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F-16 AIRCREW TRAINING DEVELOPMENT PROJECT

Contract No. F02604-79-C8875

DATA AUTOMATION OF TASK AND GOAL ANALYSIS: EXISTING SYSTEM REVIEW AND RECOMMENDATIONS

DEVELOPMENT REPORT No. 11
MARCH 1981

Prepared in fulfillment of CDRL no. B016

by

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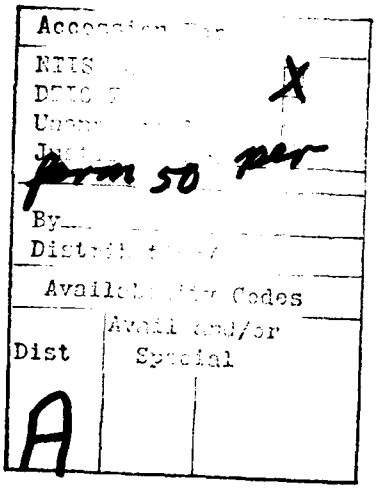
PREFACE

This report was created for the F-16 Aircrew Training Development Project contract no. F02604-79-C8875 for the Tactical Air Command to comply with the requirements of CDRL no. B016. The project entailed the design and development of an instructional system for the F-16 RTU and instructor pilots. During the course of the project, a series of development reports was issued describing processes and products. A list of those reports follows this page. The user is referred to Report No. 34, A Users Guide to the F-16 Training Development Reports, for an overview and explanation of the series, and Report No. 35, F-16 Final Report, for an overview of the Instructional System Development Project.



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Copies of these reports may be obtained by writing the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314. All reports were reviewed and updated in March 81.

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EXECUTIVE SUMMARY

Development report no. 11 reviews the existing data automation system for task and goal analysis before making recommendations (1) concerning the use/nonuse of automatic data processing (ADP) in support of task and goal analysis processing and (2) proposing a suitable automated system, if automation is recommended:

Two possible methods of utilizing ADP support are discussed: (1) as an authoring aid and (2) to assist in record keeping, validation, and updating of task and goal lists.

Although ADP could be used during the early authoring stage of task and goal analysis by providing automatically sequenced prompts ("how to do it" displays), it is not recommended for two reasons.

1. The interactive nature of the analysis processes (frequent reconsideration, juggling, and rewriting of task/subtask hierarchies) is better handled on a large working surface where alternatives are all in view for arrangement and possible modificiation.

2. Subtle judgements are included in analyses which are best handled by experienced training analysis specialists.

ADP is well suited for handling the accumulation, storage, and recall of the hundreds of F-16 tasks and the task numbers, behaviors, conditions, standards, and CRO data for each of the F-16 tasks. Validation reviews and updating are also handled easily by ADP.

The existing TAC ADP system uses the Burroughs 550 computer system and is described in TACM 50-300. This system provides good ADP support in reducing information survey time. However, it has important short comings involving:

1. Card input time and storage: All program input is recorded on punched data cards. This is a cumbersome system because task data must be coded and formatted, cards must then be punched by a qualified keypunch operator and hand carried to the data automation unit. Stored cards are subject to jumbling and require a substantial staffing

2. Off-line operation turnaround time: Data extraction is not rapid. It usually requires several hours because the user does not interface directly with the program. The user must

submit cards, which are stacked/queued to await processing and the final printout.

3. Program maintenance/user sophistication: The present system is powerful, but effective use requires a project staff member with a good working knowledge of the computer program.

4. The lack of a goal analysis program: The present program analyzes tasks but not goals.

Recommendation: We recommend using the DEC WPS-8 Word Processing System. This system is now used at the F-16 project office. The system is very cost effective and offers immediate support for task and goal analysis. Although it lacks some of the formatting abililities of the present system, it has a powerful sorting ability and also other major advantages i.e., (1) incorporates micro-electronics for size-reduction, (2) is a self-contained microprocessing system with a printer, therefore, eliminating cumbersome punch cards, (3) interface is direct through a keyboard and screen, (4) work is performed on-line so turnaround time is immediate (5) storage is on convenient flexible diskettes, each of which holds over 3,000 punchcards (6) operation is simple, and doesn't require a program language code. Secretaries usually develop the basic skills in one week of concentrated practice/training.

