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**AESOP: A GENERAL PURPOSE APPROACH TO REAL-TIME,  
DIRECT ACCESS MANAGEMENT INFORMATION SYSTEMS**

JUNE 1966

J. Spiegel  
J. K. Summers  
E. M. Bennett

Prepared for  
**DEPUTY FOR ENGINEERING AND TECHNOLOGY  
DIRECTORATE OF COMPUTERS**

ELECTRONIC SYSTEMS DIVISION  
AIR FORCE SYSTEMS COMMAND  
UNITED STATES AIR FORCE  
L. G. Hanscom Field, Bedford, Massachusetts



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**Project 5050**

Prepared by

THE MITRE CORPORATION  
Bedford, Massachusetts

Contract AF19(628)-5165

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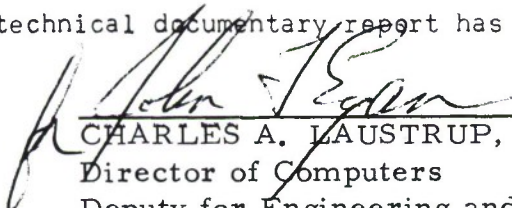
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## FOREWORD

The contribution of Joyce Wiatroski in the designing and programming of the illustrated management information system of the future is gratefully acknowledged.

This technical documentary report has been reviewed and is approved.

  
\_\_\_\_\_  
CHARLES A. LAUSTRUP, Col, USAF  
Director of Computers  
Deputy for Engineering and Technology

## ABSTRACT

AESOP, a laboratory-based prototype of a general purpose, on-line, visually-oriented information system, is used to investigate ways of handling many different types and levels of command and management problems spanning organizational levels from the executive suite down through the staff and operations analysts to the actual system designers and programmers. In particular, it deals with those organizational activities that require highly flexible, direct-access capabilities.

The system is configured for easy use by the inexperienced as well as by the sophisticated, and utilizes a variety of user station devices to facilitate such flexibility, including a cathode-ray-tube display, a lightgun, a typewriter, and associated push-buttons. At each station, it is capable of generating, editing, and formatting information on-line, as well as building, executing, and debugging on-line the analytic and mathematical procedures and algorithms of both the users and the system itself, depending upon the organizational area or level of the user. Although the basic prototype system was developed for use in military command and management planning and information systems, its philosophy and concepts are applicable to industrial and academic organizations.

AESOP: A General Purpose Approach to Real-Time  
Direct Access Management Information Systems \*

Electronic data processing has made available to organizational management vast resources of timely, accurate, and current data. It has given them the support of powerful and rapid computational facilities capable of manipulating such data for wide varieties of managerial purposes. However, techniques for the managerial use of this electronic capacity for data storage and retrieval, or this capacity for the analysis of complex operational models, are only in their infancy. The future of computer-aided management is reflected not so much in the past utilization of data processing by industrial organizations as it is reflected in the military utilization of complex data processing. The United States Air Force recognized, at the start of the computer revolution over a decade ago, that the full power of central processing and central memory was most useful only when that power was delivered in real-time to the desks of the users of the system.

When the power of direct-accessing techniques is realized in industrial organizations, we can look forward to the same radical innovation and reorganization of organizational life and operational behavior that military command experienced earlier. An indication of future information systems that might be used for on-line interactive computer management can be obtained if we start with our knowledge of the remote station techniques for directly accessing central

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\* This paper was presented at the American Management Association meeting in New York, February 1966.

processors and central memory on a time-shared basis within operating military environments, \* and with capabilities such as those of the AESOP Prototype now operating at The MITRE Corporation. Extrapolation from these can yield some small glimpses into what will become the new world of organizations.

It is well not to forget that the vast superiority of telephone communication over telegraphic communication in today's day-to-day management activities stems not from the fact that one or the other is more conducive to central switching, to dialing, to long-lines transmission, or similar central system activities, but rather from the fact that the technology of the direct-access telephone handset makes it possible for anyone to use the power of the central communications system with personal ease and efficiency. In much the same sense, the power of tomorrow's time-shared, on-line, direct-access data processing will not come when the keyboard of the computer console is placed alongside the desk of the manager. It will come when the tools of the on-line manager can be placed on his desk, as easy for him to use as his telephone, and will bring all of the power of the system to him on his own unique terms. If a time-shared direct access system terminates in a multiplicity of teletypes or typewriter keyboards, the system then becomes a direct access system for programmers, for scientists and engineers, or for clerks or other classes of personnel willing and able to communicate with the central processor through such devices.

For senior management, however, the mechanism of communication with the processing system must be far more capable of doing what the telephone does for him now. It must permit him to interact with the processor without having to learn a new language or code, without having to know how to type,

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\* For example, the North American Air Defense Command.



without having to wait until the processor noisily hammers out its message to him one printed character after another. The typewriters, teletypes, and even the vast arrays of pushbuttons that so often accompany current and popular impressions of direct access management systems are still of much value, but only in the hands of the skilled technicians whose jobs require their special capabilities.

Let us start our look at the AESOP-like management system of the future at the desk of the manager of the future.\* The manager of the future has on his desk, in addition to his telephone, a small cathode-ray-tube display, much like a small TV set, capable of generating strings of alphanumeric characters, maps, charts, graphs, and many of the other normal visual records which managers now are accustomed to experiencing by means of reports, documents, letters, memoranda, and similar paper products.

Each display in the AESOP Prototype consists of a page of a file resembling a notebook where each page has 30 lines numbered consecutively and there are as many pages as there are such sets of 30 lines. Each display has a set of columns that are referred to as a section of a file. There are as many sections as there are sets of columns. The user's selection of a specific page and section of a file specifies a subset of lines and columns. Customarily, but not necessarily, lines identify objects, columns identify properties, as shown in Figure 1.

