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A METHODOLOGICAL APPROACH TO THE ANALYSIS AND AUTOMATIC HANDLING OF TASK INFORMATION FOR SYSTEMS IN THE CONCEPTUAL PHASE

LAWRENCE E. REED
JOHN P. FOLEY, JR.

BEHAVIORAL SCIENCES LABORATORY
6570th AEROSPACE MEDICAL RESEARCH LABORATORIES

and

RALPH S. GRAHAM
JONATHAN B. HILGEMAN

DEPUTY FOR SYSTEMS ENGINEERING
AERONAUTICAL SYSTEMS DIVISION

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FOREWORD

This report was prepared by the Personnel and Training Requirements Branch, Training Research Division, Behavioral Sciences Laboratory under Project 1710, Task 171006, "Personnel, Training and Manning Factors in the Conception and Design of Aerospace Systems." The investigation is one of a series being conducted on the identification of personnel skills required by advanced systems, and data handling methods.

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The task data used for testing the technique presented in this report were analyzed jointly by personnel of the Behavioral Sciences Laboratory and Aeronutronic, a Division of Ford Motor Company, Newport Beach, California, under Contract No. AF33(657)8639. Mr. Robert Shannon, Mr. Paul Horowitz, Dr. Gilbert E. Miller, and Dr. Herbert A. Berry of Aeronutronic, assisted in this effort.

ABSTRACT

Adequate consideration of the human skills required by future systems has long been neglected in the conceptual phase of man-machine system development. This neglect in part has been due to lack of a uniform and workable method for gathering, processing, and using early human factors information for improving the design and development of systems. The methodological approach presented in this report was predicated on this need. This report presents a technique for analyzing and processing task and task requirements data generated during the conceptual phase of system development. The technique includes: (a) a category system for organizing, classifying, and coding task information; (b) a task analysis format for recording and coding task descriptions and task requirements; and (c) computer update and retrieval programs. Task requirement data appearing in documents resulting from the Air Force Study Requirement program are analyzed and used for testing the technique on an actual personnel training problem. The test program indicates that the technique can be used to assist human factors specialists to isolate and process task and task requirements associated with advanced systems for making personnel, training, and training equipment recommendations.

PUBLICATION REVIEW

This technical documentary report is approved.

Walter F. Grether

WALTER F. GRETHER
Technical Director
Behavioral Sciences Laboratory

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SECTION I

THE NEED FOR A DATA BANK

Adequate consideration of the human skills required by future systems has long been neglected in the conceptual phase of man-machine system development. This neglect has been in part due to lack of a uniform and workable method for gathering, recording, analyzing, and displaying such information early in the development cycle of systems. Human factors specialists have not had a model for handling data they generate. The information is usually scattered in so many locations that its usefulness is diminished, or actually lost. As a result, it has been impossible to make reliable predictions about whether the system can be operated and maintained by the personnel available to the Air Force, or to make trade-offs in the design so that the human skill requirements will not be excessive.

Early human factors information is most essential. Design changes for obtaining optimum trade-offs between man and machine capabilities become increasingly difficult as the system hardens. As design decisions are made, more and more constraints are built into the system; hence, man becomes a slave to machine design. Figure 1 illustrates this man-machine relationship.

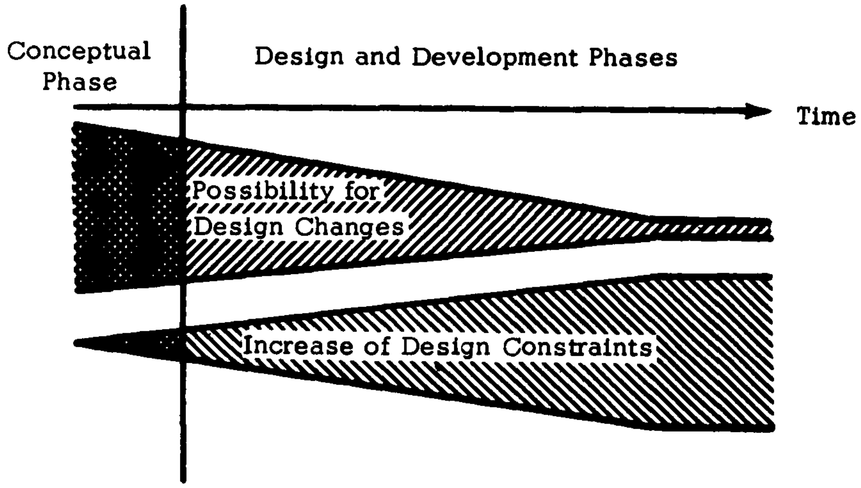

Figure 1. Effectiveness of Human Factors Information in the Developmental Cycle of Systems

Few unchangeable constraints are built into the system very early in its conception. At this point in time, the systems are essentially nothing more than ideas on paper. Precisely at this stage, consideration of the human element can be most effective. The requirement is then for a framework for recording and handling human factors information. The technique should be flexible enough that its output can serve as an input to early conceptual efforts as well as later developmental work.

This report does not propose solutions to all problems encountered by the human factors specialist. It offers a framework into which problems can be structured for solution and it attempts to answer the following questions:

1. Can the engineering data appearing in the conceptual phase of system development generate meaningful personnel task and task requirements *data that can be used effectively during design?

2. Can these data be organized and handled by means of electronic data processing equipment?

Successful answers to these questions were sought by means of a technique for generating task and task requirements data from any space system concept. This report also presents a method for storing, comparing, and using these data for making personnel, training, and training equipment decisions in connection with systems still in the conceptual phase of development. The method was designed to make a usable and permanent record of early information; it is also a record that can be updated and expanded to include later design information. The technique should result in an effective transitional device between the conceptual and developmental phases of man-machine systems. The data "bank" described in this report accomplishes these functions.

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*The task refers to performance; task requirements refer to the criteria of performance or the demands that the system, man, or the situation make upon one another, e.g., the working environment, time criticality, performance accuracy.

SECTION II

A TECHNIQUE FOR CATALOGING AND CODING TASK ANALYSIS DATA GENERATED DURING THE CONCEPTUAL PHASE

AN APPROACH TO TASK ANALYSIS

Task analysis has been defined as:

> ...an analytic process employed to determine the specific behaviors required of human components in a man-machine system. It involves determining, on a time base, the detailed performance required of man and machine, the nature and extent of their interactions, and the effects of environmental conditions and malfunctions. Within each task, behavioral steps are isolated in terms of the perceptions, decisions, memory storage, and motor outputs required, as well as the errors which may be expected (ref. 8).

This definition is meant for systems in the acquisition phase, but it is broad enough to be usefully applied to system concepts. The major objective is to determine man's role in the system and to guide the development of systems by optimizing the use of human resources.

The principal difference between task data generated during the conceptual phase and the later system development phases is in the level of available analytical detail. Often, the engineering data available during the conceptual phase are meager and subject to frequent and rapid changes. The analyst has little, if any, opportunity to examine system hardware. The lack of actual hardware places a serious restriction on the analysis of system concepts, but this does not mean that the available information is beyond analysis. The procuring government agencies and their contractors reach many decisions during the conceptual phase concerning the mission, system configuration, anticipated subsystems, and the operational concept of the system. The analyst can draw rough conclusions from these data on expected task and task requirements associated with system operation.

In general, task analyses have been applied to anticipate job requirements when some hardware is in existence, or when the system is in the blueprint stage of development. The analytic steps may be summarized as follows:

1. Determine the system, subsystem, and component functions
2. Develop operational function flow charts
3. Trace each subsystem and component function to the machine output and to the type of input required.

4. Determine feedback requirements

5. Identify the total tasks that will be required to operate the system

6. Develop time, location, and frequency information for each task

7. Identify the conditions that may cause error in task performance.

For systems in the conceptual phase of development, the analysis must be accomplished prior to the time that blueprints are in existence. With some limitations, however, the same procedures may be followed. For example, for a proposed manned space system, the analyst can state that the operator will perform his duties in a controlled environment. He should be able to state what general types of devices will be used by the operator to measure and control his environment. Two conclusions may be made concerning the equipment and the type of tasks that man will perform. The first is simply that equipment will be provided for measuring (e.g., dial indicators and lights) and controlling (e.g., switches and valves) the space vehicle environment; the second is that it will be necessary for the operator to monitor the environmental status and maintain it within certain tolerances. This example can be carried down to further detail by identifying the types of environmental parameters that may be involved and by predicting the amount of time that the operator will spend monitoring and controlling the vehicle environmental subsystem.

In the example above, the methods used to identify tasks during the conceptual and design phases of system development are essentially equivalent. In both, the task serves to translate the man-machine functional relationships into specific human behaviors. While the level of detail differs, the definition of the task remains the same. For the purpose of the present report a task is defined as something an individual does. This definition will hold whether the descriptive level is gross, e.g., monitor the system environmental status, or detailed, e.g., monitor a particular environmental status indicator having certain describable characteristics. The definition also transcends the usual necessity of directly relating a task to machine outputs. That is, a task can encompass activities, such as, resting, sleeping, or eating. While this information may not appear relevent to task analysis, it will assist the analyst to account for all predictable activities performed in an operational space mission.

The approach to task analysis, as discussed above, can be summarized as follows: (a) task analysis techniques should be broad enough to include data of varying levels of detail as the system design progresses; and (b) task analysis should encompass all activities performed by the human operator. The remainder of this section will be devoted to methods by which this approach can be implemented and combined simultaneously with data handling techniques.

DEVELOPMENT OF A CATEGORY SYSTEM

The first step was to select a method whereby task and task requirements data can be systematically organized and prepared for automatic data processing. The selection of an appropriate method was based on the following criteria: it should (a) be sufficiently flexible to provide for task data generated from design alternatives, (b) provide the breadth necessary to accommodate task data from a variety of projected space systems, (c) be sufficiently flexible to accommodate data generated throughout system development, and (d) be simple enough for use by relatively unsophisticated personnel. A review of numerous methods led to the conclusion that the criteria could be met by classifying pertinent task requirements into categories. By providing appropriate categories, the analyst can more efficiently plan his work. The role of the categories would be simply that of a comprehensive dictionary or catalog of subject headings.

Several problems regarding classification schemes in general should be given consideration. The first concerns the degree to which task requirements can be categorized reliably. Several analysts may choose different categories to identify the same task requirement, or they may select the same category to identify different requirements. Much of this inconsistency will depend on how well the categories are defined and the amount of overlap that exists between them. There are, however, several methods by which reliability can be maximized. One method would be for the analysts to agree on the use of certain terms. Second, a single person (or a small number of individuals) could check the data prior to computer storage. Third, reliability studies could be conducted through the same computer programs used to store and retrieve task requirements. In any case, attention should be given to standardizing the terms prior to or during the analysis.

The second problem concerns the value of classifying task requirements. It is not clear that behavioral categories, such as visual discrimination, finger dexterity, and eye-hand coordination, are classifiable or have any real value during the early periods of system development. This problem can be partly resolved by providing successive levels of detail within the categories. The classification scheme should contain categories that identify both small and gross units of behavior. The actual value of this method of classifying behavior can be judged solely on the basis of user acceptability.

The selection of appropriate categories was based on (a) the type and amount of engineering information available during the conceptual phase, (b) the amount and kind of task requirements that can be extrapolated from available engineering information, and (c) the type of data needed by the human factors specialist during the conceptual as well as other phases of system development. Reports written by system contractors in response to the Air Force Study Requirement (SR) program were reviewed in detail to ascertain the type and amount of information available during the conceptual phase. Since different approaches, assumptions, and design alternatives arise from different study groups, these reports provided a sample of existing conceptual engineering information. An examination of the formats used during the past years to document task and task requirements data revealed the type of data usually provided by the human factors specialist. The review of the SRs and formats led to the selection of the following 27 category titles:

System
Source of Information
System Configuration

Mission (primary vehicle)
Mission (secondary vehicle)
Mission Phase
Position
Crew Size
Functions
Subtask
Task Sharing
Subsystems
Tools and Equipment
Machine Output
Human Output
Communications
Psychological Processes
Task Criticality
Time Criticality
Frequency of Performance
Time-Line Information
Time to perform
Task Location
Task Area Environment
Type of Training
Training Media
Training Equipment Characteristics

Following selection of the main categories, it was necessary to specify the confines of each by identifying representative subcategories. The first step was to collect sample data that would logically fall within each category. Numerous documents and publications, such as study requirements, technical reports, and military specifications, were used for this purpose (refs. 2, 9, 14, 20). By way of illustration, representative subsystems were derived from a review of study requirements. Documents associated with several design alternatives for each of nine system concepts were closely scrutinized for subsystem information. Representative subsystems were extracted and listed on data formats. To reduce the list to a manageable size, recommended subsystems for each system and system design alternative were compared and duplicates discarded.

The next step was to put order into the information contained within each category. This involved grouping the selected terms into classes having certain attributes in common and naming each group appropriately. Since one of the primary objectives was to make the category system flexible enough to include data at varying levels of detail, the terms were grouped into less and less inclusive classes.

Two problems were encountered in grouping the terms assigned to each category. First, different terms were used for essentially the same purpose. For example, various SR reports, written by different study groups, used different terms to identify the same subsystem. Second, the subsystem groupings within the SRs would vary in content from report to report, i.e., equipment having the same function was occasionally treated under different subsystems. Both of these problems were partly solved by re-examining the SR reports; identifying the subsystems that were essentially equivalent, but given a different nomenclature; eliminating discrepancies from the category listing; and classifying subsystems into functional groups.

The procedures discussed above resulted in a comprehensive catalog of categories and subcategories (section IV).

DEVELOPMENT OF A CODING METHOD

A coding method was developed to permit computer storage and retrieval of task data. The criteria that governed the selection of an appropriate method follow:

Flexibility The method should be flexible enough that data generated during the conceptual phase, as well as other phases of system development, can be converted into codes, i.e., both gross and detailed task information should be codable. The coding should be expandable so that new categories and subcategories can be coded.

Uniqueness Each code should represent a single item in the list of categories and subcategories. This criterion cannot be overemphasized since the same term, given in a different context, may be repeated in several categories.

Simplicity The coding method should be simple enough that data can be coded efficiently and reliably.

The coding method that satisfied the above criteria is based on numerals. The information contained within each category is presented in outline form and each indented subject heading (subcategory) is assigned a two digit code. Subject headings of equal rank (level) within each category are represented as cells containing up to 63 two-digit numbers. (Due to computer restrictions, not more than 63 subject headings can be coded for any one rank). Two-digit codes representing particular ranks are combined into single-code series. Due to certain computer restrictions (see section III), only twelve characters can be used for code designation; therefore, not more than six cells are used in any one code series. This limits the information contained in a category to six levels of detail.

An illustration of the method whereby two-digit numbers are converted into code series is given in figure 2. As an example, let us say that an analyst desires to list and code the type of equipment that will be designed for a particular system. In the early period of systems development, he can only state that navigation subsystems will be used. The coding involved in this example would be: 01-03-01. The first two digits represent the major category; the sets of digits that follow represent the navigation and control, and navigation subcategories, respectively. As system development proceeds into design, the analyst will find that he can carry his analysis to a greater level of detail. He can identify particular subsystems, tasks, and subtasks necessary to operate equipment. If, for example, a particular time-critical navigation task requires the operation of indirect optical equipment, that subsystem would be coded 01-03-01-02-01-02; time

EXAMPLE	CATEGORIES AND SUBCATEGORIES	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6	CODE SERIES
Subsystems	I	01						01
Structure	A		01					01-01
Propulsion	B		02					01-02
Nav & control	C		03					01-03
Navigation	1			01				01-03-01
Sun Scanner	a				01			01-03-01-01
Optical	b				02			01-03-01-02
Type	(1)					01		01-03-01-02-01
Direct	(a)						01	01-03-01-02-01-01
Indirect	(b)						02	01-03-01-02-01-02
Horizon Scanner	c				03			01-03-01-03
Radar	d				04			01-03-01-04
Control	2			02				01-03-02
Time Criticality	II	02						02
Critical	A		01					02-01
Noncritical	B		02					02-02

Figure 2. Steps in Converting Categories and Subcategories into Code Series.

criticality would be coded 02-01. In cases where a particular task, or subtask, involves more than one subcategory in the same category, the code series associated with each must be indicated. For example, if a task involves the operation of a sun scanner and a horizon scanner, the coding would be given as a double entry, thus:

01-03-01-01
01-03-01-03

A differentiation must be made between data that do not apply to a particular task and data that are not available during analysis. Code 62 indicates that data are unavailable; 63 indicates that the category or subcategory is not applicable. Updating is accomplished by eliminating code 62 from the series and inserting the appropriate code in its place.

The task statement is conspicuously absent from the list of categories and codes. In the methodology presented here, all tasks with their subtasks, are numbered sequentially in accordance with the order of events in time. In conjunction with the code series representing a particular system, the task/subtask number becomes part of the control, or index number, for computer storage and retrieval (see section III). The computer program allows for a total of 9999 tasks per system, i.e., for each subcategory listed in category 1, and up to 99 subtasks per task.

DATA COLLECTION FORMAT

A format for recording narrative task information and codes was developed in keeping with the following criteria: The format should (a) provide sufficient space for entering all information associated with a single task or subtask, (b) be designed for ease of use by the analyst, and (c) be designed to facilitate accurate card punching. A recommended data worksheet is shown in figure 3. Space is provided for narrative descriptions of the task, subtask, and task sharing. All major category titles are listed with their corresponding code occupying the first cell. The categories have been ordered so that the first eight need not always be recoded from format to format. Larger spaces were designed into the format for categories having the greatest probability of requiring more than one code series. Finally, six cells were provided for the task or task/subtask number. The task number is entered in the first four cells; the subtask, the last two. Each task and subtask number is recorded from right to left. For example, task number 1, and its first subtask, are recorded in the fourth and sixth cells, respectively.

The data worksheet was designed so that the portion containing the codes can be removed after card punching. The remainder can then be filed, or bound for quick reference.

For the purpose of clarity, each completed worksheet is referred to as a record.

METHOD OF ANALYSIS

The foregoing pages have outlined a method by which task and task requirements data can be organized and prepared for computer storage. While the object of this report is not to describe how task analyses in general are accomplished, procedures for applying the categories and subcategories as an analytic aid will be discussed.

In general, the steps required to perform a task analysis will vary in accordance with the system to which it is applied and with the needs of the analyst. Usually, the first step in the analysis demands a clear statement of the mission requirements and system constraints. Mission requirements may include the mission capabilities and performance characteristics, environmental conditions, prespecified subsystems and sub-subsystems, manpower, etc. An example of a constraint may be that the system will be manned. After the analyst has identified mission requirements, he may find it convenient to develop a mission profile in graphical or pictorial form. Indicated on the profile would be the mission phases, time information, etc.