We feel the benefits of the DEC-WPS-8, many of which are readily available, will provide the USAF F-16 program with a modern, responsive, and flexiblle ADP system. Not only is the system inexpensive but it should result in extensive savings of time and money.

CONTENTS

DATA AUTOMATION OF TASK AND GOAL ANALYSIS: EXISTING SYSTEM REVIEW AND RECOMMENDATIONS

This report is a review of the existing data automation system for task and goal analysis. Its major considerations are (1) a recommendation on whether to support the task and goal analysis processes with automatic data processing (ADP) (2) a review of the existing Tactical Air Command (TAC) data automation system and, depending on the initial recommendation of whether or not to automate, (3) a proposed system for data automation either using or adapting the existing data automation system or employing a new system. This last consideration can be divided into (a) recommendations for a system to meet immediate needs or (b) recommendations for an optimum system. The latter will be dealt with as part of a separate Management System Needs Analysis/ Design Concepts Paper. The former will be dealt with in the final section of this paper.

CONSIDERATION OF THE NEED FOR ADP SUPPORT

There are two possible ways to provide ADP support to the task and goal analyses: (1) As an authoring aid and (2) to help manage record keeping, validation, and updating of the task and goal lists.

ADP AUTHORING AIDS

During the initial authoring of the task and goal analyses, ADP support can be used as an authoring aid which consists of a series of prompts, or interactive protocols ("how to do it" displays), presented in proper sequence to ensure that all questions relevent to each analysis are considered. In other words, the ADP system leads the subject matter expert through the analysis processes one step at a time.

This type of ADP support for the task and goal analyses is not recommended for two reasons. The first is the interactive nature of the analysis processes. Hierarchies of tasks and subtasks are constantly being reconsidered, juggled, and rewritten as new tasks are added. Such work is better performed on a large working surface upon which alternatives can be presented

clearly in view of each other where modifications can be made rapidly. A blackboard, corkboard or table top are ideal for this.

The second reason that ADP support of this interactive type is not recommended is that many subtle judgments are involved in analysis which are best handled by an experienced training analysis specialist. Some of the necessary decisions which arise during analysis cannot be adequately dealt with through a programmed system of prompts. Similar ADP support is useful at other points in the instructional systems development (ISD) process, where decisions are better ordered and clear cut and where less judgment is involved. An example of such an area is the media selection process. There, an interactive operating mode serves well, even for inexperienced workers.

ADP USE IN RECORD KEEPING, VALIDATION, AND UPDATING

The second area in which ADP support of the task and goal analyses may be desired is in the processes of record keeping, validation data processing, and the updating of task and goal analyses. During the development of task and goal lists, it quickly becomes apparent that bookkeeping is a major problem. The initial F-16 task list contains well over 500 tasks, each of which includes a task number, a behavior, a condition, a standard of performance, a criterion-referenced objective (CRO) data set, which is extensive, and data from validation reviews. The necessity of revising and renumbering tasks during updating creates a tremendous bookkeeping load merely to post the changes. In addition, in a manual system it is likely that information would be misplaced and important data linkages be lost. In addition to posting and updating needs to support task analysis, there are sorting requirements for the selection of subsets of tasks meeting specified criteria. For example, a change in the heads-up display (HUD) of the aircraft may require that all tasks related to use of the HUD must be checked for possible updating. In an emerging weapons system, changes come in high volume, and this type of selection process is very difficult to handle manually for a data base as large as the F-16 task list. The addition of training objectives, several for each task, and the need for performing all of the above bookkeeping functions for them further complicates the problem.

The needs expressed in this section can be easily met by an ADP system. In fact, most systems are designed to be directly applicable to such needs. Therefore, ADP support for the task and goal analysis processes in the area of record keeping, validation, and updating is strongly recommended.

