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A SOFTWARE LIBRARY FOR THE
C2 CONCEPT EVALUATION CAPABILITY

BY
R. E. WAGNER

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The Command and Control Concept Evaluation Capability (C² CONCAP) provides ESD development planners with computer aids for selecting, analyzing, evaluating, and refining system concepts. This Technical Report describes briefly the library of software which is currently available to help in the development of models of command and control concepts. Much of the library is commercial off-the-shelf packages which are useful in creating displays and data bases.

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ABSTRACT

The Command and Control Concept Evaluation Capability (C^2 CONCAP) provides ESD development planners with computer aids for selecting, analyzing, evaluating, and refining system concepts. This Technical Report describes briefly the library of software which is currently available to help in the development of models of command and control concepts. Much of the library is commercial off-the-shelf packages which are useful in creating displays and data bases.

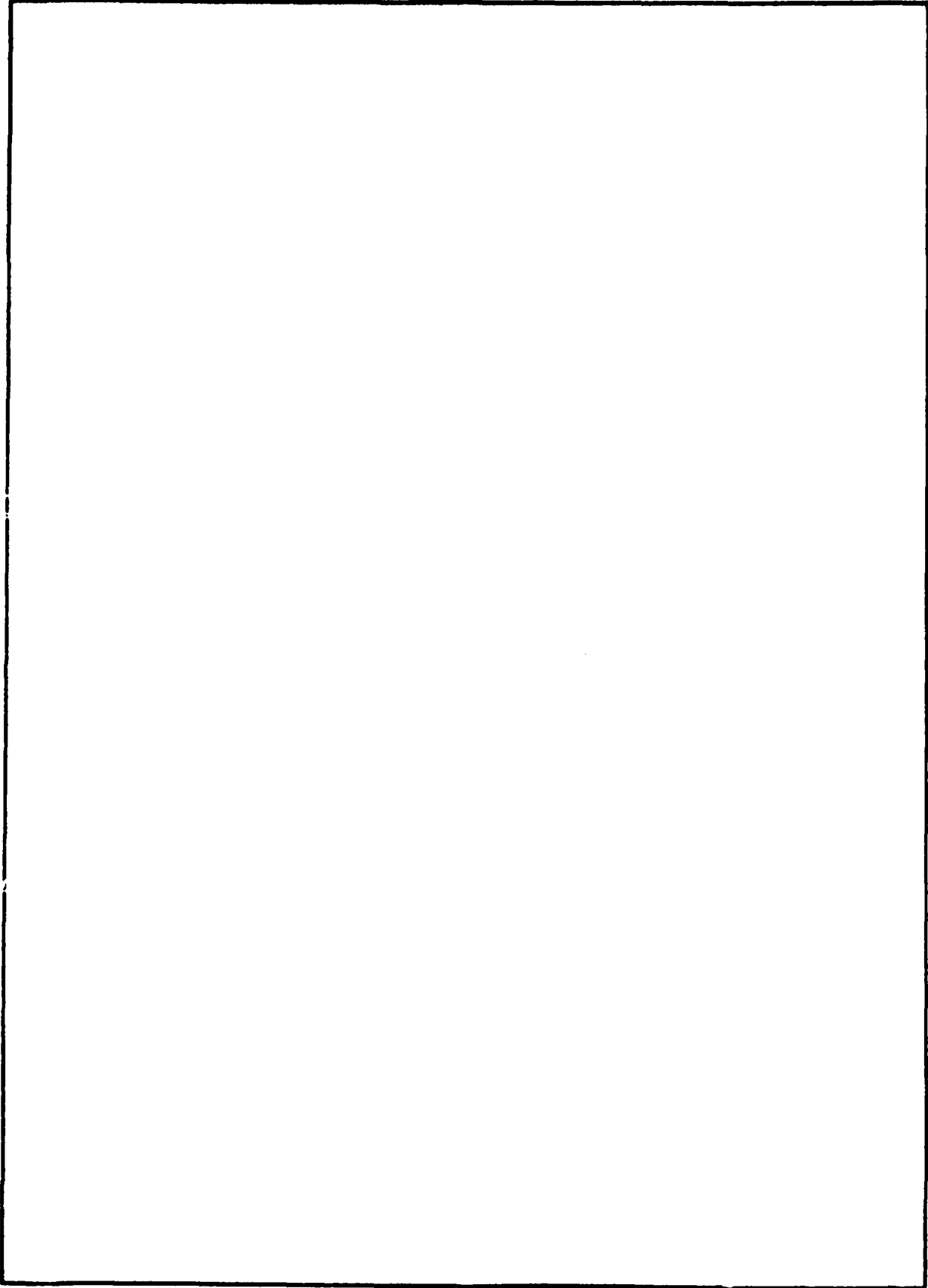| Accession For	
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1.0 INTRODUCTION AND PURPOSE

