To use this index find the row of the Security Index Table with the same security classification as the proposed ADPS. Systems selected with the same security classification as the proposed ADPS are designated by an "X" in this row under the system acronym. System description sections of the selected systems of greatest interest are

Organization
Operations

Other system description sections of interest are

History
Description
Hardware
Application Program Development
File Conversion
Documentation

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

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13. ABSTRACT This handbook of Air Force automatic data processing experience is a pilot version of one to be produced in the next phase of the project. The ADP experience data was collected by interview at 18 Air Force ADP installations; the handbook produced during the next phase of the project will be updated from experience periodically reported to Headquarters, USAF, from some 200 ADP systems. The purpose of the pilot version is to acquaint Air Force personnel with the concept of using highly organized, summarized, and retrievable ADP experience in judging proposals for new automation. The pilot version of the handbook contains data collected after the fact from only 18 ADP systems, and hence the handbook has limited usefulness for actual evaluation of ADPS proposals. It does, however, contain cost estimation equations and narrative experience that will be useful until the 200 system handbook can be produced in Phase III.

Experience relevant to a proposed ADPS is retrieved from the handbook via information extracted from the proposal. The extracted information consists of quantitative workload descriptors of the proposed ADPS (e.g., number of input data fields and number of output formats) and certain qualitative descriptors (e.g. centralized or decentralized operations and presence or absence of direct access storage). The quantitative workload descriptors are used with cost estimation iso-graphs in the handbook to predict costs, so that proposed cost factors (e.g., man-months of development effort and dollars per month of hardware cost for application production) may be compared with Air Force experience. Both quantitative and qualitative descriptors are used to retrieve relevant information form the 18 system descriptions found in the handbook. The retrieved experience will

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GPO 886-551

(Continued from Abstract)

be used to check consistency and to uncover potential problems of the proposed ADPS that may be encountered during system development and operation.

A primer on the use of this handbook applied to a hypothetical ADPS proposal is published separately as ESD-TR-66-672. A final report covering activities and conclusions of the project is also published separately as ESD-TR-66-671.