As the analysis proceeds, the profile is expanded to include the elements contained within the mission phases, such as rendezvous, docking, and post-rendezvous. The major objective of dividing the mission phases into their constituent elements is to simplify the analysis by offering smaller units to work with. Coding can be initiated at this point in the analysis. The code series associated with the mission elements, time periods, etc. are entered directly

TASK DATA WORKSHEET	TASK/SUBTASK NUMBER						

CATEGORY TITLE	CODE					
SYSTEM	01					
SOURCE OF INFORMATION	02					
SYSTEM CONFIGURATION	03					
MISSION (primary vehicle)	04					
MISSION (secondary vehicle)	05					
MISSION PHASE	06					
POSITION	07					
CREW SIZE	08					
FUNCTIONS	09					
SUBTASK	10					

CATEGORY TITLE	CODE					
TASK SHARING	11					
SUBSYSTEMS	12					
TOOLS AND EQUIPMENT	13					
MACHINE OUTPUT	14					
HUMAN OUTPUT	15					
COMMUNICATION	16					
PSYCHOLOGICAL PROCESSES	17					

CATEGORY TITLE	CODE					
TASK CRITICALITY	18					
TIME CRITICALITY	19					
FREQUENCY OF PERFORMANCE	20					
TIME-LINE INFORMATION	21					
TIME TO PERFORM	22					
TASK LOCATION	23					
TASK AREA ENVIRONMENT	24					
TYPES OF TRAINING	25					
TRAINING MEDIA	26					
TRAINING EQUIPMENT CHARACTERISTICS	27					

TASK DESCRIPTION:

DESCRIPTION OF TASK SHARING:	SUBTASK DESCRIPTION:

SYSTEM:	SOURCE OF INFORMATION:	TASK/SUBTASK NUMBER:						

Figure 3. Task Data Worksheet

on the mission profile. The code series associated with the elements are identified and recorded.

The next step is to identify each operation and subsystem to be included in the system. The function, i.e., the purpose of each operation and subsystem, is identified in as much detail as the system concept data will allow. While this information could be annotated and coded in the mission profile, it would probably be more convenient to lay out a flow chart showing the sequential relationships of all functions. Each function should be numbered sequentially and coded on the chart.

Tasks and their subtasks are isolated and labeled after the functions have been allocated to man-machine combinations. Narrative task and subtask statements are then recorded on separate data worksheets. In general, the task statement can be recorded on the worksheet containing the first subtask of the task, i.e., the same task statement need not be repeated on all worksheets containing subtasks for a single task. The numbering of all tasks and subtasks should be consistent with the numbers used in the functional flow diagram described in the preceding paragraph.

As each narrative task and subtask statement is entered on the data worksheets, it will be possible to record the code series representing previously identified information. This may include: (a) the system (category 1), (b) the source of information (category 2), (c) the type of mission (category 4), (d) the mission phase in which each task or subtask is performed (category 6), (e) the subsystem involved in the task or subtask (category 12), and (f) the function (category 9).

The procedures described in the preceding paragraphs comprise what is called <u>function analysis</u>. Task analysis is initiated after the tasks and their subtasks have been isolated. The analysis usually begins with a determination of the machine and human output elements (categories 14 and 15, respectively) and the particular psychological processes involved (category 17). The steps that follow are concerned with the determination of task/subtask criticality, time criticality, frequency of task performance, work stations, and environmental conditions. Preliminary estimates of task initiation time and duration are made if there are sufficient system concept data available. The particular order in which the task requirements are isolated will, of course, depend on the needs of the analyst. In any case, the code series associated with each requirement is selected from the catalog (section IV) and recorded on the data worksheets.

The final steps in the analysis include the identification of (a) positions and (b) training requirements. While it may be possible for the analyst to make preliminary assignments of tasks to positions during the analysis of individual tasks, positions are usually determined by grouping tasks in accordance with certain predetermined criteria. For example, all tasks having certain requirements are grouped into a single position. This step can be accomplished through the use of the computer programs. That is, a retrieval routine can be written so that tasks having certain requirements in common are identified (see section IV). The code series associated with each position (see category 7) should be recorded on the data worksheets containing the requirements. The same procedures can be used to specify training requirements.

In general, function and task analysis can be considered to be dynamic processes that continue throughout all phases of system development. All changes in system concept or design that may have an effect on human performance should be subjected to analysis. Data worksheets must be updated to reflect each change.

DATA BANK CONFIGURARION

The preceding discussions have outlined a technique whereby task and task requirements can be categorized, coded, and prepared for automatic processing. Up to this point the emphasis has been placed on the inputs to the bank and nothing has been said about the types of outputs that may be expected. Finally, no evidence has been presented so far that indicates that the techniques can be used. A study will be summarized to illustrate the application of the technique to certain training problems.

TYPES OF OUTPUT

In its present stage of development, the bank does not generate information. Only those data that have been placed in the bank can be taken out. The data are so stored that they can be retrieved in many different structures. The outputs will furnish the information necessary for answering many personnel and engineering questions.

To present a clear picture of the types of outputs, it might be well to first consider the general configuration of the bank. The principal unit of the bank is the task. All other information serves to either identify or specify the requirements associated with the task. The categories and subcategories were generated from a consideration of these two types of information. Together with the computer retrieval and update programs, they form what may be called the total configuration of the bank.

The interrelationships of the bank configuration are shown in figure 4. The center area of the figure (the information contained within the dashed lines) represents a single task or subtask record. While only the main category titles appear in this portion of the figure, they represent the flow of all possible information contained within the confines of the "Catalog of Categories and Codes." The initial data input to the bank is represented by the top left block. On the right is the data input to computer storage and the data output from the computer. Also on the right, is the flow of information from the computer output to the data record and back to the computer input for updating. The flow shown on the right does not return to any particular category, because data storage and retrieval are not restricted to any one type or combination of data contained within the bank. The categories contained within the dotted lines are usually dependent on the results of a retrieval request. For example, assignments of tasks to positions depends on certain requirements prescribed by the analyst. After the data records containing the requirements have been retrieved from computer storage, the code series associated with each position is entered on the appropriate data worksheets and returned to computer storage by means of the update program.

In addition to making task data rapidly available, the technique presented here has the advantage of allowing the retrieval of any logical combination of categories and subcategories. The analysis of information contained within the bank can be initiated at any level of detail desired. For example, assuming that

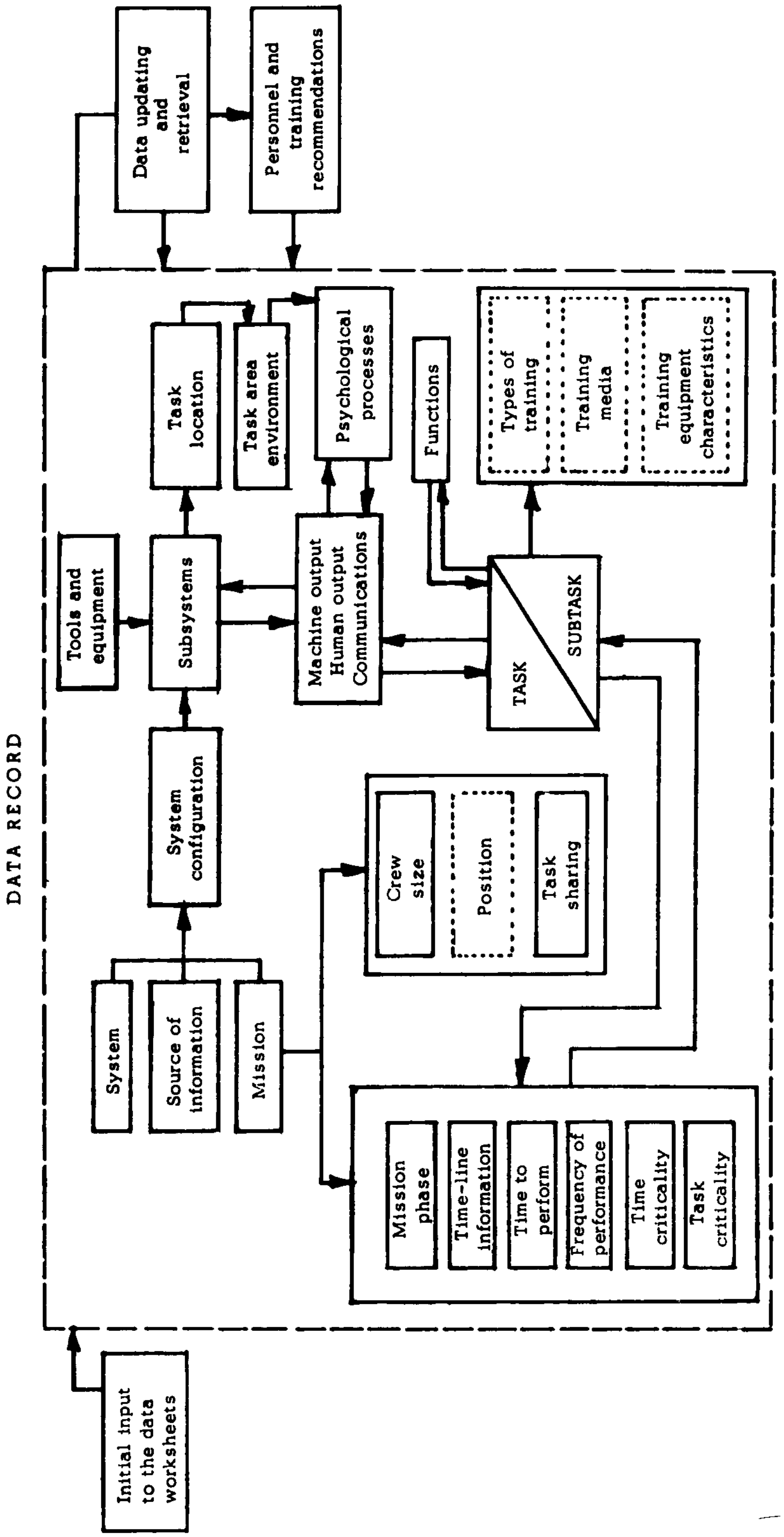

Figure 4. Data Bank Configuration

complete time-based information has been recorded and stored, all tasks performed within certain specified time limits during a mission by a particular position can be retrieved. By expanding the request program, the analyst can place restrictions on the type of data that is retrieved. For example, the request can be limited to information about training equipment for tasks that are critical, are performed under certain environmental conditions, or require particular human outputs. The computer output will furnish information concerning the need for certain training equipment. As a second example, all tasks performed by a specific individual during a mission phase, or a time period or both, can be retrieved from the bank to provide an estimate of task loading based on a count of the number of tasks assigned to each.

The flexibility of the bank permits data storage of many system concepts. Systems can be compared across any combination of requirements. The analyst may want to know, for example, whether certain positions can be assigned to different systems. By comparing the position requirements across systems, the retrieved data can be applied to manpower predictions.

Although the retrieval request must be limited to the information contained in the "Catalog of Categories and Codes," data that are not directly listed in the catalog may be requested by phrasing the query in terms of the information that is stored. For example, it may be requested that all tasks that are passive in nature be retrieved. While passive tasks are not identified as such in the catalog, certain characteristics of passive tasks can be identified. Passive tasks may be defined as those that do not require human control of a machine. This definition provides the information necessary to request data contained in the catalog, i.e., all tasks that do not involve category 15 (HUMAN OUTPUT) are retrieved from the bank.

TEST PROGRAM

Two questions were asked early in this report: can engineering data appearing in the conceptual phase of system development generate meaningful task and task requirements data, and can these data be organized and handled by means of electronic data processing equipment? Generally, techniques cannot be guaranteed to work until they have been applied to given situations. Rather than speculate, a test program was initiated in connection with an actual training problem. The data were drawn from classified documents, thus the presentation of the test program is limited to gross statements concerning the procedures and findings, and the problems that were encountered.

Problem Area

The problem was to identify the tasks and task requirements that should be considered in designing of a training facility for future space systems. The results of the study (refs. 13, 15, 16, 17, 18, 19, 22, 23) were to be used for making personnel training and training equipment recommendations for several systems still in the conceptual phase of development.

The techniques presented in this report were used to identify, describe, and process the following types of data:

1. System, mission, crew size, types of positions, subsystems.

2. Data necessary for writing position descriptions of each crew member

   a. Tasks assigned to each position
   b. Task sharing
   c. Environmental conditions
   d. Specific performance requirements
   e. Subsystem affected by the functional application of the tasks
   f. Skills involved
   g. Task functions
   h. Types of training

3. Data for writing crew descriptions

   a. Tasks by positions
   b. Shared tasks
   c. Environment
   d. Types of training

4. Collective look at human performance in the system

   a. Total number of tasks assigned to each position
   b. Total number and percent of shared tasks
   c. Total number and percent of tasks assigned to each position by mission phase
   d. Total number and percent of skills involved in each task by position and mission phase
   e. Total number and percent of tasks that are passive or active by position and mission phase

Procedures

The procedures included the following steps:

1. Selection of data source. Since the study was concerned with personnel training for future space systems, reports resulting from the Air Force Study Requirement (SR) program were selected for analysis. The systems selected are listed in Category 1 (pg. 39). A single contractor's report was chosen for analysis for each SR. The reports were selected on the basis of (a) containing a complete description of the system and subsystems, (b) the amount of human factors data presented, and (c) the amount of training and training equipment information contained in the report.

2. Task analysis and coding. All identifiable tasks and subtasks associated with operator personnel were extracted from the SR reports and subjected to analysis in accordance with the items appearing in the "Catalog of Categories

and Codes." Task and subtask statements were recorded on separate data worksheets along with the codes representing the requirements for each.

3. Data storage and retrieval. The completed data worksheets for each analyzed SR report were submitted for card-punching and computer storage. Data retrieval was initiated following the computer storage of task requirements for all systems. Three retrieval routines were used to process the information asked for in the problem area. The first retrieved task requirements by system, and position; the second by system, position, and mission element; the third, differentiated passive and active tasks by system and mission element.

The computer output for the first two retrieval programs was edited so that items (task requirements) within the same category would be listed in the same column. The third simply retrieved the control numbers (task/subtask number and system code series) of tasks that were identified as passive. Passive tasks were considered to be those that do not require a human output, i.e., tasks not containing information in category 15 (HUMAN OUTPUT), and that do not involve a communications output from the human, i.e., tasks recorded in category 16 (COMMUNICATION) as not requiring an output transmission from the human. The number of active tasks was computed by subtracting the number of passive tasks from the total number of tasks contained in each system.

The quantitative data called for in item 4 of the problem area were computed manually from the outputs of the first two retrieval routines.

Results

This test program successfully served the dual purpose of testing the techniques for analyzing, coding, and processing system concept data, and providing data in support of the problem area. Since actual data cannot be presented here, the results will be discussed in terms of the application of the techniques to specific training problems and problems that were encountered during analysis.

Application to the problem area. The information called for in the problem area can be summed up as follows: What will personnel be trained to do? What are the major skills? Who will be trained? The method used to answer these questions was straight-forward; it required that tasks, and task requirements, and hardware data be retrieved from the bank in a usable form. What remained was to bring the retrieved data into perspective with personnel training and training equipment recommendations for future systems.

Hypothetical data similar to the type analyzed and retrieved from the bank will serve to illustrate the method whereby system concept data were applied to the problem area. One of the preliminary steps was to determine the extent of human participation in the operation of each proposed system. Quantitative data were obtained by counting the number of tasks per mission element, and passive vs active tasks per mission element. Figure 5 integrates these data into a mission profile containing hypothetical time estimates.

The two factors used to measure the extent of human participation in systems

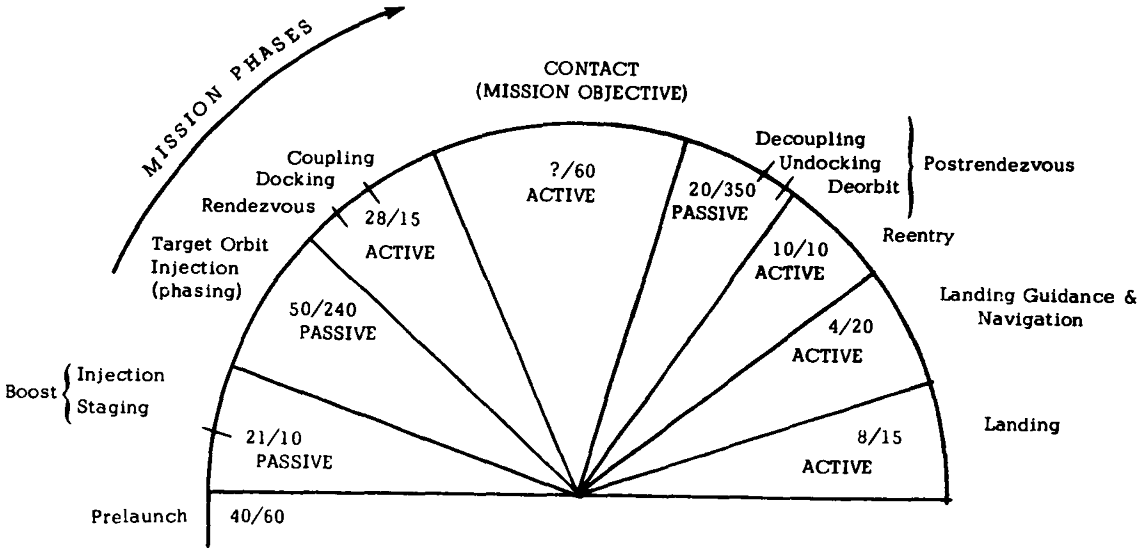

Figure 5. Profile for 12-Hour Mission (Number of Tasks/Time in Minutes)

were task loading (the number of tasks per unit time) and the nature of the tasks (passive vs active). An examination of the mission profile reveals the following:

1. Assuming that automatic control is the primary mode of operation during boost, injection, and phasing, man's role in the system is passive. While task loading during boost (21 tasks in 10 minutes) is high, most of the tasks are concerned with monitoring operations, hence are passive in nature.

2. As the mission progresses to its objective, man's role becomes increasingly active. Time is at a premium and the operator must exercise greater control over the machine. Task loading during contact with an orbiting vehicle will usually be dependent on the mission objective. For example, emergency rescue missions will undoubtedly require greater activity on the part of the operator than during routine maintenance missions.

3. The postrendezvous operations are characterized by low task loading. The tasks are either passive or can be accomplished by automatic means of operation.

4. The reentry, landing guidance and navigation, and landing phases of the mission require active human participation. Time is again at a premium and the operator must exercise control over the machine.

The mission profile was given further meaning by determining the criticality of the tasks performed by the operator during each mission phase and mission element. The computer output data revealed that the tasks following prelaunch have increasing criticality as the mission progresses, decrease in criticality during the contact phase, and become highly critical during reentry and landing.

Several training implications can be derived from the preliminary conceptual data presented above. For the purpose of illustration, we can assume that training should concentrate on the mission phases and elements containing the greatest number of critical tasks, that require active human participation over system operation, and have the highest task loading. Solely on the basis of the data presented thus far, we can conclude that training should emphasize the mission functions applied to rendezvous, docking, coupling, contact (depending on the type of mission objective), reentry, landing guidance and navigation, and landing operations.

Specific training recommendations were made by integrating and combining the data in the mission profile with the tasks necessary to accomplish each function, the environmental condition under which each identified crew member must perform his function, and all other requirements (e.g., task and time criticality) that may influence task performance. The results of this step identified the type of training and training equipment for each system and each crew member.

What remained was to identify the tasks and training requirements that were common to some or all systems. This was accomplished by comparing the types of missions assigned to each system and the tasks associated with each. The results of this step identified the types of training and training equipment that must be system specific and those that could be used for training on some or all systems.