The Command and Control Concept Evaluation Capability (C^2 CONCAP) provides ESD development planners with computer aids for selecting, analyzing, evaluating, and refining system concepts. This Technical Report is an index to the library of software which is currently available to help in the development of models of command and control concepts. A standard format has been used to describe each package. Further details can be obtained at the computer facility or from the author.

The C^2 CONCAP consists of an integrated set of hardware and software which was assembled since October 1980 as a part of Project 4960 under the direction of ESD/XR. The computer is a DEC PDP 11/70. Its operating system is RSX-11M. Insofar as possible, software in the facility library was purchased, to take full advantage of the availability of commonly used software and good user documentation. Use of commercial software has also shortened the time for development of applications by providing generic capabilities common to most of the applications. The generic capabilities include online interactions via tabular and color graphics displays, and the management of files of data. Many of the graphics displays have been geographically oriented, which dictated a need for map data. Most of the software packages in the library were chosen to facilitate the rapid development of software with these general characteristics.

2.0 OPERATING SYSTEM SOFTWARE

The primary operating system currently being used at the CONCAP
facility is RSX-11M. RSX-11M was purchased from Digital Equipment
Corporation. This section presents the general characteristics of
RSX-11M along with a brief discussion of the various system utilities.

2.1 RSX-11M

RSX-11M is an online disk-based operating system that runs on any
PDP-11 processor (with the exception of the micro processor based
11/03). It provides an environment for both program development and
execution of multiple tasks using an event-driven, priority structured
scheduling technique. As part of its multi-user program development,
RSX-11M also provides: (1) user login/logout (with password protection),
(2) device and file access protection, (3) round robin scheduling of
tasks by priority and (4) concurrent execution of equal priority tasks
by executive level swapping. RSX-11M is a fully supported operating
system with a large user community. Furthermore, RSX-11M offers a
wide range of programming languages including FORTRAN IV, COBOL, PL/I,
C, PASCAL, ALGOL, and BASIC. Currently, the CONCAP facility is primarily
using FORTRAN, but has available all of the above mentioned except PL/I.

2.2 OPERATING SYSTEM UTILITIES

The RSX-11M operating system also provides the user with a set of
general purpose utilities. These utilities allow users to create and
edit source program and data files, manipulate these files and perform
general system activities. Table 2-1 presents a summary of these
utilities and a more detailed discussion of each utility is presented
below.

2.2.1 Editing Utilities

EDT

EDT is an interactive text editor that is useful for creating
and maintaining text files. It provides unlimited access to an
entire file and provides character-mode editing for users with
video terminals.

EDI

EDI is a line oriented, interactive editor used to create and
maintain text and source files.

TABLE 2-1

RSX-11M System Utilities

Editing Utilities

EDT	–	DEC Editor
EDI	–	Line Text Editor
KED	–	Keypad Editor

File Manipulation Utilities

PIP	–	Peripheral Interchange Program
FLX	–	File Transfer Program

File Spooling Utilities

PRI, QUE	–	Print and Queue Utility

Volume Maintenance Utilities

FMT	–	Disk Volume Formatted
BAD	–	Bad Block Location Utility
BRU	–	Back-up and Restore Utility
PRESRV	–	Preservation Utility
VFY	–	File Structure Verification
DSC	–	Disk Save and Compress Utility Program