REVIEW OF THE EXISTING TAC DATA AUTOMATION SYSTEM

The existing TAC data automation system consists of a program developed for the Burroughs 3500 computer system. This program is described in TACM 50-300, Data Automation Program for Support of Task Analysis and Aircrew Training Course Design, dated March 1977. The program performs functions described in this extract from the manual:

> "The time required to manually survey a large volume of information is reduced by the use of this program. The principles used in ISD are the product of a developing science, and the computer program does not automate course design. The program primarily functions as a memory device for information which may be selectively retrieved by user-established criterion."

The program performs sorting functions as defined by the user on a data base. It is a good vehicle for ADP support considering the generation of the computer hardware for which it was designed, the Burroughs 3500 large-scale system. However, there are several important problems with the program and system.

Card Input and Storage

All input to the program is performed through the use of punched data cards. This is a cumbersome system for several reasons: First, the data for a task must be coded into proper formats, then, the cards must be punched on a keypunch machine, which may require qualified civilian keypunch operators. Next, the punched cards must be hand carried to the data automation unit on the air base. Card storage must be carefully maintained to prevent the cards from being jumbled. These conditions allow several opportunities for errors or other problems to arise, in addition to the added staffing expense.

Off-line Operation Turnaround Time

Another major problem area with the existing program involves the use of off-line operation and the consequent turnaround time. The user does not interface directly with the program. Instead, the user's cards are submitted to the base data automation unit. Then, the cards are loaded in a queue to await processing along with the rest of the base requirements. After processing, the user receives a printout of the results. This delay is known as "turnaround time". "Although exceptions will occur, it is wise to expect no better than overnight services. . . ." With a setup like this, there is little possibility for quickly correcting errors. This would be a serious shortcoming for task and goal analysis work.

Program Maintainability/User Sophistication

The system is very powerful, but to be used effectively it requires a good working knowledge of the computer program. The complexity of the program is such that a project staff member with programming level skills and "a good working knowledge of the principles of ISD" would be needed to operate the program.

Goal Analysis Program

The last major problem with the existing program is the lack of a goal analysis program. The present program is for task analysis. Some of the data collected for each task are goal related (such as information on energy/power consciousness and anxiety), but for all goal analysis data to be effectively recorded on the system there would have to be a new program. This would require the services of a programmer experienced with the system.

RECOMMENDATION

There are many problems involved with the use of the existing TAC data automation program, as noted above. We feel that the disadvantages outweigh the advantages, especially in the light of an alternative system. As stated at the beginning of this report, we are concerned here with a solution to the immediate data automation needs of the task and goal analysis, not with the optimum solution. Our recommendation is to use the DEC WPS-8 Word Processing System presently in use at the F-16 project office. This system was acquired in accordance with Section II of the revised proposal for information processing support to aid report generation, list processing, and data base maintenance. As stated in that document, word processing systems are very cost effective. This particular system includes a list processing routine that makes it ideal as an immediate support for task and goal analysis data automation. In fact much of the task analysis data base has already been stored on the system as part of report generation. This system lacks some of the formatting abilities of a large-scale data processing system like the existing program, but its sorting ability is about as powerful. In addition, there are several major advantages to this system over the existing system.

Recent advances in micro-electronics have allowed great reductions in the size of processing systems. The WPS-8 is a self

contained microprocessing system with printer. It is not required for use outside the project needs, whereas the existing TAC program runs on a time-shared computer system. Interface with the WPS-8 is direct through a keyboard and screen display rather than through a cumbersome card system. Work is performed on-line, so turnaround time is immediate as opposed to overnight. Installation can be made in almost any office. The system runs off normal 110 AC current and occupies the space of a large desk.

Storage is on floppy disks (diskettes), each of which can hold 265 thousand chararcters, the equivalent of over 3,000 data punch cards, on a diskette about the size of a 45-rpm phonograph record. Any number of document diskettes can be used, one at a time. Changing diskettes is a simple matter.

Staffing is the next major advantage. The word processing system does not require a programming language of an extensive system of codes. The programming is built into the system. Most operations involve one or two button pushes on the keyboard. The operator need not be a programming level individual--a secretary can become skilled on the system after about a week of training and practice.

It is our recommendation to continue to apply the word processing system to supply immediate data automation support to the task and goal analysis processes rather than employ the TAC program on the Burroughs 3500 system.