Problems encountered. Two principal problems--neither unexpected--were encountered during the analysis and coding of system concept data. Many of the subcategories appearing in the catalog were found to suffer from lack of definition and could not be used reliably. The categories that presented the greatest difficulty were: category 9 (FUNCTIONS), category 14 (MACHINE OUTPUT), category 15 (HUMAN OUTPUT), and category 17 (PSYCHOLOGICAL PROCESSES). Attempts to maximize interjudge agreement were made by encouraging communication between analysts about problems encountered, coding task requirements at a higher level of generalization, and reorganizing and redefining the categories and subcategories that were especially vague. The catalog, as presented in this report, reflects the changes based on the experience gained from the analysis. Much remains to be done to maximize reliability.

The second problem was the level to which available system concept data could be interpreted. Since the SR reports suffer from a dearth of human factors data, the problem was dealt with by extracting task requirements directly from the available engineering information. In many cases the amount of information that could be analyzed differed from report to report. The resulting variations among the data worksheets presented problems during retrieval, since the data necessary for making comparisons across systems were missing for some systems. In such cases, less precise comparisons could be made by retrieving at a more general level of detail.

USES AND LIMITATIONS OF THE BANK

The techniques developed here do not present a radical departure from the task analysis methods used in the past. The added advantages are that the bank permits an orderly approach to the analysis of system concept task data, an efficient transition of conceptual data to later design phases, and rapid processing of task data. In general, the uses of the data and the data bank techniques can be summarized as follows:

1. To organize system concept task and task requirements data into a manageable and uniform framework

2. To organize task and task requirements data across system concepts (This feature permits comparisons across systems; it also assists in setting forth the requirements for proposed new systems by comparing elements that are common to all or some systems. For example, one can determine the extent to which elements can be interchanged from system to system.)

3. To promote design flexibility and reduce the number of changes during later system development phases

4. To assist the engineer and scientist in improving the design of systems

5. To permit the use of updated task and task requirements information in support of system design and training equipment

6. To assist the analyst by identifying new personnel skills required to operate future aerospace systems (Comparisons can be made by matching personnel skills required by contemporary systems against those necessary to operate future systems.)

7. To predict personnel training, manning, and training equipment requirements for future aerospace systems

8. To permit the analyst to determine (a) the psychological factors essential to personnel performance, (b) personnel performance criteria, (c) task loading, and (d) trade-offs between personnel, training and other system design considerations

9. To assist in the development of a standardized task language that can be used reliably by individuals having different professional backgrounds

10. To standardize the structure and level of detail of human factors information generated during the conceptual and developmental phases of aerospace systems.

11. To indicate where additional research (basic and applied) is needed to advance the state-of-the-art

While the bank has numerous uses, it is subject to many limitations. The technique was primarily to test the feasibility of analyzing and processing data generated during the conceptual phase of system development. The data bank, as presently developed, has the following limitations:

1. The computer programs are limited to updating and retrieval; they cannot generate additional files of data or process statistical and other mathematical data.

2. Although the classification scheme appearing in the Catalog of Categories and Codes has been tested for task and task requirement data generated during the conceptual phase of system development, it has not been tested for later design phases.

3. The classification scheme is limited to space system operator tasks and task requirements.

4. The reliability of the computer outputs depends on the extent to which task and task requirements are selected and coded reliably.

SUMMARY AND FUTURE PLANS

The results of a test program showed that the techniques described in this report can be used to assist the human factors specialist to isolate tasks and task requirements associated with advanced space systems and to make recommendations for personnel training and training equipment. The data bank was predicated on the need for a systematized method for analyzing, organizing, and processing task and task requirements generated during the conceptual phase of system design. This section has outlined a technique whereby system concept data associated with operator personnel can be classified and prepared for computer storage. The types of outputs, uses, and limitations of the technique were discussed.

What remains to be discussed are plans for increasing the flexibility of the data bank. The limitations of the technique advanced in this report restrict the extent and type of task and task requirements data that can be classified, coded, and processed. Plans are being formulated to make the following improvements:

1. The classification scheme will be expanded to include maintenance and other ground support personnel task requirements.

2. A method will be developed whereby data can be classified, stored, and processed throughout system development, test, training, and operation, i.e., provide a method for comparing data across systems longitudinally through all development phases of a given system, or both simultaneously.

3. Computer programs will be developed for performing statistical and other mathematical operations.

4. Computer programs will be added for processing narrative and pictorial information generated throughout system development.

5. A method will be provided whereby data can be disseminated and used by system engineers and scientists for improving the design of systems.

SECTION III

COMPUTER PROGRAMS

INTRODUCTION

Two IBM 7090 computer programs have been written for processing the information contained in the data bank. The programs that perform the required functions consist of an update program and a retrieval program that maintain and screen, respectively, a master file tape. This file contains one record of both data and control information for each distinct task-system configuration.

The update program makes changes in data records, inserts new records, and deletes old ones as required.

The retrieval program screens the master file, retrieves certain key records from it and writes those records as an output file for listing. The data used in the screening describes particular task-system configurations or specific categories or both by code (see the "Catalog of Categories and Codes"). Thus, the particular task-system records or all records that contain the specific categories indicated or both are written on tape and may be subsequently edited. The printed tape gives a listing of the records, including both the control and information data, that were retrieved.

STRUCTURE OF THE MASTER FILE

A. The data for the master file is initially punched on cards.

1. The first card field layout of a record is as follows:

1-6	7-18	19-30	31-42 43-54 55-66 67-78	79-80
task number	system category	record length (initially blank)	descriptive categories (see catalog)	card number

2. Subsequent cards are as follows:

1-6	7-18	19-30 31-42 43-54 55-66 67-78	79-80
task number	system category	12 character descriptive categories (See catalog)	card number

B. The master file deck is taped and ordered by task system configuration and card number

UPDATE PROGRAM

The update program* assembles information (as described above) into a variable record master file tape, and maintains a master file tape that has already been established.

A. The input to the updating program consists of a master file tape and a change file tape.

1. The master file is as described above.

2. The change file contains all desired change data which can be categorized into one of three groups according to the type of action to be performed.

   (a) Replacement changes are modifications to particular records of the file.

   (b) Additions are new entries to the master.

   (c) Deletion changes consist of records to be scratched from the file.

B. The output from updating is a new master and an error file.

1. The new master reflects the changes as specified by the change file.

2. The error file contains all records from the change file in which various errors were detected. The error checks are as follows:

   (a) An update card number greater than 13

   (b) An update record with more than 13 cards

   (c) An update record with duplicate card numbers

C. The restrictions of the update program are as follows:

1. All change records must conform to the field layout indicated in the file structure.

2. Replacement changes must contain the total data for the record.

3. Deletion changes require only one card with only the task-system number and card number punched (the card must be numbered "1").

4. The change file must be sorted by task system number and card number.

*See appendix for detailed write-up and program listing.

5. The update program is written in the IBM Commercial Translator language and must be run under the 7090/94 Basic Monitor.

RETRIEVAL PROGRAM

The retrieval program* consists of two sections. Section one is a pre-coded bookkeeping program designed to rapidly screen the master file (contained in a single or multitape file configuration). Master file tapes are read and screened simultaneously.

The second section is coded at the time of the retrieval requests. This facilitates extensive options for requests and allows output details to coincide with particular problem demands. Screening for particular task-system configurations can be accomplished. Searches for any logical combination of specific categories, while screening for the requested system, task-system, or task may also be accomplished. Requiring particular items to be absent is as plausible as requiring their presence and is therefore allowed. The retrieved data may be written in a single file, suitable for printing, while master file tapes are being processed. The output from the retrieval program is presently a coded data representation of the task-system configuration, or categories or both retrieved from the master file. This limitation necessitates using the Catalog of Categories and Codes (section IV) for decoding the output. By additional programming, this manual decoding step may be eliminated. That is, a translator routine can be used to substitute appropriate English-language abbreviations for the coded data. Such a subroutine is one of the computer programs planned for the total package.

The basic restrictions for the retrieval program are the following:

1. The previously described master file must be used.

2. Coding must be in the Commercial Translator Processor language.

3. Retrieval requests must be codable in the above language.

*See appendix for detailed write-up and program listing.

SECTION IV

CATALOG OF CATEGORIES AND CODES

This section contains discussions and lists of categories, subcategories, and codes. The short discussions preceding the category listing (page 39) summarizes the content, justification, and unique features of each category. Examples are presented to illustrate the application of the coding method and to clarify the use of certain subcategories.

The category listing is suggestive and not definitive. Representative categories and subcategories were selected for their usefulness to the analyst and to cover a wide range of subjects. Where necessary, the analyst can modify, delete or add to the category listing to meet his own needs.

EXPLANATORY COMMENTS

Category 1 - SYSTEM (page 39)

This category is designed to include any number of planned space systems. Presently it contains the spectrum of planned Air Force systems. The systems are classified by representative operational groups. While the list is limited to projected space systems, operational, or systems under development may be added to the list as needed.

This category is divided into two subcategories: System and Other. The latter has been included so that task analysis data related to subsystems can be coded and processed through the data bank.

Category 2 - SOURCE OF INFORMATION (page 40)

This category identifies the source of the information being analyzed. Further detail can be added to the list. For example, under the subcategory Government agencies, particular laboratories, offices, individuals, and documents can be identified and included in the list.

Category 3 - SYSTEM CONFIGURATION (page 41)

The configurations listed in this category are representative of those recommended for the systems listed in category 1. In some cases the subcategories may not describe the configuration of certain systems. For example, a system may be cylindrical in shape but also have wings. In this case, the code series associated with both characteristics should be identified and coded to describe the system being analyzed. Configurations not appearing in the list must be added.

The configuration of a system can have a sizable impact on the various tasks that must be accomplished by operator personnel. For example, the landing procedures associated with a lifting body configuration will differ from those proposed for winged systems. A lifting body may return to earth by means of a parachute and the pilot will have little control over the landing procedures. With a winged system, the pilot may have more control. The training implications associated with these different system configurations are evident and must be taken into account while making decisions about training.

Category 4 - MISSION (PRIMARY) VEHICLE (page 42)

The mission of the primary vehicle refers to the mission or missions of the system being analyzed. If the Global Surveillance System (GSS) is being analyzed, it will be considered the primary vehicle. If the analysis of the GSS contains tasks performed by personnel assigned to a support system such as the Space Logistic Maintenance and Rescue (SLOMAR) system, the SLOMAR will be considered the secondary vehicle. On the other hand, if the SLOMAR system is under study, it will be considered the primary vehicle and the system being supported, the secondary vehicle.

The missions appearing in this category are representative of those assigned to the systems in category 1. Any system may be designed for several mission objectives or may be assigned to missions not originally expected. In such cases multiple code series must be recorded to identify each mission objective. Single missions will be coded when the system is assigned to one type of mission or one mission is being analyzed for a system having multiple-mission capabilities.

Category 5 - MISSION (SECONDARY VEHICLE) (page 45)

Category 4 and category 5 are equivalent, except that the latter is divided into manned and unmanned missions. While the missions appearing under the subcategories Manned and Unmanned, are the same as those listed in category 4, only those missions that can logically be assigned to unmanned systems were listed under the second subcategory.

The use of this category will start when the operational tasks performed on the primary vehicle are associated with or influence the tasks performed on the secondary vehicle. These types of tasks are usually carried out during the rendezvous, contact, and postrendezvous phases.

Category 6 - MISSION PHASE (page 50)

Mission phases describe the major sequence of events in a given mission. A mission phase exhibits coherence within the mission profile and has recognizable starting and stopping points. For example, the following phases may represent a typical mission cycle: prelaunch - boost - earth orbit - reentry - landing. The eight mission phases (pages 50,51) identified in this category are representative of those recommended for the systems listed in category 1. Each mission phase may be subdivided into several elements. The criteria for selecting the elements are essentially the same as those used for identifying the mission phases. All elements represent cohesive and well defined activities that can be defined in terms of the various missions recommended for the system as listed in category 1 (page 39).

The identification of mission phases and, where possible, mission phase elements is one of the initial steps in performing a full mission task analysis on a system in the conceptual phase of development. After each has been identified, the first task to be considered in the analysis should be the task that initiates each phase. If time-based task information is available for the whole mission, the task analysis can start at any point in time within the mission (see category 21).

Category 7 POSITION (page 52)

The positions listed in this category are consistent with those recommended for the systems in category 1. The position titles should not be confused with current Air Force serial codes, (AFSCs) since the possibility exists that future space personnel may not be selected from a pool of trained aircraft operator and maintenance personnel. The space vehicle pilot, for example, may or may not be an aircraft pilot.

The definition of each position listed in this category should remain flexible because the assignment of an isolated task or subtask to a position, without regard to the total requirements associated with all tasks to be performed in the system may be misleading. Also, the analyst may inadvertently assign the same or similar tasks to different positions in cases where the task requirements dictate that the same position should be assigned those tasks. The resulting confusion would make it difficult to identify all requirements associated with a position.

The allocation of a universe of tasks to particular positions should be deferred until after all tasks and subtasks for the system have been identified. This method of analysis will take into account the constraints imposed by the system (e.g., the number of men that will operate the system) as well as the requirements associated with the task and subtask (e.g., man-machine relationships and performance requirements).

Although this category is specifically directed to space operator positions, the subcategory Ground operator personnel was included in the list because many of the tasks assigned to space vehicle personnel are directly related to the actions of ground station operators. This subcategory is concerned with all ground operator personnel that are assigned tasks with a direct bearing on the operation of the orbiting space vehicle. A further breakdown of this subcategory can be made if it should become necessary to identify the specific ground operators involved in the task.

The subcategory Secondary vehicle personnel was included in the list of positions to indicate that certain tasks assigned to primary vehicle crew members may be dependent upon tasks performed by secondary vehicle personnel.

The subcategory All crew members indicates that all personnel perform a common task, e.g., fasten seat belts. The pertinent code series that identifies all personnel accomplishing common tasks (not to be confused with shared tasks--see category 11) should be recorded on the data worksheets. In other situations, only one code series will be used to identify a position.

A list of specialties has been provided in this category. Each specialty should be coded into one of the following subcategories: Specialist (technician), Engineer, and Scientist.

Category 8 - CREW SIZE (page 54)

This category identifies all crew members within a space vehicle or a lunar base. While it might not be necessary to include this information on each task and subtask record, the justification for this category is based on the grounds that a method was needed to identify crew availability for situations where task assignments are shifted to personnel not originally assigned to the task. For example, in emergency situations a crew member assigned to a certain task may be forced to perform a different function. The analyst must select the appropriate crew member to perform the emergency procedures as well as to assign someone to the original task. To do this, two main factors must be examined closely, namely, the number of crew members within the vehicle, and the position associated with each. After these factors have been determined, the analyst must identify the type and availability of the crew member best suited to accomplish the task. This may be done by identifying the requirements associated with the task, the type of training required to accomplish the task (see categories 17 and 25), and the work load assigned to the selected crew member at the time of the emergency (see categories 20, 21, and 22).

The positions listed in this category are essentially equivalent to those in category 7. The subcategory Ground operator personnel has been omitted since it does not apply to identification of the space crew members. The subcategory Total crew size was added to indicate the size of a crew in cases where the position types are unidentifiable.

Category 9 - FUNCTIONS (page 56)

This category consists of an alphabetical list of action verbs. Each task and subtask is identified according to the purpose it serves. In most cases, the verb appearing in the task/subtask statement itself can be used to determine the function of the task. For example, if a particular task description reads: "monitor the environmental control system," the verb monitor indicates the function of the task. If the verb appearing in the task description is not sufficiently descriptive, an appropriate verb must be selected by the analyst.

The method of assigning functions to tasks and subtasks, as described in the preceding paragraph, might seem in reverse to the usual process, since a function is normally defined in terms of a universe of tasks having certain describable characteristics in common. However, the importance of determining the function of each task cannot be overlooked, because after the tasks are coded, they are identifiable only through the task sequence number. The primary value of this category is that it permits the analyst to study the differences and similarities between task functions without referring to the detailed task requirements. For example, all tasks concerned with monitoring operations within or across systems can be retrieved from the data bank. If the analyst wishes to compare functions having certain requirements in common, he may enlarge the query to include additional task specifications, such as tasks that are performed: (a) on certain subsystems (see category 12), (b) at a particular time within the mission profile (see categories 6 and 21), (c) under the same or similar environmental conditions (see category 24), (d) by particular individuals (see category 7), (e) at the same station within the vehicle (see category 23).

The selection of functions from the list may present problems. There is no experimental evidence to show that the functions are independent; any categorization of this information will of necessity include functions that overlap, and functions with boundaries that are ill-defined. The selection of action verbs from the list will no doubt be subject to individual bias; that is, a different verb might be selected by different analysts for essentially the same task. To reduce confusion, it would be advisable that some agreement be reached between judges prior to or during the analysis of personnel tasks.

This problem can be further minimized through the computer retrieval programs themselves. For example, analogous functions can be identified and retrieved from the data bank. Through a cross-check with the task description and certain task requirements, it may be concluded that certain tasks are sufficiently similar to be identified with the same action verb. Continuous cross-checking will also assist in eliminating overlap and in defining the boundaries of each verb, and should eventually lead to the development of a standardized language.

Category 10 - SUBTASK (page 60)

A subtask is the smallest identifiable element of a task. In cases where tasks involve sequential inputs and outputs, subtasks must be identified. For example, a particular task may be: monitor the environmental control indicators. To determine the elements, two distinct aspects of the task must be identified. First, the analyst must identify the smallest units of human behavior associated with the task, e.g., a specific motor action. In the sample task statement given above, it might be determined that the operator must turn a selector switch to monitor each environmental parameter. Accordingly, this task is composed of at least two distinct subtasks: (1) turn the selector switch to the appropriate environmental parameter and (2) take a readout from the indicator. The smallest definable unit of behavior associated with the first subtask is motor and the second is visual. The total number of subtasks will depend upon the number of environmental parameters that must be monitored.

Second, the analyst must determine the characteristics of the equipment as well as the particular human responses, perceptions, etc., involved in each subtask. To describe the characteristics of the first subtask in the example given above, the analyst must identify the type of switch used and the finger action that must be taken by the operator to select the proper environmental parameter. The subtask will be identified through an examination of the type of indicator used to obtain environmental readouts. This information will make it possible to specify the human modality and process involved in the subtask.

The foregoing discussion implies that a single subtask loses its significance if it is not considered in relation to the total series of elements within tasks. It would have been meaningless, for example, to describe the requirements associated with turning a test switch if it had not been considered in terms of the task. The following question might be asked immediately: How will the relationship between subtasks be shown on the data worksheets? To show that subtasks are related and are elements of the same task, separate data worksheets are used to record the subtask statement and subtask requirements with the same task statement written on each.

A second method has been provided in the task number itself to show that certain subtasks are elements of the same task. A two-digit cell has been placed on the data worksheets following the task number. Each subtask is enumerated and recorded sequentially. For example, task 9827 contains two subtasks; the subtasks are recorded as follows: 982701 and 982702.

Since space has been provided on the data worksheets to record written descriptions of subtasks, the reader may wonder why the subtask has also been included as a main category. The present category can be disregarded or used by the analyst to classify subtasks into some logical order. He may do this by simply listing the needed subcategories and identifying the code series for each. If no need exists to classify subtasks, the present category can be used to record the total number of tasks within a subtask. This information will give the analyst a picture of the size of a task when single subtasks are retrieved from the data bank.