Programming Utilities

LBR	–	Librarian Utility Program
DMP	–	File Dump Utility
TKB	–	Task Builder

Program Maintenance Utilities

CMP	–	File Compare Utility
SLP	–	Source Language Input Program
PAT	–	Object Module Patch Program
ZAP	–	Task/File Patch Program

Debugging Utilities

ODT	–	Online Debugging Tool
PMD	–	Post Mortem Dump

KED

KED is an interactive, video display, character-oriented
text editor that uses the VT-100 family of terminals. Unlike EDT
and EDI, KED uses the terminal's numeric function keypad and
other special function keys to effect the editing operation.

2.2.2 File Manipulation Utilities

PIP

PIP is a very powerful utility which performs file copying
and several file control functions such as concatenating,
renaming, spooling, listing, deleting and unlocking.

FLX

FLX is file transfer utility which performs both file
transfer and format conversion. It is designed specifically for
transferring files between DOS-11, RT-11 and Files-11 volumes.

2.2.3 File Spooling Utilities

PRI, QUE

PRI and QUE are the two primary components of the Queue
Manager. That is, the Queue Manager allows files to be
automatically spooled to a line printer. File spooling is either
initiated by a print request (PRI) or by a task request.

2.2.4 Volume Maintenance Utilities

FMT

FMT is a utility which formats and verifies RP02/RP03, RP04,
RP05, RP06, RM02, RM03, RK05, RK06, RK07, and RX02 disks.

BAD

The BAD utility is used to determine the number and location
of bad blocks on a volume.

BRU

BRU is used to transfer files from a Files-11 volume (in a
compacted form) to one or more back-up volumes. BRU is also
useful for restoring lost files.

PRESRV

PRESRV is a stand-alone program which is used to create copies of volumes.

VFY

VFY is a disk verification program that verifies the consistency and validity of Files-11 volume.

DSC

DSC is a utility which copies Files-11 disk files to disk on tape. DSC runs either stand-alone or online.

2.2.5 Programming Utilities

LBR

LBR is a library maintenance program that creates and modifies library files. LBR can be used on Macro, object and universal libraries.

DMP

The DMP program is a file listing program that allows the user to examine a files contents in most of the standard formats (e.g., octal, bytes, hexadecimal, etc.).

TKB

TKB is program which creates a task image by linking one or more object modules. In addition to linking object modules, the task builder also performs:

- Resolution of references to user libraries;
- Allocation of virtual address space;
- Generation of link map and symbol definition;
- Building of an overlaid task;
- Mapping of task into shared regions of memory.

2.2.6 Program Maintenance Utilities

CMP

CMP is used to compare two text files, record by record and list the differences.

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SLP

SLP is an editing program that is used to maintain and audit source files.

PAT

PAT is an object module patch utility that updates or patches a relocatable binary object module.

ZAP

ZAP is a patch utility that updates or patches a task image or data file.

2.2.7   Debugging Utilities

ODT

ODT is an interactive debugger which allows a user to debug Macro programs.

PMD

PMD is a utility which provides a dump of a task's registers when the task terminates execution abnormally or when requested (as a snapshot).

3.0 GENERAL UTILITIES

Contained in this section are various application oriented subroutines or programs. These routines are general in nature and can be useful in many applications.

3.1 FORTRAN SYSTEM SUBROUTINE LIBRARY

The FORTRAN system subroutine library provides the user with a set of general purpose subroutine for accessing various system parameters. Table 3-1 presents a list of these routines along with a brief summary of the function performed. All of these routines are provided as part of the FORTRAN IV-Plus user library (which was purchased from Digital Equipment Corporation).

3.2 USER SUBROUTINE LIBRARY

The User Subroutine library is a library containing user developed subroutines. These routines perform a wide range of functions, that are generally useful in many applications. Table 3-2 presents a list of these routines along with a brief summary of the functions performed.

3.3 CHARACTER STRING FUNCTION LIBRARY

The Character String Function Library is a set of FORTRAN callable subroutines that provide the FORTRAN user with full character string capability. Table 3-3 presents a summary of these routines along with a brief description. This library was obtained from Digital Equipment Corporation as part of their RT-11 FORTRAN IV functions library.