<u>Category 11 - TASK SHARING</u> (page 61)

Task sharing refers to a task that requires the participation of two or more individuals. This does not mean that tasks cannot be partly or fully accomplished by one person under emergency conditions. In general, task sharing implies that a task involves a series of sequential subtasks. Accordingly, it is necessary to break down the task into its constituent elements to identify the areas of responsibility. If two or more subtasks are performed simultaneously by different positions this information should be recorded as such in category 21 (TIME-LINE INFORMATION), even though the subtasks are ordered sequentially on the data worksheets. Any particular task may involve several positions, but each position will usually be assigned to a single subtask. If more than one position is associated with a particular subtask, each should be recorded as an additional element within the task.

The positions listed in this category are identical to those in category 7 (POSITION). In cases where it is known that a task is shared, but the relevant subtasks cannot be isolated, the code series representing each position is recorded in this category. If, however, subtasks have been identified and recorded on the data worksheets, only the position responsible for the subtask is recorded. The position with which the task is shared is always recorded in category 7 (POSITION). In most cases, the subcategory recorded in category 7 will identify the position that has primary responsibility for the task.

Since the present category only indicates that a task is shared, it is important that a detailed description of what is shared be recorded on the worksheet. Space has been provided on the data worksheets for a written statement of the shared task.

Category 12 - SUBSYSTEM (page 63)

A subsystem is a major part of a system (usually consisting of several pieces of equipment or components) essential to the operational completeness of the system, e.g., airframe, navigation, communication. The information contained in this category is necessary to task analyses, because the description of human tasks must be given within the context of system hardware. Subsystems listed in this category are representative of those recommended for the systems listed in category 1. If more than one subsystem is involved in a single task or subtask, the code series for each must be recorded on the data worksheets.

Category 13 - TOOLS AND EQUIPMENT (page 69)

This category serves to identify tools and equipment that do not necessarily form an integral part of a particular subsystem. Four major subcategories are listed: Hand tools, Test equipment (nonautomatic), Special tools, and Special equipment for scientific tests. Category 12 covers automatic test equipment. Only a limited number of subcategories are listed, since tools and equipment are difficult, if not impossible, to identify during the conceptual phase of system development. As each system proceeds into design, the analyst can add new items to the list.

Category 14 - MACHINE OUTPUT (page 70)

Machine outputs are classified in terms of the information input to the human. In most instances, the machine output and the human input are identical. Typically, the various machine outputs dictate the behavior of the individual involved in a specific activity. Thus, the present category is concerned with the kinds of information that the person will obtain from the machine. A detailed identification of the type of information output of the machine will determine the specific kinds of human skills required to operate the system.

The machine outputs are classified as visual, auditory, tactile, etc. Each classification is subdivided into the type of machine output, e.g., scope, moving pointer indicator, and the characteristics of the output, e.g., size, shape, color.

In general, the characteristics of the machine output will not be identifiable during the conceptual phase of system development. Accordingly, use of this category during the analysis of conceptual information will usually be restricted to the identification of the type of output. For example, a particular task may require that the operator monitor the internal vehicle environment. The task statement indicates that some visual means is provided by the system to monitor the environmental status of the system. Further detail can be recorded if the particular type of indicator has been specified, e.g., moving scale or moving pointer. As the system proceeds into the design phase it will be possible to completely identify the characteristics of the machine output.

<u>Category 15 - HUMAN OUTPUT</u> (page 73)

Human output is defined in terms of the machine input requirements. While the title of this category includes the human component, the category is mainly oriented towards the machine. Human outputs are described in terms of the types of control and noncontrol activities required of the human by the machine.

In general, the information called for by this category will not be available during the conceptual phase of system development. In some cases, however, it will be possible to describe control mechanisms at a global level. For example, if a task calls for actuating a switch rather than operating a translation stick, a discrete adjustment is involved. Information at this level of detail can be recorded on the data worksheet even though the characteristics of the control mechanism are not identifiable.

<u>Category 16 - COMMUNICATION</u> (page 75)

Communication refers to the direct or indirect flow of information from one human to another. The method of communication can be oral, written, graphic, or through gestures. The characteristics of communication, e.g., rate, duration, can be identified where detailed task information is available.

The type of transmission refers to the flow of information to a human receiver (input) or from a human generator (output). At least two code series must be recorded for tasks that involve communications: the method of communication and the type of transmission (input or output). While no provisions have been made to differentiate between direct and indirect communications, this information is readily obtainable from category 12 (SUBSYSTEM). If no intermediary equipment, e.g., radio receiver, transmitter, interphone, is used in a task or subtask, the flow of information is direct, i.e., person - person, rather than person-subsystem-person.

<u>Category 17 - PSYCHOLOGICAL PROCESSES</u> (page 76)

In contrast to categories 14 and 15, this category is oriented to the particular human behavior involved in performing a task. The list of subcategories contains seven major psychological processes that can be used to describe operator procedures. While there is some experimental evidence that the processes listed in each subcategory are relatively independent, any categorization of human activity will of necessity include items that overlap or items with boundaries that are ill-defined. Thus, the list presented here is only suggestive and can be altered to suit the needs of the analyst.

The generation of a useful method for identifying human behaviors involved in a task presents major problems when all phases of system development must be considered. The limited amount of engineering and task information will limit the analysis. The problem is aggravated when the system presents a radical departure from current systems. Since the amount and degree of detail of available task data will usually depend on the stage of development of a system, a flexible method for classifying the psychological processes associated with tasks is needed. The present category attempts to offer a method by which behavioral, as well as performance data, can be classified at varying levels of detail.

Since only general task statements can be made during the conceptual phase of system development, the isolation of pertinent psychological processes will be limited to gross behaviors, such as motor, auditory, or visual. If the analyst needs to identify this information, he may do so by using the main subcategories listed in this category. As the system proceeds into early design stages, it will be possible to isolate the psychological variables associated with tasks, e.g., finger dexterity, visual acuity, or eye-hand coordination. Representative lists of these variables are contained within the major subcategories. The selection of appropriate variables will usually be preceded by an elaborate analysis of the subsystem. For example, a certain task requires the operator to use a remote manipulator to repair intricate equipment. Prior to isolating the various psychological processes, the characteristics of the remote manipulator, as well as the object to be manipulated, must be identified. To illustrate, let us say that the remote handling device accommodates all fingers of the operator's hand and the object to be manipulated is a small screw that must be driven into a threaded hole. Without further information, the psychological variables that apply to the task can be identified as finger dexterity, eye-hand coordination and space perception. The codes representing each of these variables is recorded on the data worksheets.

In addition to isolating the psychological processes involved in a task, the analyst may also want to indicate how demanding the task is with respect to each variable. Demand is here defined as, "the requirements that a particular aspect of the man-machine relationship place on the operator to limit, prescribe, or allow certain activities on his part" (ref. 12). The analyst may rate any particular variable as requiring a high, medium, or low demand on the operator and insert the code associated with the selected rating into the appropriate code series of that variable. Since the ratings will generally be based on intelligent guesses rather than empirical evidence, the demand scale was limited to three items to maximize interjudge reliability as much as possible.

Two items have been included in each major subcategory so that human performance data generated during the test and training program can be classified and coded. The first item, Performance requirements, identifies the criterion measurement for defining when the task has been accomplished correctly. Criteria, such as acceptable errors or time limitations, can be entered as subcategories. The second item, Performance measurement, presents performance data gathered from the test and training programs. Differences between the data recorded in these two items will show the degree to which actual performance differs from that required.

Category 18 - TASK CRITICALITY (page 80)

Criticality is defined in terms of the potential or actual effect that may result from improper personnel performance. The degree of criticality is reflected in the five items listed in this category. Each task is given a rating, or combination of ratings, indicating its degree of criticality.

The criteria for judging task criticality are as follows:

1. Critical to mission success. Failure to perform these tasks correctly will always render the system completely incapable of performing its mission.

2. Critical to personnel safety. If these tasks are not performed properly, personnel hazards may result that may or may not affect the course of a mission, e.g., failure to operate the environmental control subsystem correctly.

3. Critical but with alternative procedures. Failure to perform these tasks will affect the operation of the system, but alternative modes may be selected.

4. Critical to subsystem operation. Failure to perform these tasks will permit some operational capability but the equipment will be degraded.

5. Noncritical. Noncritical tasks are those that will not degrade the operational capability of the system when they are not accomplished correctly.

Category 19 - TIME CRITICALITY (page 81)

This category refers to the importance of completing a particular task within the prescribed time limit. Failure to perform the task within the required time limit may result in equipment malfunction or abortion of the mission.

Category 20 - FREQUENCY OF TASK PERFORMANCE (page 82)

Frequency of task performance refers to the number of times a particular task must be accomplished during a given period, e.g., a mission, mission phase, week, hour. The purpose of this category is to draw attention to the implications regarding possible in-space and or ground training on tasks that are infrequently performed, and to estimate task loading (see category 21). In regard to the first point, let us say that a certain critical task is scheduled only during the re-entry phase of a space system completing a two week mission. If the task is experienced only once during the entire mission, performance of that task might deteriorate. An analysis of the situation may reveal that in-flight training will be required to maintain crew proficiency.

When a particular task must be performed during periods covered by more than one subcategory, the combination of code series representing the periods must be recorded. If a task is scheduled to be accomplished at least once during a given phase and twice an hour, each is recorded. The subcategory Continual covers those tasks that are performed continually or at frequent unspecified intervals throughout the course of a mission. Most monitoring tasks fall in this category. For example, a crew member may be responsible for monitoring the environmental status indicators periodically to insure the safety of the individuals in the vehicle. This may not mean that specific periods are not involved in the task, i.e., the crew member may also be required to report the environmental status to the ground station during prescribed intervals. In this situation, the subcategory Continual as well as the frequency of performance must be recorded on the data worksheets.

The subcategory As required refers to tasks that are accomplished an undetermined number of times during a mission. Unscheduled space maintenance and emergency activities are examples of tasks that are performed as required.

The last two digits in each code series represents the actual frequency of performance. Thus, the items within each subcategory need not be expanded further. If a task is accomplished thirty times per shift, the number 30 is entered as the last two digits of the code series.

Category 21 - TIME-LINE INFORMATION (page 84)

This category provides information concerning the temporal relationships among tasks, as well as the task loading for any given combination of tasks. The subcategories are used only to indicate the time at which a task, or combination of tasks, is initiated. The time required to complete a task is recorded in category 22 (TIME TO PERFORM).

There is some similarity between the present category and the task sequence number. If accurate time based information is available, tasks need not be recorded sequentially, since the time-line will reveal the sequence of task performance. In general, time based information will not be available during the conceptual phase of system development and the analyst will find it necessary to rely solely on the task sequence number.

In the list of subcategories, "T-" refers to the time period prior to launch, and "T +" to the period following launch. The last two digits in each code series represent the actual time at which a task is initiated. If fractions of hours and minutes must be recorded, the appropriate code series combinations are used. For example, if a task is initiated at T + 2 hours, 30 minutes, and 20 seconds, code series are recorded in the following manner:

21-02-03-02
21-02-02-30
21-02-01-20

The subcategory Continual identifies tasks that are initiated continually throughout the course of a mission. Many types of monitoring activities will fall in this subcategory. The subcategory With relation to start of activity, indicates that a series of tasks, such as scientific tests, will be initiated in accordance with preceding events. The unique feature of this subcategory is that it may contain its own time-line. Finally, the subcategory As required, is used for tasks that are initiated at any time within the mission, such as maintenance and emergency activities.

Category 22 - TIME TO PERFORM (page 85)

Category 21, in combination with this category, accounts for the total time required to accomplish operational tasks within the time-line. Thus, it will be possible to estimate the total time that each crew member spends on the operation of a system, and the amount of time that each remains inactive. These two estimates in combination with the total number of tasks will generate task loading information.

While little, if any, task time data are available during the conceptual phase of system development, the analyst may find it helpful to estimate the maximum allowable time to perform a given task. Verification of the estimates must wait until the development of hardware.

The coding method used in this category is equivalent to the one applied in the previous two categories. Where fractions of hours and minutes must be coded to account for the time spent on a particular task, the appropriate code series combination is recorded. If a task was identified in category 21 as continual, the estimated amount of time needed to complete the task on one occasion is recorded. For example, the time required to obtain a single readout from an environmental status indicator is estimated and recorded.

Two subcategories are listed in this category to distinguish between estimated and actual time. One of these subcategories should always be coded in combination with the time entry.

Category 23 - TASK LOCATION (page 86)

The location in which a task is performed is shown in this category, e.g., pilot station or navigator station.

Several subcategories that may appear to be inappropriate to task analyses are included in the list, namely, Sleeping compartments, Kitchen, Secondary vehicle, and Ground station. Since the task analysis technique presented here must provide the flexibility and breadth necessary to provide a complete account of all activities performed by crew members, the location of each activity must be indicated and recorded. The subcategory Ground station was included in the list to identify the location of those tasks that are performed by ground station operators. A breakdown of this subcategory can be made if the analyst finds it necessary to identify specific ground operator task locations.

The location of all tasks that are shared must also be indicated. For example, if rendezvous procedures are shared with crew members in an orbiting vehicle, the subcategory Secondary vehicle is recorded in combination with the location of the task that is shared, e.g., the pilot station in the primary vehicle. When the subtasks of a shared task can be identified, and each subtask is performed by a single individual, the location of each is entered separately on the relevant data worksheets.

Category 24 - TASK AREA ENVIRONMENT (page 87)

Identification of environmental factors that may affect task performance is essential to task analyses. Environment as used here includes a wide range of factors not usually considered as environmental variables, e.g., seat restraints and space suits. These factors have been included in this category since they may contribute to overall task performance. The information contained in this category will assist the analyst in determining the total environmental situation that may create stress, degrade task performance, or both. Data concerning the diverse effects of the environmental conditions on performance are recorded in category 17 (PSYCHOLOGICAL PROCESSES).

The subcategory Generic stress is used here to describe general stress situations that cannot be defined in terms of any one, or combination of, variables. Generic stress may depend on factors that vary from situation to situation and from person to person. For example, it cannot be assumed that two individuals with the same amount and kind of training, will respond equally well to the same situation, or that the same individual will always respond in the same way to the same task. Since this subcategory deals with psychological and physiological variables that are ill-defined, caution must be exercised in rating the degree of generic stress that may inherently be present in a given task. In general, it would be advisable that this subcategory be set aside until subjects have been tested repeatedly on operational equipment.

Occasionally, it may be possible to insert quantitative data directly into the code series. If the analysis shows that acceleration forces reach 9 G, the digits, 09 can be placed at the end of the code series representing the variable. When quantitative data are nonexistent, the code series associated with the subcategory title is used.

Category 25 - TYPES OF TRAINING (page 89)

Training refers to the process by which personnel acquire or strengthen new concepts, knowledges, skills, habits, or attitudes that will enable them to perform their assigned duties with maximum reliability and efficiency. Within the context of present and future systems, training requirements can be categorized in several ways. One method would be to specify training in terms of formal school training and system operational training. A second method would be to specify training in terms of skills required. Finally, training could be categorized in terms of the level or degree of training required. The scheme chosen for classifying types of training encompasses all three methods.

Training is divided into two main types: formal school training and unit training. Each is subdivided into individual, crew, and full mission training. A list of representative skills acquired through training is presented under the subcategory Training content. The code associated with a particular skill is inserted into the code series representing the type, or combination of types, of training selected for a task. The degree of skill required is rated in accordance with the items listed under the subcategory Level of training. Three major levels have been identified: orientation, partial mastery, and complete mastery. The code representing the selected level of training is inserted into the code series associated with the appropriate type of training.

In many cases the type of training necessary for a particular task being analyzed will be covered under more than one of the types listed. For example, it might be recommended that personnel become familiar with certain procedural tasks during formal school training and that complete mastery will be reached during unit crew training. The code series combinations associated with both types of training should be recorded on the data worksheets.

Category 26 - TRAINING MEDIA (page 90)

Training media are items or combination of items used for instructional purposes to support the training of personnel. Seven classes of training media have been listed in this category. Representative items of training equipment are also identified.

Category 27 TRAINING EQUIPMENT CHARACTERISTICS (page 92)

This category identifies the functional characteristics of recommended training equipment. This information is usually obtained from an integration of task analysis data, training equipment constraints, and hardware requirements. The characteristics of training equipment, derived from the analysis of systems in the conceptual phase of development, should be identified even though the information may be tenuous and subject to change.

LIST OF CATEGORIES AND CODES

CATEGORY 1

SYSTEM

Systems	Code
R & D	
MTSS (Military Test Space Station)	01-01-01-01
MTSS (Manned Self-erecting Space Station)	01-01-01-02
Support	
SLOMAR (Space Logistics Maintenance and Rescue)	01-01-02-01
Space Plane	01-01-02-02
Recoverable Booster	01-01-02-03
Offensive	
ESWS (Earth Satellite Weapon System)	01-01-03-01
Reconnaissance	
GSS (Global Surveillance System)	01-01-04-01
(MRS)	01-01-04-02
Special	
Lunar Support	01-01-05-01
Lunex	01-01-05-02
Other	01-02

CATEGORY 2

SOURCE OF INFORMATION

	Code
Industry	
Bell Aerosystems	02-01-01
Boeing	02-01-02
Douglas	02-01-03
General Dynamics	02-01-04
General Electric	02-01-05
Goodyear	02-01-06
Hamilton Standard	02-01-07
Lockheed	02-01-08
McDonnell	02-01-09
Martin	02-01-10
North American	02-01-11
Northrop	02-01-12
Government agencies	
Air Force	02-02-01
Army	02-02-02
Navy	02-02-03
NASA	02-02-04
Universities	02-03
Other	02-04

CATEGORY 3

SYSTEM CONFIGURATION

	Code
Ballistic capsule.	03-01
Lifting body	03-02
Lifting body with elevons.	03-03
Winged	03-04
Ellipsoid	03-05
Cylindrical.	03-06
Lenticular	03-07
Cylindrical with attached ballistic re-entry capsule.	03-08
Truncated cone with attached lifting body.	03-09

CATEGORY 4

MISSION (PRIMARY VEHICLE)

	Code
Intelligence	
Reconnaissance (surveillance)	04-01-01
Warning	04-01-02
Military	
Earth bombardment	04-02-01
Space war	04-02-02
Lunar	
Orbit	04-03-01
Land and return	04-03-02
Orbit and return	04-03-03
Booster	
Recoverable	04-04-01
Nonrecoverable	04-04-02
Utility	
Navigation	04-05-01
Meteorology	04-05-02
Communications	04-05-03

Rescue

Transportation

Scientific research

Test

CATEGORY 5

MISSION (SECONDARY VEHICLE)

	Code
Manned	
Intelligence	
Reconnaissance (surveillance)	05-01-01-01
Warning	05-01-01-02
Military	
Earth bombardment	05-01-02-01
Space war	05-01-02-02
Lunar	
Orbit	05-01-03-01
Land and return	05-01-03-02
Orbit and return	05-01-03-03
Booster	
Recoverable	05-01-04-01
Nonrecoverable	05-01-04-02
Utility	
Navigation	05-01-05-01
Meteorology	05-01-05-02
Communications	05-01-05-03

Command and control. 05-01-06

Logistics

Orbit to orbit. 05-01-07-01
Ground to orbit 05-01-07-02
Scheduled 05-01-07-03
Unscheduled 05-01-07-04
Emergency 05-01-07-05

Salvage. 05-01-08

Orbital space vehicle assembly 05-01-09

Maintenance

Orbit to orbit. 05-01-10-01
Ground to orbit 05-01-10-02
Scheduled 05-01-10-03
Preventative (other than scheduled) 05-01-10-04
Unscheduled 05-01-10-05
Emergency 05-01-10-06

Medical support

Orbit to orbit. 05-01-11-01
Ground to orbit 05-01-11-02
Scheduled (preventative). 05-01-11-03
Unscheduled 05-01-11-04
Emergency 05-01-11-05

Rescue

Transportation

Scientific research

Test

Unmanned

Intelligence

Military

Earth bombardment. 05-02-02-01
Space war. 05-02-02-02

Lunar

Orbit. 05-02-03-01
Land and return. 05-02-03-02
Orbit and return 05-02-03-03

Booster

Recoverable. 05-02-04-01
Nonrecoverable 05-02-04-02

Utility

Navigation 05-02-05-01
Meteorology. 05-02-05-02
Communications 05-02-05-03

Command and control 05-02-06

Logistics

Orbit to orbit. 05-02-07-01
Ground to orbit 05-02-07-02
Scheduled 05-02-07-03
Unscheduled 05-02-07-04
Emergency 05-02-07-05

Maintenance

Scientific research

Test

CATEGORY 6

MISSION PHASE

	Code
Pre-launch	06-01
Abort from launching pad	06-01-01
Parachute recovery	06-01-02
Boost	06-02
1st stage separation	06-02-01
2nd stage separation	06-02-02
3rd stage separation	06-02-03
Coast	06-02-04
Abort prior to orbit	06-02-05
Escape tower eject	06-02-06
Injection	06-02-07
Pull-out and return	06-02-08
Earth orbit	06-03
Orbital guidance and navigation	06-03-01
Parking orbit	06-03-02
Departure from parking orbit	06-03-03
Target orbit injection	06-03-04
Rendezvous	06-03-05
Orbit to orbit	06-03-05-01
Ascent to orbit	06-03-05-02
Homing	06-03-05-03
Docking	06-03-05-04
Coupling	06-03-05-05
Contact	06-03-06
Post-rendezvous	06-03-07
Decoupling	06-03-07-01
Undocking	06-03-07-02
Boost to new orbit	06-03-07-03
Transfer orbit	06-03-08
New orbit	06-03-09
Defensive phase (evasive maneuver)	06-03-10
Over target phase	06-03-11
Intelligence	06-03-11-01
Bombardment	06-03-11-02
Scientific tests	06-03-12
De-boost	06-03-13
Jettison propulsion package	06-03-14

CATEGORY 7

POSITION

	Code
Passenger(s)	07-01
Pilot	07-02
Copilot	07-03
Copilot-maintenance officer	07-04
Navigator	07-05
Maintenance officer	07-06
Manipulator officer	07-07
Flight engineer	07-08
Medical officer	07-09
Reconnaissance officer	07-10
Optical	07-10-01
Electronic	07-10-02
Photo interpreter	07-11
Radar officer	07-12
Bombardier	07-13
Specialist (technician)	07-14-S*
Engineer	07-15-S*
Scientist	07-16-S*
*Specialty (S)	
Medical	01
Astronomer	02
Geologist	03

CATEGORY 8

CREW SIZE

	Code
Passenger(s)	08-01
Pilot	08-02
Copilot	08-03
Copilot-maintenance officer	08-04
Navigator	08-05
Maintenance officer	08-06
Manipulator officer	08-07
Flight engineer	08-08
Medical officer	08-09
Reconnaissance officer	08-10
Optical	08-10-01
Electronic	08-10-02
Photo interpreter	08-11
Radar officer	08-12
Bombardier	08-13
Specialist (technician)	08-14-S*
Engineer	08-15-S*
Scientist	08-16-S*
*Specialty (S)	
Medical	01
Astronomer	02
Geologist	03

CATEGORY 9

FUNCTIONS*

	Code
A	
accelerates	09-01-01
accomplishes	09-01-02
accounts	09-01-03
acts	09-01-04
activates	09-01-05
actuates	09-01-06
adapts	09-01-07
adjusts	09-01-08
advances	09-01-09
advises	09-01-10
aids	09-01-11
aims	09-01-12
alerts	09-01-13
aligns	09-01-14
allocates	09-01-15
alternates	09-01-16
amplifies	09-01-17
analyzes	09-01-18
answers	09-01-19
anticipates	09-01-20
applies	09-01-21
approves	09-01-22
approximates	09-01-23
arranges	09-01-24
ascertains	09-01-25
ascribes	09-01-26
assembles	09-01-27
assesses	09-01-28
assigns	09-01-29
assimilates	09-01-30
assists	09-01-31
assures	09-01-32
attaches	09-01-33
attains	09-01-34
arms	09-01-35
B	
bails out	09-02-01
balances	09-02-02
boresights	09-02-03
briefs	09-02-04

	Code
C	
calculates	09-03-01
calibrates	09-03-02
categorizes	09-03-03
centers	09-03-04
changes	09-03-05
channels	09-03-06
charges	09-03-07
charts	09-03-08
checks	09-03-09
chooses	09-03-10
classifies	09-03-11
cleans	09-03-12
clears	09-03-13
closes	09-03-14
codes	09-03-15
collects	09-03-16
communicates	09-03-17
compares	09-03-18
compiles	09-03-19
complies	09-03-20
completes	09-03-21
computes	09-03-22
condenses	09-03-23
conditions	09-03-24
conducts	09-03-25
confers	09-03-26
connects	09-03-27
consolidates	09-03-28
constructs	09-03-29
contacts	09-03-30
contributes	09-03-31
controls	09-03-32
converts	09-03-33
coordinates	09-03-34
counts	09-03-35
couples	09-03-36
copies	09-03-37
corrects	09-03-38
crawls	09-03-39

*This category was adapted from a classification appearing in ASD Technical Report 61-361 (ref. 9).

CATEGORY 10

SUBTASK

CATEGORY 11

TASK SHARING

	Code
Passenger(s)	11-01
Pilot	11-02
Copilot	11-03
Copilot-maintenance officer	11-04
Navigator	11-05
Maintenance officer	11-06
Manipulator officer	11-07
Flight engineer	11-08
Medical officer	11-09
Reconnaissance officer	11-10
Optical	11-10-01
Electronic	11-10-02
Photo interpreter	11-11
Radar officer	11-12
Bombardier	11-13
Specialist (technician)	11-14-S*
Engineer	11-15-S*
Scientist	11-16-S*
*Specialty (S)	
Medical	01
Astronomer	02
Geologist	03

CATEGORY 12

SUBSYSTEMS

	Code
Structure	
Crew compartments	12-01-01
Passenger compartment	12-01-02
Equipment compartments	12-01-03
Storage compartments	12-01-04
External skin structure	12-01-05
Heat shield	12-01-06
Internal frame structure	12-01-07
Floors	12-01-08
Wings, fins, etc	12-01-09
Tankage	12-01-10
Plumbing	12-01-11
Thrust structure	12-01-12
Heat shield	12-01-13
Hatches, doors, etc	12-01-14
Forward	12-01-14-01
Rear	12-01-14-02
Overhead	12-01-14-03
Manipulator	12-01-14-04
Airlock	12-01-15
Capsule (escape, shuttle, etc.)	12-01-16
Test station	12-01-17
Propulsion	
Propellant	12-02-01
Fuel feed system	12-02-02
Engines	
Jet powerplant	12-02-03-01
Rocket powerplant	12-02-03-02
Maneuver and retro	12-02-04
Attitude	
Pitch	12-02-05-01
Roll	12-02-05-02
Yaw	12-02-05-03
Abort	12-02-06
Primary booster	12-02-07
Secondary booster	12-02-08

Mechanical

Power

Communications

Navigation---guidance and control system

Computers

CATEGORY 13

TOOLS AND EQUIPMENT

	Code
Hand tools	13-01
Powered	13-01-01
Un-powered	13-01-02
Test equipment (nonautomatic)	13-02
Voltmeter	13-02-01
Ammeter	13-02-02
Oscilloscope	13-02-03
Signal generator	13-02-04
Detectors	13-02-05
Special tools	13-03
Special equipment for scientific tests	13-04

CATEGORY 14

MACHINE OUTPUT*

	Code
Visual	14-01
Type	14-01-01
Label	14-01-01-01
Indicator	14-01-01-02
Moving pointer	14-01-01-02-01
Moving scale	14-01-01-02-02
Counter	14-01-01-02-03
Light	14-01-01-02-04
Scope	14-01-01-02-05
Electro-optical display	14-01-01-02-06
Characteristics	14-01-02
Color	14-01-02-01
Brightness	14-01-02-02
Contrast	14-01-02-03
Temporal characteristics	14-01-02-04
Frequency	14-01-02-04-01
Duration	14-01-02-04-02
Rate of occurrence	14-01-02-04-03
Rate of change	14-01-02-04-04
Configuration	14-01-02-05
Shape	14-01-02-05-01
Size	14-01-02-05-02
Texture	14-01-02-05-03
Movement	14-01-02-06
Duration	14-01-02-06-01
Regular	14-01-02-06-02
Irregular	14-01-02-06-03
Rate	14-01-02-06-04
Acceleration	14-01-02-06-05
Resolution	14-01-02-07
Low	14-01-02-07-01
High	14-01-02-07-02
Signal/noise ratio	14-01-02-08
Audio	14-02
Type	14-02-01
Pure tones	14-02-01-01
Complex	14-02-01-02
Speech	14-02-01-03

*This category was adapted from a classification developed at the Stanford Research Institute (ref. 14).

CATEGORY 15

HUMAN OUTPUT*

	Code
Control	
Types	15-01-01
Discrete adjustment	15-01-01-01
Push button	15-01-01-01-01
Switch	15-01-01-01-02
Continuous adjustment	15-01-01-02
Lever	15-01-01-02-01
Pedal	15-01-01-02-02
Crank	15-01-01-02-03
Knob	15-01-01-02-04
Characteristics	15-01-02
Force	15-01-02-01
Direction	15-01-02-02
Displacement	15-01-02-03
Temporal characteristics	15-01-02-04
Frequency	15-01-02-04-01
Duration	15-01-02-04-02
Rate	15-01-02-04-03
Acceleration	15-01-02-04-04
Body member	15-01-03

* This category was adapted from a classification developed at Stanford Research Institute (ref. 14).

CATEGORY 16

COMMUNICATION*

	Code
Type of transmission	16-01
Input	16-01-01
Output	16-01-02
Method	16-02
Oral	16-02-01
Written	16-02-02
Graphical	16-02-03
Gestures	16-02-04
Characteristics	16-03
Corrections	16-03-01
Temporal	16-03-02
Rate	16-03-02-01
Duration	16-03-02-02
Information	16-03-03

* This category was adapted from a classification developed at Stanford Research Institute (ref. 14).

CATEGORY 17

PSYCHOLOGICAL PROCESSES

	Code
Auditory-vocal	17-01
Frequency discrimination	17-01-01-D-R-M
Intensity	17-01-02-D-R-M
Sound pattern	17-01-03-D-R-M
Direction	17-01-04-D-R-M
Demand (D)	
High	01
Medium	02
Low	03
Performance requirements (criterion measure) (R)	
Performance measurement (M)	
Number of trials to criterion	01
Time to reach criterion	02
Response latency	03
Errors (accuracy)	04
Motor	17-02
Wrist-finger speed	17-02-01-D-R-M
Finger dexterity	17-02-02-D-R-M
Manual dexterity	17-02-03-D-R-M
Rate of arm movement	17-02-04-D-R-M
Motor kinesthesis	17-02-05-D-R-M
Reaction time	17-02-06-D-R-M
Demand (D)	
High	01
Medium	02
Low	03
Performance requirements (criterion measure) (R)	
Performance measurement (M)	
Number of trials to criterion	01
Time to reach criterion	02
Response latency	03
Errors (accuracy)	04

Vision. 17-03

Brightness discrimination. 17-03-01-D-R-M
Color discrimination 17-03-02-D-R-M
Shape and form discrimination. 17-03-03-D-R-M
Size discrimination. 17-03-04-D-R-M
Acuity 17-03-05-D-R-M
Space perception 17-03-06-D-R-M
Movement perception. 17-03-07-D-R-M

Demand (D)
High. 01
Medium. 02
Low 03

Performance requirements (criterion measure) (R)

Performance measurement (M)

Number of trials to criterion 01
Time to reach criterion 02
Response latency. 03
Errors (accuracy) 04

Coordination. 17-04

Two-hand 17-04-01-D-R-M
Hand-foot. 17-04-02-D-R-M
Eye-hand 17-04-03-D-R-M

Demand (D)
High. 01
Medium 02
Low 03

Performance requirements (Criterion measure) (R)

Performance measurement (M)

Number of trials to criterion 01
Time to reach criterion 02
Response latency. 03
Errors (accuracy) 04

Tactual 17-05

Vibration discrimination 17-05-01-D-R-M
Form discrimination. 17-05-02-D-R-M

Texture discrimination. 17-05-03-D-R-M
Size discrimination 17-05-04-D-R-M
Temperature change discrimination 17-05-05-D-R-M
Movement. 17-05-06-D-R-M

Demand (D)
High 01
Medium 02
Low. 03

Performance requirements (criterion measure) (R)

Performance measurement (M)

Number of trials to criterion. 01
Time to reach criterion. 02
Response latency 03
Errors (accuracy). 04

Decision making. 17-06

Identification and selection of alternatives. 17-06-01-D-R-M
Selection from already well-defined alternatives. 17-06-02-D-R-M
Educated trial and error. 17-06-03-D-R-M
Determination of response adequacy from feedback data 17-06-04-D-R-M

Demand (D)
High 01
Medium 02
Low. 03

Performance requirements (criterion measure) (R)

Performance measurement (M)

Number of trials to criterion. 01
Time to reach criterion. 02
Response latency 03
Errors (accuracy). 04

Symbolic data operations 17-07

Recall of procedure 17-07-01-D-R-M
Obtaining information from diagrams, maps, charts, etc. . . . 17-07-02-D-R-M
Numerical operations. 17-07-03-D-R-M

Demand (D)
High 01
Medium 02
Low. 03

Performance requirements (criterion measure) (R)

Performance measurement (M)

Number of trials to criterion. 01
Time to reach criterion. 02
Response latency 03
Errors (accuracy). 04

CATEGORY 18

TASK CRITICALITY

	Code
Critical to mission success	18-01
Critical to personal safety	18-02
Critical but with alternative procedures	18-03
Critical to subsystem operation	18-04
Non-critical	18-05

CATEGORY 19

TIME CRITICALITY

	Code
Critical.	19-01
Non-critical.	19-02

CATEGORY 20

FREQUENCY OF TASK PERFORMANCE

	Code
Per mission	
1.	20-01-01
2.	20-01-02
3.	20-01-03
4.	20-01-04
etc.	20-01-05 thru 20-01-61
Per phase	
1.	20-02-01
2.	20-02-02
3.	20-02-03
4.	20-02-04
etc.	20-02-05 thru 20-02-61
Per shift	
1.	20-03-01
2.	20-03-02
3.	20-03-03
4.	20-03-04
etc.	20-03-05 thru 20-03-61
Per month	
1.	20-04-01
2.	20-04-02
3.	20-04-03
4.	20-04-04
etc.	20-04-05 thre 20-04-61
Per week	
1.	20-05-01
2.	20-05-02
3.	20-05-03
4.	20-05-04
etc.	20-05-05 thru 20-05-61
Per day	
1.	20-06-01
2.	20-06-02

CATEGORY 21

TIME-LINE INFORMATION

	Code
T-	
Hours	
1.	21-01-01-01
2.	21-01-01-02
3.	21-01-01-03
etc.	21-01-01-04 thru 21-01-01-24
Minutes	21-01-02-01 thru 21-01-02-60
Seconds	21-01-03-01 thru 21-01-03-60
Continual	21-01-04
As required	21-01-05
T+	
Seconds	21-02-01-01 thru 21-02-01-60
Minutes	21-02-02-01 thru 21-02-02-60
Hours	
1.	21-02-03-01
2.	21-02-03-02
3.	21-02-03-03
etc.	21-02-03-04 thru 21-02-03-24
Days	21-02-04
Continual	21-02-05
As required	21-02-06
With relation to start of activity (time-line independent of mission)	21-03

CATEGORY 22

TIME TO PERFORM

	Code
Hours.	22-01-01 thru 22-01-24
Minutes.	22-02-01 thru 22-02-60
Seconds.	22-03-01 thru 22-03-60
Estimated time	22-04
Actual time.	22-05

CATEGORY 23

TASK LOCATION

	Code
Within vehicle	
Crew compartment (general)	23-01-01
Pilot station	23-01-02
Copilot station	23-01-03
Navigator station	23-01-04
Flight engineer station	23-01-05
Optical sensor station	23-01-06
Electronic sensor station	23-01-07
Maintenance station	23-01-08
Medical station	23-01-09
Passenger compartment	23-01-10
Sleeping compartment	23-01-11
Cargo compartment	23-01-12
Kitchen	23-01-13
Airlock	23-01-14
Personnel and equipment transfer tunnel	23-01-15
Space operational chamber	23-01-16
Re-entry vehicle	23-01-17
Secondary vehicle	23-01-18
Extra-vehicular	23-02
Lunar station	23-03
Lunar surface	23-04
Ground station	23-05

CATEGORY 24

TASK AREA ENVIRONMENT

	Code
Physical	
G-force	24-01-01
Zero-G	24-01-00
Acceleration	24-01-01-01
Deceleration	24-01-01-02
Angle	24-01-01-03
Vibration (cps)	24-01-02
Temperature	24-01-03
Humidity	24-01-04
Noise (db)	24-01-05
Pressure (psi)	24-01-06
Illumination	24-01-07
Psychological	
Isolation and confinement	24-02-01
Sensory deprivation	24-02-02
Visual	24-02-02-01
Tactual	24-02-02-02
Auditory	24-02-02-03
Motion	24-02-02-04
Generic stress	24-02-03
High	24-02-03-01
Medium	24-02-03-02

CATEGORY 25

TYPES OF TRAINING

Code

Formal school training (training site)

Individual. 25-01-01-C-L

Crew training 25-01-02-C-L

Full mission training 25-01-03-C-L

Unit training (operational site)

Individual. 25-02-01-C-L

Crew training 25-02-02-C-L

Full mission training 25-02-03-C-L

Training content (C)

Learning isolated acts 01

Learning perceptual discriminations. 02

Practicing and making isolated decisions 03

Learning procedures (series of skilled acts, perceptual discriminations, decisions, and the use of principles) . . . 04

Learning principles and relationships. 05

Learning the meaning of words and symbols. 06

Level of training (L)

Orientation and/or familiarization 01

Partial mastery. 02

Complete mastery 03

CATEGORY 26

TRAINING MEDIA

CATEGORY 27

TRAINING EQUIPMENT CHARACTERISTICS

	Code
Information feedback	27-01
Instructor-provided feedback	27-01-01
Student-provided feedback	27-01-02
Automatic feedback	27-01-03
No feedback provided	27-01-04
Programming	27-02
Same sequence for all students	27-02-01
Sequence varies with correctness of response	27-02-02
Variation of sequence by instructor	27-02-03
No provision	27-02-04
Proficiency evaluation	27-03
Automatic recording	27-03-01
Direct observation	27-03-02
Paper and pencil tests	27-03-03
Oral quizzing	27-03-04
Environmental context	27-04
G-forces	27-04-01
Weightlessness	27-04-02
Vibration and noise	27-04-03
Temperature	27-04-04
Humidity	27-04-05
Pressure	27-04-06
Radiation	27-04-07
Orientation and disorientation	27-04-08

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APPENDIX
UPDATE AND RETRIEVAL PROGRAMS

UPDATE PROGRAM

Identification: Update Program 7090/94 Basic Monitor - Commercial Translator - ASD, WPAFB, Ohio.