3.4 READ UNLABELED TAPES - RDULMT

RDULMT is a stand-alone program which allows a user to read magnetic tapes that are neither labeled or blocked in one of the standard RSX-11M formats. RDULMT was obtained from DECUS and modified for use at the facility.

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TABLE 3-1

FORTRAN System Subroutine Library

Function Call	Purpose
ASSIGN	Specifies, at run time, device and/or filename information to be associated with a FORTRAN logical unit number.
CLOSE	Close a file on a specified logical unit.
DATE	Returns a 9-byte string containing the ASCII representation of the current date.
IDATE	Returns three integer values representing the current month, day, and year.
ERRSET	Specifies the action to be taken on detection of certain errors.
ERRSNS	Returns information about the most recently detected error condition.
ERRTST	Returns information about the most recently detected error condition.
EXIT	Terminates the execution of a program, reports termination status information, and returns control to the operating system.
USEREX	Specifies a user subprogram to be called immediately prior to task termination.
FDBSET	Specifies special I/O options to be associated with a FORTRAN logical unit.

TABLE 3-1 (Concluded)

RAD50	Converts 6-character Hollerith strings to Radix-50 representation and returns the result as a function value.
IRAD50	Converts Hollerith strings to Radix-50 representation.
R50ASC	Converts Radix-50 strings to Hollerith strings.
SECNDS	Provides system time of day or elapsed time as a floating-point function value in seconds.
TIME	Returns an 8-byte string containing the ASCII representation of the current time in hours, minutes, and seconds.

TABLE 3-2

User Subroutine Library

Function Call	Purpose
RDRAW	Reads data from a file block-by-block. This routine is useful in applications where the data to be read is in a raw or unformatted form.
HEXDEC	Converts a 4 character hex letter to decimal number.
DECHEX	Converts a decimal number to a 4 character hex letter.

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TABLE 3-3

Character String Function Library

Function Call	Purpose
CONCAT	Concatenates two variable-length strings.
GETSTR	Reads a character string from a specified FORTRAN logical unit.
INDEX	Returns the location in one string of the first occurrence of another string.
INSERT	Replaces a portion of one string with another string.
ISCOMP	Compares two character strings.
IVERIF	Indicates whether characters in one string appear in another.
LEN	Returns the number of characters in a specified string.
PUTSTR	Writes a variable-length character string on a specified FORTRAN logical unit.
REPEAT	Concatenates a specified string with itself to provide an indicated number of copies and stores the resultant string.
SCOMP	Compares two character strings.
SCOP	Copies a character string from one array to another.
STRPAD	Pads a variable-length string on the right with blanks to create a new string of a specified length.

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TABLE 3-3 (Concluded)

Character String Function Library

SUBSTR   Copies a substring from a specified
                                string.

TRANSL   Replaces one string with another
                                after performing character
                                modification.

TRIM   Removes trailing blanks from a
                                character string.

VERIFY   Indicates whether characters in one
                                string appear in another.

4.0 GRAPHICS

Discussed in this section are the currently available graphics tools. These tools currently interface with the Ramtek 9400 color graphics display system and the Tektronix 4025 terminal. The tools dicussed include PLOT-10, FIP, FONT, GAEA, and the Graphics Support Library. PLOT-10 and FIP were developed by Tektronix and Ramtek respectively whereas the remaining tools were developed in-house.

4.1 TEKTRONIX PLOT-10

Two packages (TCS and Preview) are currently available to the users of PLOT-10 compatible terminals. Both of these packages are discussed below.

4.1.1 PLOT-10 TCS

The Terminal Control System (TCS) is a basic graphics package which provides standard line drawing capabilities. This package permits the user to operate at the terminal level plus it provides such graphing conveniences as choice of linear, logarithm, or polar coordinate systems, automatic scaling, and buffered input/output for efficient graphics handling. PLOT-10 TCS may be run on any terminal which supports PLOT-10 software.