Purpose: The Update Program assembles information into a variable record master file tape and/or maintains a master file tape which has already been established.

Usage: A. Structure of the files.

1. For establishing a master.

a. The update file (initial data cards) consists of multi-card records each of which represents a particular task-system configuration.

(1) The first card field layout of such a record is as follows:

1 - 6	7 - 18	19 - 30	31-42 43-54 55-66 67-78	79 - 80
Task Number	System Number	blank	Descriptive Categories (See Catalog)	Card Number

(2) Subsequent cards are as follows:

1 - 6	7 - 18	19 - 30 31-42 43-54 55-66 67-78	79 - 80
Task Number	System Number	12 Character Descriptive Categories (See Catalog)	Card Number

b. The input master file (a dummy file) consists of three card image files as follows:

(1) A standard IOCS header label.

(2) A vacuous data file; i.e., an end of file only.

(3) A standard IOCS trailer label.

c. The output master file is written as a three file tape as follows:

(1) A standard IOCS header label.

(2) A variable record data file each record of which represents a particular task-system configuration.

(a) The first entry of such a record is as follows:

1 - 6	7 - 18	19 - 30	31-42	43-54	55-66	67-78	79 - 80	85
Task Number	System Number	Record Length (words)	Descriptive Categories (See Catalog)				Card Number	Record Mark

(b) Intermediate entries are as follows:

1 - 6	7 - 18	19 - 30	31-42	43-54	55-66	67-78	79 - 80	85
Task Number	System Number	12 Character Descriptive Categories (See Catalog)					Card Number	Record Mark

(c) The final entry is as shown in "b" followed by an end of record gap.

2. For updating a master file

   a. The update file (update data cards) is as described above (1a).

   b. The input master file is identical in format to the output master (1c).

   c. The output master is written as described above (1c).

B. Processing Procedure.

1. For establishing a master.

   a. Punch initial data cards.

   b. Tape and sort master data card file in ascending order by task-system configuration and card number.

   c. The following tape files (see additional description in the data and environment sections of the program) must be available.

      (1) Input updating.

      (2) Input master.

      (3) Output error.

      (4) Output master.

   d. Compile and execute the program deck.

2. For updating a master file.

   a. Punch update data cards.

b. Tape and sort update data card file.

c. The following tape files must be available.

(1) Input updating.

(2) Input master.

(3) Output error.

(4) Output master.

d. Compile and execute program deck.

C. Restrictions.

1. A task-system configuration must not exceed "13" cards or entries.

2. Replacement changes must contain the total data for the record.

3. Deletion changes require only one card with just the task-system number and card number punched (the card must be numbered "1").

4. The change file must be sorted in ascending order by task-system number and card number.

5. The update program is written in the IBM Commercial Translator language and must be run under the 7090/94 Basic Monitor.

```
$CMPLE CENSPT  LIST.DICT.LOAD.FILES
      *PROCEDURE                                                     CENSPUPD
            OPEN ALL FILES.                                          CENSPUPD
      START.  MOVE CTR2 TO CTR1.                                     CENSPUPD
            SET W.T.S.NUM = ZERO.                                    CENSPUPD
            SET W.T.S.NUM1 = ZERO.                                   CENSPUPD
            SET W.CDCT = ZERO.                                       CENSPUPD
      GT.MSTR1.  GET MASTER, AT END GO TO EOF.MSTR1.                 CENSPUPD
            GET UPDATING,AT END GO TO EOF.UPDTNG1.                   CENSPUPD
            GO TO CNTRL.ST.B.                                        CENSPUPD
      EOF.MSTR1.  SET W.T.S.NUM3 = HIGH.VALUE.                       CENSPUPD
      GT.UPDTNG.  GET UPDATING, AT END GO TO EOF.UPDTNG2.            CENSPUPD
            GO TO CNTRL.ST.U.                                        CENSPUPD
      EOF.UPDTNG1.  SET W.T.S.NUM = HIGH.VALUE.                      CENSPUPD
            GO TO CNTRL.ST.M.                                        CENSPUPD
      EOF.UPDTNG2.  IF W.T.S.NUM3 = HIGH.VALUE THEN GO TO            CENSPUPD
            END.RUN OTHERWISE SET W.T.S.NUM=HIGH.VALUE.              CENSPUPD
            GO TO CNTRL.CHCK.                                        CENSPUPD
      GT.MSTR2.  GET MASTER, AT END GO TO EOF.MSTR2.                 CENSPUPD
            GO TO CNTRL.ST.M.                                        CENSPUPD
      EOF.MSTR2.  IF W.T.S.NUM=HIGH.VALUE THEN GO TO END.RUN OTHERWISE CENSPUPD
            SET W.T.S.NUM3 = HIGH.VALUE.                             CENSPUPD
            GO TO CNTRL.CHCK.                                        CENSPUPD
      END.RUN.  CLOSE ALL FILES.                                     CENSPUPD
            STOP RUN.                                                CENSPUPD
      CNTRL.ST.M.  SET W.T.S.NUM3 = MASTER CARD1 T.S.NUM.            CENSPUPD
            GO TO CNTRL.CHCK.                                        CENSPUPD
      CNTRL.ST.U.  IF (UPDATING CD.NUM = 13) OR (UPDATING CD.NUM LT 13) CENSPUPD
            THEN GO TO ST.NUM.                                       CENSPUPD
            SET UPDATING CD.NUM=99.                                  CENSPUPD
            SET W.CDCT = ZERO.                                       CENSPUPD
            GO TO ERR.ANLYS.                                         CENSPUPD
      ST.NUM.  SET K=UPDATING CD.NUM.                                CENSPUPD
            SET W.T.S.NUM=UPDATING T.S.NUM.                          CENSPUPD
            GO TO CNTRL.CHCK.                                        CENSPUPD
      CNTRL.ST.B.  SET W.T.S.NUM3 = MASTER CARD1 T.S.NUM.            CENSPUPD
            IF UPDATING CD.NUM =13 OR UPDATING CD.NUM LT 13 THEN     CENSPUPD
            GO TO ST.NUM1.                                           CENSPUPD
            SET UPDATING CD.NUM=99.                                  CENSPUPD
            SET W.CDCT = ZERO.                                       CENSPUPD
            GO TO ERR.ANLYS.                                         CENSPUPD
      ST.NUM1.  SET K=UPDATING CD.NUM.                               CENSPUPD
            SET W.T.S.NUM=UPDATING T.S.NUM.                          CENSPUPD
      CNTRL.CHCK.  GO TO LSS.THN WHEN W.T.S.NUM3 LT W.T.S.NUM,       CENSPUPD
            EQL.TO WHEN W.T.S.NUM3 = W.T.S.NUM,GRTR.THN WHEN         CENSPUPD
            W.T.S.NUM3 GT W.T.S.NUM.                                 CENSPUPD
```

```
LSS.THN.  GO TO DLYD.WRT WHEN W.T.S.NUM1 NOT=-000          0000000-.CENSPUPD
      GO TO LSS.THN1 WHEN W.CDCT = ZERO.                            CENSPUPD
      SET W.UPDATING RED.LNGTH = W.CDCT*14.                         CENSPUPD
      FILE W.UPDATING IN OUTPUT.MASTER.                             CENSPUPD
      MOVE CTR2 TO CTR1.                                            CENSPUPD
      SET W.T.S.NUM1 = ZERO.                                        CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      GO TO GT.MSTR2.                                               CENSPUPD
LSS.THN1.  SET J = MASTER CARD1 REC.LNGTH/14.                       CENSPUPD
      DO IMWU FOR I = 1(1)J.                                        CENSPUPD
      SET W.UPDATING RED.LNGTH = MASTER REC.LNGTH.                  CENSPUPD
      FILE W.UPDATING IN OUTPUT.MASTER.                             CENSPUPD
      MOVE CTR2 TO CTR1.                                            CENSPUPD
      SET W.T.S.NUM1 = ZERO.                                        CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      GO TO GT.MSTR2.                                               CENSPUPD
EQL.TO.  GO TO DLYD.WRT WHEN W.T.S.NUM1 NOT =-000          0000000-.CENSPUPD
      GO TO START WHEN K = ZERO.                                    CENSPUPD
      DO IUWU.                                                      CENSPUPD
      GO TO ERR.ANLYS WHEN W.CDCT = 0.                              CENSPUPD
      IF W.CDCT LT 13 OR W.CDCT = 13 THEN GO TO GT.UPDTNG.          CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      SET UPDATING CD.NUM = 98.                                     CENSPUPD
      GO TO ERR.ANLYS.                                              CENSPUPD
GRTR.THN.  GO TO GRTR.THN1 WHEN W.T.S.NUM1 NOT                      CENSPUPD
      =-00000000000000     -.                                       CENSPUPD
      SET W.T.S.NUM1= W.T.S.NUM.                                    CENSPUPD
      GO TO GRTR.THN2.                                              CENSPUPD
GRTR.THN1.  GO TO DLYD.WRT WHEN W.T.S.NUM1 NOT = W.T.S.NUM.         CENSPUPD
GRTR.THN2.  DO IUWU.                                                CENSPUPD
      GO TO ERR.ANLYS WHEN W.CDCT = 0.                              CENSPUPD
      IF W.CDCT LT 13 OR W.CDCT = 13 THEN GO TO GT.UPDTNG.          CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      SET UPDATING CD.NUM = 98.                                     CENSPUPD
      GO TO ERR.ANLYS.                                              CENSPUPD
DLYD.WRT.  GO TO DLYD.WRT1 WHEN W.CDCT NOT = ZERO.                  CENSPUPD
      MOVE CTR2 TO CTR1.                                            CENSPUPD
      SET W.T.S.NUM1 = ZERO.                                        CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      GO TO CNTRL.CHCK.                                             CENSPUPD
DLYD.WRT1.  SET W.UPDATING RED.LNGTH = W.CDCT*14.                   CENSPUPD
      FILE W.UPDATING IN OUTPUT.MASTER.                             CENSPUPD
      MOVE CTR2 TO CTR1.                                            CENSPUPD
      SET W.T.S.NUM1 = ZERO.                                        CENSPUPD
      SET W.CDCT = ZERO.                                            CENSPUPD
      GO TO CNTRL.CHCK.                                             CENSPUPD
```

```
ERR.ANLYS.  MOVE UPDATING TO ERRER.                                   CENSPUPD
        FILE ERRER IN OUTPUT.ERROR.                                   CENSPUPD
        GO TO GT.UPDTNG.                                              CENSPUPD
IMWU.   BEGIN SECTION                                                 CENSPUPD
        GO TO (C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13) ON I.      CENSPUPD
C1.     MOVE MASTER CARD1 TO W.UPDATING CARD1.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C2.     MOVE MASTER CARD2 TO W.UPDATING CARD2.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C3.     MOVE MASTER CARD3 TO W.UPDATING CARD3.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C4.     MOVE MASTER CARD4 TO W.UPDATING CARD4.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C5.     MOVE MASTER CARD5 TO W.UPDATING CARD5.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C6.     MOVE MASTER CARD6 TO W.UPDATING CARD6.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C7.     MOVE MASTER CARD7 TO W.UPDATING CARD7.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C8.     MOVE MASTER CARD8 TO W.UPDATING CARD8.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C9.     MOVE MASTER CARD9 TO W.UPDATING CARD9.                        CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C10.    MOVE MASTER CARD10 TO W.UPDATING CARD10.                      CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C11.    MOVE MASTER CARD11 TO W.UPDATING CARD11.                      CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C12.    MOVE MASTER CARD12 TO W.UPDATING CARD12.                      CENSPUPD
        GO TO IMWU.END.                                               CENSPUPD
C13.    MOVE MASTER CARD13 TO W.UPDATING CARD13.                      CENSPUPD
IMWU.END.  END IMWU.                                                  CENSPUPD
IUWU.   BEGIN SECTION.                                                CENSPUPD
        GO TO (K1,K3,K5,K7,K9,K11,K13,K15,K17,K19,K21,K23,K25) ON K.CENSPUPD
K1.     GO TO K2 WHEN CTR1 W.CD1 = 0.                                 CENSPUPD
        SET UPDATING CD.NUM = 97.                                     CENSPUPD
        SET W.CDCT = ZERO.                                            CENSPUPD
        GO TO K27.                                                    CENSPUPD
K2.     SET CTR1 W.CD1 = 1.                                           CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD1.                         CENSPUPD
        SET W.CDCT = W.CDCT + 1.                                      CENSPUPD
        GO TO IUWU.END.                                               CENSPUPD
K3.     GO TO K4 WHEN CTR1 W.CD2 = 0.                                 CENSPUPD
        SET UPDATING CD.NUM = 96.                                     CENSPUPD
        SET W.CDCT = 0.                                               CENSPUPD
        GO TO K27.                                                    CENSPUPD
K4.     SET CTR1 W.CD2 = 1.                                           CENSPUPD
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            MOVE UPDATING CD TO W.UPDATING CARD2.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K5.    GO TO K6 WHEN CTR1 W.CD3 = 0.                            CENSPUPD
            SET UPDATING CD.NUM = 95.                                CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
            GO TO K27.                                               CENSPUPD
     K6.    SET CTR1 W.CD3 = 1.                                      CENSPUPD
            MOVE UPDATING CD TO W.UPDATING CARD3.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K7.    GO TO K8 WHEN CTR1 W.CD4 = 0.                            CENSPUPD
            SET UPDATING CD.NUM = 94.                                CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
            GO TO K27.                                               CENSPUPD
     K8.    SET CTR1 W.CD4 = 1.                                      CENSPUPD
            MOVE UPDATING CD TO W.UPDATING CARD4.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K9.    GO TO K10 WHEN CTR1 W.CD5 = 0.                           CENSPUPD
            SET UPDATING CD.NUM = 93.                                CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
            GO TO K27.                                               CENSPUPD
     K10.   SET CTR1 W.CD5 = 1.                                      CENSPUPD
            MOVE UPDATING CD TO W.UPDATING CARD5.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K11.   GO TO K12 WHEN CTR1 W.CD6 = 0.                           CENSPUPD
            SET UPDATING CD.NUM = 92.                                CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
            GO TO K27.                                               CENSPUPD
     K12.   SET CTR1 W.CD6 = 1.                                      CENSPUPD
            MOVE UPDATING CD TO W.UPDATING CARD6.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K13.   GO TO K14 WHEN CTR1 W.CD7 = 0.                           CENSPUPD
            SET UPDATING CD.NUM = 91.                                CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
            GO TO K27.                                               CENSPUPD
     K14.   SET CTR1 W.CD7 = 1.                                      CENSPUPD
            MOVE UPDATING CD TO W.UPDATING CARD7.                    CENSPUPD
            SET W.CDCT = W.CDCT + 1.                                 CENSPUPD
            GO TO IUWU.END.                                          CENSPUPD
     K15.   GO TO K16 WHEN CTR1 W.CD8 = 0.                           CENSPUPD
            SET UPDATING CD.NUM =90.                                 CENSPUPD
            SET W.CDCT = 0.                                          CENSPUPD
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        GO TO K27.                                      CENSPUPD
K16.    SET CTR1 W.CD8 = 1.                             CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD8.           CENSPUPD
        SET W.CDCT =W.CDCT + 1.                         CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K17.    GO TO K18 WHEN CTR1 W.CD9 = 0.                  CENSPUPD
        SET UPDATING CD.NUM =89.                        CENSPUPD
        SET W.CDCT = 0.                                 CENSPUPD
        GO TO K27.                                      CENSPUPD
K18.    SET CTR1 W.CD9 = 1.                             CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD9.           CENSPUPD
        SET W.CDCT =W.CDCT + 1.                         CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K19.    GO TO K20 WHEN CTR1 W.CD10 = 0.                 CENSPUPD
        SET UPDATING CD.NUM =88.                        CENSPUPD
        SET W.CDCT = 0.                                 CENSPUPD
        GO TO K27.                                      CENSPUPD
K20.    SET CTR1 W.CD10 = 1.                            CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD10.          CENSPUPD
        SET W.CDCT = W.CDCT + 1.                        CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K21.    GO TO K22 WHEN CTR1 W.CD11 = 0.                 CENSPUPD
        SET UPDATING CD.NUM = 87.                       CENSPUPD
        SET W.CDCT = 0.                                 CENSPUPD
        GO TO K27.                                      CENSPUPD
K22.    SET CTR1 W.CD11 = 1.                            CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD11.          CENSPURD
        SET W.CDCT = W.CDCT + 1.                        CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K23.    GO TO K24 WHEN CTR1 W.CD12 = 0.                 CENSPUPD
        SET UPDATING CD.NUM = 86.                       CENSPUPD
        SET W.CDCT = 0.                                 CENSPUPD
        GO TO K27.                                      CENSPUPD
K24.    SET CTR1 W.CD12 = 1.                            CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD12.          CENSPUPD
        SET W.CDCT = W.CDCT + 1.                        CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K25.    GO TO K26 WHEN CTR1 W.CD13 = 0.                 CENSPUPD
        SET UPDATING CD.NUM = 85.                       CENSPUPD
        SET W.CDCT = 0.                                 CENSPUPD
        GO TO K27.                                      CENSPUPD
K26.    SET CTR1 W.CD13 = 1.                            CENSPUPD
        MOVE UPDATING CD TO W.UPDATING CARD13.          CENSPUPD
        SET W.CDCT = W.CDCT + 1.                        CENSPUPD
        GO TO IUWU.END.                                 CENSPUPD
K27     MOVE CTR3 TO CTR1.                              CENSPUPD
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IUWU.END.  END IUWU.                                          CENSPUPD
*DATA                                                         CENSPUPD
UPDATING          01RECORD      EL                            CENSPUPD
CD                02                                          CENSPUPD
T.S.NUM           03                                          CENSPUPD
TSK               04              9(6)                        CENSPUPD
SYS               04              9(12)                       CENSPUPD
CTGR1             03              9(12)                       CENSPUPD
CTGR2             03              9(12)                       CENSPUPD
CTGR3             03              9(12)                       CENSPUPD
CTGR4             03              9(12)                       CENSPUPD
CTGR5             03              9(12)                       CENSPUPD
CD.NUM            03              9(2)                        CENSPUPD
BLNKS             03              X(4)                        CENSPUPD
W.UPDATING        01RECORD      EL                            CENSPUPD
CARD1             02                                          CENSPUPD
T.S.NUM           03                                          CENSPUPD
TSK               04              9(6)                        CENSPUPD
SYS               04              9(12)                       CENSPUPD
RED.LNGTH         03            ER8(12)                       CENSPUPD
CTGR1             03            EL9(12)                       CENSPUPD
CTGR2             03              9(12)                       CENSPUPD
CTGR3             03              9(12)                       CENSPUPD
CTGR4             03              9(12)                       CENSPUPD
CD.NUM            03              9(2)                        CENSPUPD
BLNKS             03              X(3)                        CENSPUPD
                  02RCDMRK                                    CENSPUPD
CARD2             02            EL                            CENSPUPD
T.S.NUM           03                                          CENSPUPD
TSK               04              9(6)                        CENSPUPD
SYS               04              9(12)                       CENSPUPD
CTGR1             03              9(12)                       CENSPUPD
CTGR2             03              9(12)                       CENSPUPD
CTGR3             03              9(12)                       CENSPUPD
CTGR4             03              9(12)                       CENSPUPD
CTGR5             03              9(12)                       CENSPUPD
CD.NUM            03              9(2)                        CENSPUPD
BLNKS             03              X(3)                        CENSPUPD
                  02RCDMRK                                    CENSPUPD
CARD3             02            EL                            CENSPUPD
T.S.NUM           03                                          CENSPUPD
TSK               04              9(6)                        CENSPUPD
SYS               04              9(12)                       CENSPUPD
CTGR1             03              9(12)                       CENSPUPD
CTGR2             03              9(12)                       CENSPUPD
CTGR3             03              9(12)                       CENSPUPD
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CTGR4          03             9(12)                    CENSPUPD
CTGR5          03             9(12)                    CENSPUPD
CD.NUM         03             9(2)                     CENSPUPD
BLNKS          03             X(3)                     CENSPUPD
               02RCDMRK                                CENSPUPD
CARD4          02           EL                         CENSPUPD
I.S.NUM        03                                      CENSPUPD
TSK            04             9(6)                     CENSPUPD
SYS            04             9(12)                    CENSPUPD
CTGR1          03             9(12)                    CENSPUPD
CTGR2          03             9(12)                    CENSPUPD
CTGR3          03             9(12)                    CENSPUPD
CTGR4          03             9(12)                    CENSPUPD
CTGR5          03             9(12)                    CENSPUPD
CD.NUM         03             9(2)                     CENSPUPD
BLNKS          03             X(3)                     CENSPUPD
               02RCDMRK                                CENSPUPD
CARD5          02           EL                         CENSPUPD
I.S.NUM        03                                      CENSPUPD
TSK            04             9(6)                     CENSPUPD
SYS            04             9(12)                    CENSPUPD
CTGR1          03             9(12)                    CENSPUPD
CTGR2          03             9(12)                    CENSPUPD
CTGR3          03             9(12)                    CENSPUPD
CTGR4          03             9(12)                    CENSPUPD
CTGR5          03             9(12)                    CENSPUPD
CD.NUM         03             9(2)                     CENSPUPD
BLNKS          03             X(3)                     CENSPUPD
               02RCDMRK                                CENSPUPD
CARD6          02           EL                         CENSPUPD
I.S.NUM        03                                      CENSPUPD
TSK            04             9(6)                     CENSPUPD
SYS            04             9(12)                    CENSPUPD
CTGR1          03             9(12)                    CENSPUPD
CTGR2          03             9(12)                    CENSPUPD
CTGR3          03             9(12)                    CENSPUPD
CTGR4          03             9(12)                    CENSPUPD
CTGR5          03             9(12)                    CENSPUPD
CD.NUM         03             9(2)                     CENSPUPD
BLNKS          03             X(3)                     CENSPUPD
               02RCDMRK                                CENSPUPD
CARD7          02           EL                         CENSPUPD
I.S.NUM        03                                      CENSPUPD
TSK            04             9(6)                     CENSPUPD
SYS            04             9(12)                    CENSPUPD
CTGR1          03             9(12)                    CENSPUPD
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        CTGR2          03             9(12)                                   CENSPUPD
        CTGR3          03             9(12)                                   CENSPUPD
        CTGR4          03             9(12)                                   CENSPUPD
        CTGR5          03             9(12)                                   CENSPUPD
        CD.NUM         03             9(2)                                    CENSPUPD
        BLNKS          03             X(3)                                    CENSPUPD
                       02RCDMRK                                               CENSPUPD
        CARD8          02          EL                                         CENSPUPD
        T.S.NUM        03                                                     CENSPUPD
        TSK            04             9(6)                                    CENSPUPD
        SYS            04             9(12)                                   CENSPUPD
        CTGR1          03             9(12)                                   CENSPUPD
        CTGR2          03             9(12)                                   CENSPUPD
        CTGR3          03             9(12)                                   CENSPUPD
        CTGR4          03             9(12)                                   CENSPUPD
        CTGR5          03             9(12)                                   CENSPUPD
        CD.NUM         03             9(2)                                    CENSPUPD
        BLNKS          03             X(3)                                    CENSPUPD
                       02RCDMRK                                               CENSPUPD
        CARD9          02          EL                                         CENSPUPD
        T.S.NUM        03                                                     CENSPUPD
        TSK            04             9(6)                                    CENSPUPD
        SYS            04             9(12)                                   CENSPUPD
        CTGR1          03             9(12)                                   CENSPUPD
        CTGR2          03             9(12)                                   CENSPUPD
        CTGR3          03             9(12)                                   CENSPUPD
        CTGR4          03             9(12)                                   CENSPUPD
        CTGR5          03             9(12)                                   CENSPUPD
        CD.NUM         03             9(2)                                    CENSPUPD
        BLNKS          03             X(3)                                    CENSPUPD
                       02RCDMRK                                               CENSPUPD
        CARD10         02          EL                                         CENSPUPD
        T.S.NUM        03                                                     CENSPUPD
        TSK            04             9(6)                                    CENSPUPD
        SYS            04             9(12)                                   CENSPUPD
        CTGR1          03             9(12)                                   CENSPUPD
        CTGR2          03             9(12)                                   CENSPUPD
        CTGR3          03             9(12)                                   CENSPUPD
        CTGR4          03             9(12)                                   CENSPUPD
        CTGR5          03             9(12)                                   CENSPUPD
        CD.NUM         03             9(2)                                    CENSPUPD
        BLNKS          03             X(3)                                    CENSPUPD
                       02RCDMRK                                               CENSPUPD
        CARD11         02          EL                                         CENSPUPD
        T.S.NUM        03                                                     CENSPUPD
        TSK            04             9(6)                                    CENSPUPD
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SYS          04           9(12)          CENSPUPD
CTGR1        03           9(12)          CENSPUPD
CTGR2        03           9(12)          CENSPUPD
CTGR3        03           9(12)          CENSPUPD
CTGR4        03           9(12)          CENSPUPD
CTGR5        03           9(12)          CENSPUPD
CD.NUM       03           9(2)           CENSPUPD
BLNKS        03           X(3)           CENSPUPD
             02RCDMRK                    CENSPUPD
CARD12       02        EL                CENSPUPD
T.S.NUM      03                          CENSPUPD
TSK          04           9(6)           CENSPUPD
SYS          04           9(12)          CENSPUPD
CTGR1        03           9(12)          CENSPUPD
CTGR2        03           9(12)          CENSPUPD
CTGR3        03           9(12)          CENSPUPD
CTGR4        03           9(12)          CENSPUPD
CTGR5        03           9(12)          CENSPUPD
CD.NUM       03           9(2)           CENSPUPD
BLNKS        03           X(3)           CENSPUPD
             02RCDMRK                    CENSPUPD
CARD13       02        EL                CENSPUPD
T.S.NUM      03                          CENSPUPD
TSK          04           9(6)           CENSPUPD
SYS          04           9(12)          CENSPUPD
CTGR1        03           9(12)          CENSPUPD
CTGR2        03           9(12)          CENSPUPD
CTGR3        03           9(12)          CENSPUPD
CTGR4        03           9(12)          CENSPUPD
CTGR5        03           9(12)          CENSPUPD
CD.NUM       03           9(2)           CENSPUPD
BLNKS        03           X(3)           CENSPUPD
             02RCDMRK                    CENSPUPD
MASTER       01RECORD  EL                CENSPUPD
CARD1        02                          CENSPUPD
T.S.NUM      03                          CENSPUPD
TSK          04           9(6)           CENSPUPD
SYS          04           9(12)          CENSPUPD
REC.LNGTH    03        ER9(12)           CENSPUPD
CTGR1        03        EL9(12)           CENSPUPD
CTGR2        03           9(12)          CENSPUPD
CTGR3        03           9(12)          CENSPUPD
CTGR4        03           9(12)          CENSPUPD
CD.NUM       03           9(2)           CENSPUPD
BLNKS        03           X(4)           CENSPUPD
CARD2        02        EL                CENSPUPD
```

T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD3	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD4	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD5	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD6	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD

SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD7	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD8	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD9	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD10	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD

CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD11	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD12	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
CARD13	02	EL	CENSPUPD
T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD
SYS	04	9(12)	CENSPUPD
CTGR1	03	9(12)	CENSPUPD
CTGR2	03	9(12)	CENSPUPD
CTGR3	03	9(12)	CENSPUPD
CTGR4	03	9(12)	CENSPUPD
CTGR5	03	9(12)	CENSPUPD
CD.NUM	03	9(2)	CENSPUPD
BLNKS	03	X(4)	CENSPUPD
ERRER	01RECORD	EL	CENSPUPD
CD	02	X(78)	CENSPUPD
CD.NUM	02	X(2)	CENSPUPD
BLNKS	02	X(4)	CENSPUPD
W.STORAGE	01	EL	CENSPUPD
W.T.S.NUM	03		CENSPUPD
TSK	04	9(6)	CENSPUPD

```
SYS            04     9(12)                 CENSPUPD
W.T.S.NUM1     03                           CENSPUPD
TSK            04     9(6)                  CENSPUPD
SYS            04     9(12)                 CENSPUPD
W.T.S.NUM3     03                           CENSPUPD
TSK            04     9(6)                  CENSPUPD
SYS            04     9(12)                 CENSPUPD
K              03    IR99                   CENSPUPD
J              03    IR99                   CENSPUPD
I              03    IR99                   CENSPUPD
W.CDCT         03    IR99                   CENSPUPD
CTR1           03    IL                     CENSPUPD
W.CD1          04    IR9                    CENSPUPD
W.CD2          04    IR9                    CENSPUPD
W.CD3          04    IR9                    CENSPUPD
W.CD4          04    IR9                    CENSPUPD
W.CD5          04    IR9                    CENSPUPD
W.CD6          04    IR9                    CENSPUPD
W.CD7          04    IR9                    CENSPUPD
W.CD8          04    IR9                    CENSPUPD
W.CD9          04    IR9                    CENSPUPD
W.CD10         04    IR9                    CENSPUPD
W.CD11         04    IR9                    CENSPUPD
W.CD12         04    IR9                    CENSPUPD
W.CD13         04    IR9                    CENSPUPD
CTR2           03    IL                     CENSPUPD
W.CD1          04    IR-0-                  CENSPUPD
W.CD2          04    IR-0-                  CENSPUPD
W.CD3          04    IR-0-                  CENSPUPD
W.CD4          04    IR-0-                  CENSPUPD
W.CD5          04    IR-0-                  CENSPUPD
W.CD6          04    IR-0-                  CENSPUPD
W.CD7          04    IR-0-                  CENSPUPD
W.CD8          04    IR-0-                  CENSPUPD
W.CD9          04    IR-0-                  CENSPUPD
W.CD10         04    IR-0-                  CENSPUPD
W.CD11         04    IR-0-                  CENSPUPD
W.CD12         04    IR-0-                  CENSPUPD
W.CD13         04    IR-0-                  CENSPUPD
CTR3           03    IL                     CENSPUPD
W.CD1          04    IR-1-                  CENSPUPD
W.CD2          04    IR-1-                  CENSPUPD
W.CD3          04    IR-1-                  CENSPUPD
W.CD4          04    IR-1-                  CENSPUPD
W.CD5          04    IR-1-                  CENSPUPD
W.CD6          04    IR-1-                  CENSPUPD
```

```
W.CD7            04          IR-1-                                           CENSPUPD
W.CD8            04          IR-1-                                           CENSPUPD
W.CD9            04          IR-1-                                           CENSPUPD
W.CD10           04          IR-1-                                           CENSPUPD
W.CD11           04          IR-1-                                           CENSPUPD
W.CD12           04          IR-1-                                           CENSPUPD
W.CD13           04          IR-1-                                           CENSPUPD
*ENVIRONMENT                                                                 CENSPUPD
INPUT.MASTER        FILE  INPUT,BCD,TAPE,BLOCKSIZE 182,BEGIN,               XCENSPUPD
                          MASTER,BLOCK CONTROL,PLACE LENGTH IN              XCENSPUPD
                          REC.LNGTH                                          CENSPUPD
                    SPECIFINPUT.MASTER,UNIT1-A(1)-,LOW,LABELS,              XCENSPUPD
                          SERIAL -00012-,REEL -0001-,LOW                     CENSPUPD
INPUT.UPDATING      FILE  INPUT,BCD,TAPE,BLOCKSIZE 14,UPDATING               CENSPUPD
                    SPECIFINPUT.UPDATING,UNIT1-B(1)-                         CENSPUPD
OUTPUT.ERROR        FILE  OUTPUT,BCD,TAPE,BLOCKSIZE 14,ERRER                 CENSPUPD
                    SPECIFOUTPUT.ERROR,UNIT1-A(2)-                           CENSPUPD
OUTPUT.MASTER       FILE  OUTPUT,BCD,TAPE,BLOCKSIZE 182,BEGIN,              XCENSPUPD
                          W.UPDATING,FIND LENGTH IN RED.LNGTH,NO            XCENSPUPD
                          CONTROL WORD                                       CENSPUPD
                    SPECIFOUTPUT.MASTER,UNIT1-B(2)-,LOW,LABELS,             XCENSPUPD
                          SERIAL -00019-,REEL -0001-,LOW                     CENSPUPD
*FINISH
```

DATA RETRIEVAL PROGRAM

Identification: Data Retrieval Program 7090/94 Basic Monitor - Commercial Translator - ASD, WPAFB, Ohio

Purpose: The Data Retrieval Program retrieves pertinent requested information from prepared master file magnetic tape reels through a rapid buffering system.

Usage: (INPUT)

Two files are designated for the master file tapes. These are noted as MASTER·TASK·FILE1* and MASTER·TASK·FILE2*. When master file reels remain for processing they are requested via the on-line printer. It is necessary to supply the Data Retrieval program with the number of reels to be searched. This is done in line PRESET of the Data Retrieval program (card DTRET001).

(OUTPUT)

One file for output of retrieval data is allotted for the user. This is noted as OUT1*. Automatic reel switching is standard when an OUT1 tape reel is full.

(RETRIEVAL)

Requests for specific data retrieval must be programmed in the RETRIEVAL section (cards DTRET177 to DTRET188). For each record on the master file tape the system number is referred to as SYSTEM, the task number is referred to as TASK and each subtask is referred to as SUBTASK(I) where I ranges from 1 to COUNT. COUNT is supplied for each record.

The TASK number and SYSTEM number of located data is placed in OTASK and OSYSTEM. This is then filed via RETRIEVAL1 on OUT1.

A careful inspection of this section, RETRIEVAL1 record (cards DTRET240 to DTRET247), and OUT1 file (card DTRET279) will allow the user to modify or completely change these sections as requirements for retrieval demand.

*The tape unit will be assigned by the computer and displayed on the on-line printer during execution phase.

Restrictions: (INPUT)

a. All data to be searched on the master file tapes must be according to the criteria set up in the Update Program.

b. The master file for one reel will be mounted on MASTER·TASK·FILE2, when multi-reels are being searched both MASTER·TASK·FILE1 and MASTER·TASK·FILE2 will be used with no order necessary.

c. Non-standard label processing is provided. A six character name is placed on the tape. This name must be specified in lines LABEL1·CHECK and LABEL2·CHECK (cards DTRET054 and DTRET089). The six characters are placed between the quote marks in each line. Presently these are blanks.

(OUTPUT)

a. If more than one file for retrieved data is desired the user must OPEN the extra file in the line following PRESET (card DTRET002) and provide the necessary description in the DATA and ENVIRONMENT sections as stipulated by Commercial Translator.

b. If housing more record descriptions than RETRIEVAL1 on file OUT1 it is necessary to appropriately enlarge the BLOCKSIZE to incorporate the added space.