4.1.2 PLOT-10 Preview Routines

The Tektronix PLOT-10 Preview Routines build upon the PLOT-10 TCS package. This package contains higher level routines and is Calcomp (or Zeta) compatible. This package provides most of the standard Calcomp callable routines and permits a user to "preview" plots prior to being submitted for hardcopy output to a plotter. Although this "preview" capability exists, the package can be used simply to generate graphic displays on any terminal which supports PLOT-10 software.

4.2 FORTRAN INTERFACE PACKAGE - FIP

The FORTRAN Interface Package (FIP) is a set of FORTRAN and Macro-11 routines which serves as an interface between the FORTRAN programmer and the Ramtek 9400 instruction set. FIP consists of five levels of software. Among them are the Macro-11 device driver (Level 1) and a set of FORTRAN programs (Level 2) which interfaces the driver to the higher level programs. There is nearly a one-to-one correspondence between the Level 3 routines and the union of the Ramtek instruction set and parameter list. The user can send any

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Ramtek instruction or set any parameter by a call to one of approximately 300 Level 3 routines. The level 4 routines allow more complex interaction with the display processor. They allow interactive color selection and video lookup table manipulation, and plot package calls compatible with Calcomp/Versaplot. The Level 5 routines are runable programs which allow the user to run level 1 through 4 routines to test the effect they have on the color display.

In summary, the FIP package allows the user to manipulate the Ramtek through FORTRAN calls without concerning himself with the complex syntax of the Ramtek 9400 instruction set.

4.3 FONT GENERATOR - FONT

The FONT design program is an interactive graphics program which allows a user to design sets of character symbols using the trackball, the Ramtek 9400 color processor and a color display. A FONT is a set of 64 symbols which can be easily displayed in any of hundreds of sizes, projections, colors, and orientations. The Ramtek can store up to sixteen programmable fonts at a time, and up to 1024 individual characters may be defined and stored.

The FONT program takes cursor positions as input, thus allowing the user to build symbols one element at a time. After a character symbol is built, the program displays the symbol in several projections. It also displays a set of 21 integers which the user can use as arguments within application programs to define that symbol for display.

The FONT program will be very useful for anyone interested in graphic displays with symbols other than the standard 7 x 9 block ASCII character set.

4.4 GEOGRAPHIC AREA ENLARGEMENT APPARATUS - GAEA

The Geographic Area Enlargement Apparatus (GAEA) is a geographic data base manipulation package which is currently under development. GAEA provides the user with a tool to develop regional maps containing world coastlines, political boundaries, rivers and cities. Sources of geographic data to GAEA currently includes world data bank and digitized data from a data tablet.

GAEA can also be used to quickly generate a digital data base representing any figure or drawing.

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The portion of GAEA currently operational provides the user with the capability to easily interface with a data tablet (Bit-Pad-One). Through this tablet, a user can

- Request a change in sampling rate;
- Open/close output files;
- Send vectors or points to the output file;
- Monitor the process on the Ramtek 9400 color display;
- Erase the screen;
- Display tablet status information.

4.5 GRAPHICS SUPPORT LIBRARY

The Graphics Support Library was developed in-house and provides users with a set of routines for performing transformations. In particular, the library includes the needed auxiliary routines to generate various map projections. Table 4-1 presents a list of these routines along with a brief description of the functions performed.

TABLE 4-1

Graphics Support Library

CURSOR	Designs a new cursor font.
GMPRD	Multiplies two general matrixes to form a result matrix.
FRAME	Generates a frame for the palette routine on Ramtek.
PALETTE	Fill 64 frame elements with 64 different colors.
VLTZIP	Rotates the video look-up table once.
ALIGN	Generates video alignment dots on the Ramtek.
SETUP	Performs level 3 Ramtek initialization and video look-up table.
BITPAD	Performs interactive control of the data tablet.
RECSPH	Performs rectangular to spherical coordinated conversion.
SPHREC	Performs spherical to rectangular coordinated conversion.
SPHLL	Performs spherical to Lat./Lon. coordinate conversion.
LLSPH	Performs Lat./Lon. to spherical coordinate conversion.
RECLL	Performs Lat./Lon. to spherical coordinate conversion.
LLREC	Performs Lat./Lon. to rectangular coordinate conversion.
DECRAD	Performs degrees to radians coversion.
RADDEG	Performs radians to degree conversion.