c. If changing the RETRIEVAL1 record description in the DATA section note that the record of alphanumeric (A) type, external, must be adhered to.

```
*PROCEDURE                                                        DTRET000
PRESET. OPEN OUT1.SYSTEM.OUTPUT.                                  DTRET001
        SET N = 1.    N IS THE NUMBER OF REELS FOR TASK FILES.    DTRET002
        MOVE ZEROS TO CK1.CK2.TASKE.SYSE.                         DTRET003
        DO CLEAR.REELS FOR I=1(1)N.                               DTRET004
        IF N LESS THAN 2 THEN SET CK1 = 9. OPEN MASTER.TASK.FILE2.DTRET005
        GO TO CK.LABEL2.                                          DTRET006
        OPEN MASTER.TASK.FILE2.                                   DTRET007
        OPEN MASTER.TASK.FILE1.                                   DTRET008
CK.LABEL1. SET WHERE = 1.                                         DTRET009
           DO LABEL1.CHECK.                                       DTRET010
           GET RECORD FROM MASTER.TASK.FILE1. AT END GO TO        DTRET011
           CK.LABEL2.                                             DTRET012
CK.LABEL2. SET WHERE = 2.                                         DTRET013
           DO LABEL2.CHECK.                                       DTRET014
           GET RECORD FROM MASTER.TASK.FILE2. AT END GO TO        DTRET015
           CHECK.FILE2.                                           DTRET016
        GO TO CHECK.FILE2.                                        DTRET017
CLEAR.REELS. MOVE ZERO TO REEL(I).                                DTRET018
CHECK.FILE1. IF CK1 = 9 THEN GO TO CK.FILE2 OTHERWISE             DTRET019
             GO TO OBTAIN.TASK1.                                  DTRET020
CHECK.FILE2. IF CK2 = 9 THEN GO TO CK.FILE1 OTHERWISE             DTRET021
             GO TO OBTAIN.TASK2.                                  DTRET022
OBTAIN.TASK1. GET TASKRECORD1. AT END GO TO EOF1.                 DTRET023
              MOVE TASKRECORD1 CARD TAS(1) TO TASK.TASKE.         DTRET024
              MOVE TASKRECORD1 CARD SYS(1) TO SYSTEM.SYSE.        DTRET025
              SET COUNT = 5*TASKRECORD1 CARD FIELD(1.1) / 14 -1.  DTRET026
              SET CARDS = TASKRECORD1 CARD FIELD(1.1) / 14.       DTRET027
              DO MOVE.FIELD1 FOR I=2(1)5.J=1(1)1.                 DTRET028
              IF CARDS IS GREATER THAN 1 THEN DO MOVE.FIELD1 FOR  DTRET029
              I=1(1)5.J=2(1)CARDS.                                DTRET030
      SET WHERE = 5.                                              DTRET031
      SET TSKLNGTH = TASKRECORD1 CARD FIELD(1.1).                 DTRET032
              DO RETRIEVAL.                                       DTRET033
              GO TO CHECK.FILE2.                                  DTRET034
MOVE.FIELD1. SET K = 5*(J-1)+I-1.                                 DTRET035
              MOVE TASKRECORD1 CARD FIELD(J.I) TO SUBTASK(K).     DTRET036
OBTAIN.TASK2. GET TASKRECORD2. AT END GO TO EOF2.                 DTRET037
              MOVE TASKRECORD2 CARD TAS(1) TO TASK.TASKE.         DTRET038
              MOVE TASKRECORD2 CARD SYS(1) TO SYSTEM.SYSE.        DTRET039
              SET COUNT = 5*TASKRECORD2 CARD FIELD(1.1) / 14 -1.  DTRET040
              SET CARDS = TASKRECORD2 CARD FIELD(1.1) / 14.       DTRET041
              DO MOVE.FIELD2 FOR I=2(1)5.J=1(1)1.                 DTRET042
              IF CARDS IS GREATER THAN 1 THEN DO MOVE.FIELD2 FOR  DTRET043
              I=1(1)5.J=2(1)CARDS.                                DTRET044
      SET WHERE = 6.                                              DTRET045
```

```
         SET TSKLNGTH = TASKRECORD2 CARD FIELD(1,1).                   DTRET046
                DO RETRIEVAL.                                          DTRET047
                GO TO CHECK.FILE1.                                     DTRET048
    MOVE.FIELD2. SET K = 5*(J-1)+I-1.                                  DTRET049
               MOVE TASKRECORD2 CARD FIELD(J,I) TO SUBTASK(K).         DTRET050
    LABEL1.CHECK. BEGIN SECTION.                                       DTRET051
                GET IDENTIFICATION1, AT END                            DTRET052
                GO TO CHANGE.DENSITY.A.                                DTRET053
                IF TITLE1 NOT= -       - THEN GO TO ALARM11.           DTRET054
                MOVE R1 TO NO.                                         DTRET055
                IF NO IS GREATER THAN N THEN GO TO ALARM12.            DTRET056
                IF REEL(NO) NOT= ZERO THEN GO TO ALARM13.              DTRET057
                SET REEL(NO) = 99.                                     DTRET058
                END LABEL1.CHECK.                                      DTRET059
    ALARM11. DISPLAY-TAPE LABEL FOUND INCORRECT.-.                     DTRET060
             FILE ERROR11.                                             DTRET061
             CLOSE MASTER.TASK.FILE1.                                  DTRET062
             DISPLAY-REPLACE MASTER.TASK.FILE1 WITH NEW REEL.-.        DTRET063
             DISPLAY-PUSH START TO CONTINUE.-.                         DTRET064
             STOP 1.                                                   DTRET065
             OPEN MASTER.TASK.FILE1.                                   DTRET066
             GO TO ERROR.RETURN.                                       DTRET067
    ALARM12. DISPLAY-TAPE LABEL CORRECT BUT REEL NUMBER TOO LARGE.-.   DTRET068
             FILE ERROR12.                                             DTRET069
             CLOSE MASTER.TASK.FILE1.                                  DTRET070
             DISPLAY-REPLACE MASTER.TASK.FILE1 WITH NEW REEL.-.        DTRET071
             DISPLAY-PUSH START TO CONTINUE.-.                         DTRET072
             STOP 1.                                                   DTRET073
             OPEN MASTER.TASK.FILE1.                                   DTRET074
             GO TO ERROR.RETURN.                                       DTRET075
    ALARM13. DISPLAY-TAPE PREVIOUSLY PROCESSED.-.                      DTRET076
             FILE ERROR13.                                             DTRET077
             CLOSE MASTER.TASK.FILE1.                                  DTRET078
             DISPLAY-REPLACE MASTER.TASK.FILE1 WITH NEW REEL.-.        DTRET079
             DISPLAY-PUSH START TO CONTINUE.-.                         DTRET080
             STOP 1.                                                   DTRET081
             OPEN MASTER.TASK.FILE1.                                   DTRET082
             GO TO ERROR.RETURN.                                       DTRET083
    ERROR.RETURN. GO TO (CK.LABEL1,CK.LABEL2,READ.LABEL.A,             DTRET084
                READ.LABEL.B) ON WHERE.                                DTRET085
    LABEL2.CHECK. BEGIN SECTION.                                       DTRET086
                GET IDENTIFICATION2, AT END                            DTRET087
                GO TO CHANGE.DENSITY.B.                                DTRET088
                IF TITLE2 NOT= -       - THEN GO TO ALARM21.           DTRET089
                MOVE R2 TO NO.                                         DTRET090
                IF NO IS GREATER THAN N THEN GO TO ALARM22.            DTRET091
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                IF REEL(NO) NOT= ZERO THEN GO TO ALARM23.
                SET REEL(NO) = 99.
                END LABEL2.CHECK.
ALARM21. DISPLAY-TAPE LABEL FOUND INCORRECT.-.
         FILE ERROR21.
         CLOSE MASTER.TASK.FILE2.
         DISPLAY-REPLACE MASTER.TASK.FILE2 WITH NEW REEL.-.
         DISPLAY-PUSH START TO CONTINUE.-.
         STOP 2.
         OPEN MASTER.TASK.FILE2.
         GO TO ERROR.RETURN.
ALARM22. DISPLAY-TAPE LABEL CORRECT BUT REEL NUMBER TOO LARGE.-.
         FILE ERROR22.
         CLOSE MASTER.TASK.FILE2.
         DISPLAY-REPLACE MASTER.TASK.FILE2 WITH NEW REEL.-.
         DISPLAY-PUSH START TO CONTINUE.-.
         STOP 2.
         OPEN MASTER.TASK.FILE2.
         GO TO ERROR.RETURN.
ALARM23. DISPLAY-TAPE PREVIOUSLY PROCESSED.-.
         FILE ERROR23.
         CLOSE MASTER.TASK.FILE2.
         DISPLAY-REPLACE MASTER.TASK.FILE2 WITH NEW REEL.-.
         DISPLAY-PUSH START TO CONTINUE.-.
         STOP 2.
         OPEN MASTER.TASK.FILE2.
         GO TO ERROR.RETURN.
CK.FILE1. IF CK1 = 9 THEN GO TO STOP.RUN OTHERWISE GO TO
          OBTAIN.TASK1.
CK.FILE2. IF CK2 = 9 THEN GO TO STOP.RUN OTHERWISE GO TO
          OBTAIN.TASK2.
EOF1. DO MORE.FOR.A FOR I=1(1)N.
      CLOSE MASTER.TASK.FILE1.
      DISPLAY-REMOVE REEL FROM MASTER.TASK.FILE1.-.
      SET CK1 = 9.
      GO TO CK.FILE2.
MORE.FOR.A. IF REEL(I) = ZERO THEN GO TO READ.LABEL.A.
READ.LABEL.A. CLOSE MASTER.TASK.FILE1.
              SET WHERE = 3.
              DISPLAY-MOUNT NEW REEL ON MASTER.TASK.FILE1.-.
              DISPLAY-PUSH START TO CONTINUE.-.
              STOP 1.
              OPEN MASTER.TASK.FILE1.
              DO LABEL1.CHECK.
              GET RECORD FROM MASTER.TASK.FILE1, AT END
              GO TO CHECK.FILE2.
```

```
              GO TO CHECK.FILE2.                                        DTRET138
EOF2. DO MORE.FOR.3 FOR I=1(1)N.                                        DTRET139
        CLOSE MASTER.TASK.FILE2.                                        DTRET140
        DISPLAY-REMOVE REEL FROM MASTER.TASK.FILE2.-.                   DTRET141
        SET CK2 = 9.                                                    DTRET142
        GO TO CK.FILE1.                                                 DTRET143
MORE.FOR.3. IF REEL(I) = ZERO THEN GO TO READ.LABEL.B.                  DTRET144
READ.LABEL.B. CLOSE MASTER.TASK.FILE2.                                  DTRET145
              SET WHERE = 4.                                            DTRET146
              DISPLAY-MOUNT NEW REEL ON MASTER.TASK.FILE2.-.            DTRET147
              DISPLAY-PUSH START TO CONTINUE.-.                         DTRET148
              STOP 2.                                                   DTRET149
              OPEN MASTER.TASK.FILE2.                                   DTRET150
              DO LABEL2.CHECK.                                          DTRET151
              GET RECORD FROM MASTER.TASK.FILE2. AT END                 DTRET152
              GO TO CHECK.FILE1.                                        DTRET153
              GO TO CHECK.FILE1.                                        DTRET154
CHANGE.DENSITY.A. CLOSE MASTER.TASK.FILE1.                              DTRET155
                  DISPLAY-CHANGE DENSITY OF MASTER.TASK.FILE1.-.        DTRET156
                  DISPLAY-PRESS START TO CONTINUE.-.                    DTRET157
                  STOP 1.                                               DTRET158
                  OPEN MASTER.TASK.FILE1.                               DTRET159
                  GO TO CK.LABEL1.                                      DTRET160
CHANGE.DENSITY.B. CLOSE MASTER.TASK.FILE2.                              DTRET161
                  DISPLAY-CHANGE DENSITY OF MASTER.TASK.FILE2.-.        DTRET162
                  DISPLAY-PRESS START TO CONTINUE.-.                    DTRET163
                  STOP 2                                                DTRET164
                  OPEN MASTER.TASK.FILE2.                               DTRET165
                  GO TO CK.LABEL2.                                      DTRET166
REDUN1. DISPLAY-REDUNDANCY ON CHANNEL A.-.                              DTRET167
        FILE REDUN.ERROR1.                                              DTRET168
        FILE REDUN.ERROR.                                               DTRET169
        GO TO CHECK.FILE2.                                              DTRET170
REDUN2. DISPLAY-REDUNDANCY ON CHANNEL B.-.                              DTRET171
        FILE REDUN.ERROR2.                                              DTRET172
        FILE REDUN.ERROR.                                               DTRET173
        GO TO CHECK.FILE1.                                              DTRET174
STOP.RUN. CLOSE OUT1.SYSTEM.OUTPUT.                                     DTRET175
          STOP RUN.                                                     DTRET176
RETRIEVAL. BEGIN SECTION.                                               DTRET177
       DO SEARCH FOR I=1(1)COUNT.                                       DTRET178
       MOVE SYSTEM TO OSYSTEM.                                          DTRET179
       MOVE TASK TO OTASK.                                              DTRET180
       FILE RETRIEVAL1.                                                 DTRET181
       GO TO RETRIEVAL.EXIT.                                            DTRET182
SEARCH. IF SUBTASK(I) GT -149999999999- AND                             DTRET183
```

```
          SUBTASK(I) LT -170000000000- AND                              DTRET184
          SUBTASK(I) NOT= -1563        - AND                            DTRET185
          SUBTASK(I) NOT= -1663        - THEN                           DTRET186
          GO TO RETRIEVAL.EXIT.                                         DTRET187
      RETRIEVAL.EXIT. END RETRIEVAL.                                    DTRET188
      *DATA                                                             DTRET189
      ERROR11          1RECORD                                          DTRET190
                       2          E A(27)- CH A TAPE LABEL INCORRECT.-  DTRET191
      ERROR12          1RECORD                                          DTRET192
                       2          E A(27)- CH A TAPE LABEL CORRECT BU-  DTRET193
                       2            A(24)-T REEL NUMBER TOO LARGE.-     DTRET194
      ERROR13          1RECORD                                          DTRET195
                       2          E A(21)- CH A TAPE PREVIOUSLY-        DTRET196
                       2          E A(11)- PROCESSED.-                  DTRET197
      REDUN.ERROR1     1RECORD                                          DTRET198
                       2          E A(16)- CH A REDUNDANCY-             DTRET199
                       2          E A(14)- AFTER READING-               DTRET200
      ERROR21          1RECORD                                          DTRET201
                       2          E A(27)- CH B TAPE LABEL INCORRECT.-  DTRET202
      ERROR22          1RECORD                                          DTRET203
                       2          E A(27)- CH B TAPE LABEL CORRECT BU-  DTRET204
                       2          E A(24)-T REEL NUMBER TOO LARGE.-     DTRET205
      ERROR23          1RECORD                                          DTRET206
                       2          E A(21)- CH B TAPE PREVIOUSLY-        DTRET207
                       2          E A(11)- PROCESSED.-                  DTRET208
      REDUN.ERROR2     1RECORD                                          DTRET209
                       2          E A(16)- CH B REDUNDANCY-             DTRET210
                       2          E A(14)- AFTER READING-               DTRET211
      REDUN.ERROR      1RECORD                                          DTRET212
                       2          E A(23)- TASK-SYSTEM NUMBER OF -      DTRET213
       TASKE           2          E A(6)                                DTRET214
       SYSE            2          E A(12)                               DTRET215
      IDENTIFICATION1  1RECORD                                          DTRET216
       FOOLS-GOLD      2            X(19)                               DTRET217
       R1              2          E 9(4)                                DTRET218
       WHITE-ELEPHANTS 2            X(49)                               DTRET219
       TITLE1          2          E A(6)                                DTRET220
       TRINKETS        2            X(6)                                DTRET221
      IDENTIFICATION2  1RECORD                                          DTRET222
       RUBBISH         2            X(19)                               DTRET223
       R2              2          E 9(4)                                DTRET224
       REFUSE          2            X(49)                               DTRET225
       TITLE2          2          E A(6)                                DTRET226
       RIFRAF          2            X(6)                                DTRET227
      TASKRECORD1      1RECORD    E                                     DTRET228
       CARD            2        13                                      DTRET229
```

```
 TAS             4              9(6)                              DTRET230
 SYS             4              9(12)                             DTRET231
 FIELD           4          5   9(12)                             DTRET232
  FROTH          4              X(6)                              DTRET233
TASKRECORD2      1RECORD     E                                    DTRET234
 CARD            2          13                                    DTRET235
 TAS             4              9(6)                              DTRET236
 SYS             4              9(12)                             DTRET237
 FIELD           4          5   9(12)                             DTRET238
  FROTH          4              X(6)                              DTRET239
RETRIEVAL1       1RECORD     E                                    DTRET240
                 2           E  A(10)-A       -                   DTRET241
                 2           E  A(12)-TASK NUMBER-                DTRET242
 OTASK           2           E  A(6)                              DTRET243
                 2           E  A(25)-                      -     DTRET244
                 2           E  A(25)-SYSTEM NUMBER -             DTRET245
 OSYSTEM         2           E  A(12)                             DTRET246
                 2RCDMRK     E                                    DTRET247
TASKS            1           E                                    DTRET248
 TASK            2              A(6)                              DTRET249
 SYSTEM          2              A(12)                             DTRET250
TSKLNGTH        02           ER9(12)                              DTRET251
 SUBTASK         2          64  A(12)                             DTRET252
 COUNT           2           I 99                                 DTRET253
 CARDS           2           IR99                                 DTRET254
 I               2           IR99                                 DTRET255
 J               2           IR99                                 DTRET256
 K               2           IR99                                 DTRET257
 N               2           IR99                                 DTRET258
 NO              2           IR99                                 DTRET259
 CK1             2           IR9                                  DTRET260
 CK2             2           IR9                                  DTRET261
 WHERE           2           IR9                                  DTRET262
 REEL            2          6I                                    DTRET263
                 3             R99                                DTRET264
*ENVIRONMENT                                                      DTRET265
SYSTEM.OUTPUT     FILE  OUTPUT,BCD,TAPE,ERROR11,ERROR12,ERROR13, CDTRET266
                        ERROR21,ERROR22,ERROR23,REDUN.ERROR1,    CDTRET267
                        REDUN.ERROR2,REDUN.ERROR,BLOCKSIZE 14,   CDTRET268
                        BEGIN                                     DTRET269
                  SPECIFSYSTEM.OUTPUT,UNIT1-OU-,OPENW,CLOSEW      DTRET270
MASTER.TASK.FILE  FILE  INPUT,BLOCKSIZE 182,ON ERROR REDUN1,BEGINCDTRET271
                1       ,IDENTIFICATION1,BLOCK CONTROL,          CDTRET272
                        TASKRECORD1,BLOCK CONTROL                 DTRET273
                  SPECIFMASTER.TASK.FILE1,UNIT1-A(1)-,CLOSER      DTRET274
MASTER.TASK.FILE  FILE  INPUT,BLOCKSIZE 182,ON ERROR REDUN2,BEGINCDTRET275
```

```
                2        ,IDENTIFICATION2,BLOCK CONTROL,         CDTRET276
                         TASKRECORD2,BLOCK CONTROL                DTRET277
                      SPECIFMASTER.TASK.FILE2,UNIT1-B(1)-,CLOSER  DTRET278
OUT1                  FILE  OUTPUT,BLOCKSIZE 16 ,BEGIN,RETRIEVAL1 DTRET279
                      SPECIFOUT1,UNIT1-UT1-                       DTRET280
                                                                  DTRET281
*FINISH                                                           DTRET282
```

Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio. Rpt. No. AMRL-TDR-63-78. A METHODOLOGICAL APPROACH TO THE ANALYSIS AND AUTOMATIC HANDLING OF TASK INFORMATION FOR SYSTEMS IN THE CONCEPTUAL PHASE. Final report, Aug 63, iv + 120 pp. incl. illus., 24 refs. Unclassified report

Human skills required by future systems have long been inadequately considered in the conceptual phase of man-machine system development. Neglect in part has been due to lack of a uniform and workable method for gathering, processing, and using early human factors information for improving the design and development of systems. The methodological approach presented in this report was predicated on this need. This report presents a technique for analyzing and processing task and (over)

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1. Task Analysis
2. Data Processing
3. Aerospace Systems

I. AFSC Project 1710, Task 171006
II. Behavioral Sciences Laboratory
III. Reed, L. E. Foley, J. P., Jr.
IV. Graham, R. S. Hilgeman, J. B. Deputy for Engineering, Aeronautical Systems Division

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task requirements data generated during the conceptual phase of system development. The technique includes: (a) a category system for organizing, classifying, and coding task information; (b) a task analysis format for recording and coding task descriptions and task requirements; and (c) computer update and retrieval programs. Task requirement data appearing in documents resulting from the Air Force Study Requirement program are analyzed and used for testing the technique on an actual personnel training problem. The test program indicates that the technique can be used to assist human factors specialists to isolate and process task and task requirements associated with advanced systems for making personnel, training, and training equipment recommendations.

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VI. Aval fr OTS: $2.75

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Aerospace Medical Division, 6570th Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio. Rpt. No. AMRL-TDR-63-78. A METHODOLOGICAL APPROACH TO THE ANALYSIS AND AUTOMATIC HANDLING OF TASK INFORMATION FOR SYSTEMS IN THE CONCEPTUAL PHASE. Final report, Aug 63, iv + 120 pp. incl. illus., 24 refs. Unclassified report

Human skills required by future systems have long been inadequately considered in the conceptual phase of man-machine system development. Neglect in part has been due to lack of a uniform and workable method for gathering, processing, and using early human factors information for improving the design and development of systems. The methodological approach presented in this report was predicated on this need. This report presents a technique for analyzing and processing task and (over)

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1. Task Analysis
2. Data Processing
3. Aerospace Systems

I. AFSC Project 1710, Task 171006
II. Behavioral Sciences Laboratory
III. Reed, L. E. Foley, J. P., Jr.
IV. Graham, R. S. Hilgeman, J. B. Deputy for Engineering, Aeronautical Systems Division

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task requirements data generated during the conceptual phase of system development. The technique includes: (a) a category system for organizing, classifying, and coding task information; (b) a task analysis format for recording and coding task descriptions and task requirements; and (c) computer update and retrieval programs. Task requirement data appearing in documents resulting from the Air Force Study Requirement program are analyzed and used for testing the technique on an actual personnel training problem. The test program indicates that the technique can be used to assist human factors specialists to isolate and process task and task requirements associated with advanced systems for making personnel, training, and training equipment recommendations.

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V. In DDC collection
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