STEROG	Performs a STEROGRAPHIC projection of Lat./Lon. to X,Y.
LLRECS	Performs Lat./Lon. to equi-rectangular conversion.
LLRECL	Performs equi-rectangular to Lat./Long. conversion.

5.0 DATA MANAGEMENT

Contained in this section are the current capabilities available for data managment. The tools discussed are RMS-11 and DATATRIEVE (both of which were purchased from Digital Equipment Corporation).

5.1 RMS-11 RECORD MANAGEMENT SERVICES

Record Management Services (RMS) provides a set of general purpose file handling capabilities. RMS-11 allows user-written application programs to create, access, and maintain data files with efficiency and economy. RMS-11's variety of file organizations and access modes give the user the ability to choose those methods best suited to the application. RMS-11 files can be organized sequentially, relatively and by the indexing method. Based upon these file organizations, RMS-11 records can be accessed sequentially, randomly by relative record number, or by indexing on one or more keys.

5.2 DATATRIEVE

DATATRIEVE is an inquiry language and report writing system that provides direct, easy access to data contained in RMS files. It allows you to look at data, change it, or sort it interactively. You can add new records to a file, delete old ones, or modify existing ones to maintain an accurate, up-to-date file. In addition, DATATRIEVE provides report generation aids for creating reports in a wide variety of formats.

DATATRIEVE requires no programming skills. Its simple-to-use interactive command language means that even novice users can learn to use it easily.

6.0   SCREEN AND DOCUMENT FORMATTERS

This section discusses tools for formatting both video screens and documents. The screen formatting tools consist of FMS (which was purchased from Digital Equipment Corporation) and DGP (which was developed in-house). The document formatter (RUNOFF) was obtained from the Digital Equipment Users Society (DECUS).

6.1   FORMS MANAGEMENT SYSTEM - FMS

The Form Management System (FMS-11) software brings the speed, convenience and accuracy of computerized processing to users who have been using printed forms for collecting and transmitting data.

The FMS-11 package consists of three main components. The first, the Form Editor, simplifies creating, modifying and storing forms for future video display. The second component, the Form Utility, allows a user to create and manipulate a library of one or more forms or produce a hard copy of forms created by the Form Editor. The final component, the Form Driver, permits an application program written in either COBOL-11, BASIC-PLUS-2,FORTRAN IV, FORTRAN IV-PLUS, or Macro-11, to display forms created by the Form Editor and gather information recorded in the form by the user.

6.2   DISPLAY GENERATION PACKAGE - DGP

The Display Generation Package (DGP) is a general purpose graphics package which can generate either static displays or dynamic displays on any graphics terminal which supports Tektronix PLOT 10 or Calcomp-type software. DGP is a set of FORTRAN routines and is accessed through a user-defined calling program.

Three types of display format may be created with this package: tabular, geographic, and tabular/geographic combinations. Within each category, the actual format is defined by the user since DGP accepts as input both the display content and format. Basically, the package consists of a main driver, which serves as the user interface, several flags to establish proper display update, shared Common Block data to provide dynamically changing display data, and a number of support routines which read the user input and generate the displays.

6.3   DOCUMENT FORMATTER -RUNOFF

RUNOFF is a program to facilitate the preparation of typed or printed documents, such as reports, manuals, etc. The user prepares his material on any terminal using an appropriate editor. The user

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includes not only textual material, but also case and formatting information. RUNOFF then takes the generated file and reproduces it onto a line printer or terminal. It performs all the formatting and case shifting as directed and will also perform line justification, page numbering and titling, etc., as directed.

7.0 CONCLUSIONS

As can be observed, the software currently available at the C^2 CONCAP facility consists primarily of commercial off-the-shelf software or general purpose user developed routines. This approach has been taken to allow the facility to be used more effectively as a development and evaluation tool. This approach will continue in the future along with the continued review and evaluation of new software packages and tools.

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