The user's notebook contains as many files as are required to hold the organization's data base, and also an arbitrary number of files with completely

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\* Keep in mind, however, that everything discussed below exists today either in the military or in the laboratory, and represents nothing more than current technology.



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PAGE #1 OF #1  
SECTION #1 OF 18

AIRFIELD	AIRFIELD ORDNANCE STATUS	AS OF 05/08/82							
LN	NAME	COUNTRY	LAT	LONG	ELEV	REF-NO	MAINTCE		TABULAR
#01	ABADAN	IRAN	3023N	4814E	10				TREE
#02	AHMADNEST	IRAN	3119N	4838E	50				FILE MANIP
#03	AHMADNORTH	IRAN	3121N	4848E	40				ERASE
#04	BATMAN	TURKEY	3755N	4108E	1745				COPY
#05	DEZFUL	IRAN	3223N	4828E	500				
#06	HARADAN	IRAN	3450N	4832E	5731				
#07	ISFAHAN	IRAN	3237N	5141E	5238				
#08	JASC	IRAN	2959N	5745E					
#09	KERMAN	IRAN	3015N	5008E					
#10	KERMANSHAH	IRAN	3419N	4707E	4331				
#11	KURUMABAD	IRAN	3326N	4818E	3750				
#12	MIRJANA	IRAN	2921N	5120E					
#13	QOM	IRAN	3441N	5051E	3000				
#14	BHIRAZ	IRAN	2932N	5238E	4998				
#15	SULTANABAD	IRAN	3407N	4944E					
#16	ZAHIDAN	IRAN	2928N	5054E					
#17									NEXT PAGE
#18									PREV PAGE
#19									
#20									NEXT SECT
#21									
#22									PREV SECT
#23									
#24									RESTORE
#25									
#26									DISP LINE
#27									
#28									DO
#29									
#30									PRINT

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Figure 1. Page 1 Section 1 of a File Dealing with Airfields

blank pages that serve as the environment within the notebook in which the individual user builds his private data base and personal report formats.

In addition to this relatively standard capability, there is his lightgun. The lightgun is a small photoelectric device capable of sensing any of the signals appearing on the desk top display whenever it is simply pointed at the location of that signal. The signal is then referenced back to the central processor in order to indicate the user's intention or desires. By pointing to critical elements on the display, the user has a relatively simple and reliable mechanism for communication and interaction with the processor. If the user of the lightgun wants the computer to perform some action, he merely points this pointer at the appropriate command displayed to him on the display, and the computer will operate accordingly. Figure 2a shows a displayed portion of a file — in this case page 1 section 1 of a file dealing with Visitors. Figure 2b shows that same file with the lightgun firing on one of the side commands, NEXT PAGE. Figure 2c shows the same file but now with page 2, section 1 displayed. In the same manner, one can communicate to the processor desires for other changes.

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PAGE 01 OF 02  
SECTION 01 OF 01

VISITOR		VISITOR REGISTER				VISITOR DATA			OF VISIT	
LN	SURNAME	FIRSTNAME	RANK	BR	ORG	DAYS	MONTH	YEAR		
#01	LEWMAN,	ARNOLD,	B-GEN	USAF	AU	20-20	APRIL	1965	* TABULAR	
#02	CALBERTSON	ALLMAN,T.	B-GEN	USAF	RADC	22-20	MARCH	1965	* TREE	
#03	HARDWAY,	E.S.	B-GEN	USA	ANC	21-23	JUNE	1965	* FILE MANIP	
#04	HEUSCHE,	GEORGE,H.	A-COJ	RCAF	JBHD	17-19	MAY	1965	* ERASE	
#05	RICHARDSON	ROB.C.3RD.	B-GEN	USAF	FSC	22-25	MARCH	1965	* COPY	
#06	AUGUST,	JACK,H.	COL	USAF	TAC	20-22	SEPT.	1965		
#07	ANDERSON,	REID,J.	COL	USAF	MATS	20-22	SEPT.	1965		
#08	BALESTRI,	WILLIAM,L.	CAPT	USN	IND	18-20	AUG.	1964		
#09	BALLUCO,	LAWRENCE,H.	COL	USAF	AFMDC	20-22	SEPT.	1965		
#10	BALDIDGE,	J.A.	CAPT	USN	IND	20-22	SEPT.	1965		
#11	BANKER,	ROBERT,D.	COL	USAF	RTD	18-21	JAN.	1965		
#12	BARRY,	ROBERT,A.	COL	USAF	NORAD	20-23	JULY	1964		
#13	BAVARD,	MICHAEL,F.	COL	USA	ESD	09-11	JUNE	1964		
#14	BECKWITH,	JAMES,D.	COL	USAF	ADC	18-19	NOV.	1964		
#15	BEST,	WILLIAM,H.	COL	USAF	AFCS	22-25	MARCH	1965		
#16	BINDING,	GEORGE,P.	COL	USAF	AFCP	21-24	SEPT.	1964	* NEXT PAGE	
#17	BISHOP,	EDWARD,L.	COL	USAF	SAC	18-19	NOV.	1964	* PREV PAGE	
#18	BOLSTRIDGE	LESLIE,J.	COL	USAF	SECOR	21-23	JUNE	1965	* NEXT PAGE	
#19	BRANDENBERG	V.FRANK,E.C.	COL	USAF	ESD	18-21	JAN.	1965	* NEXT SECT	
#20	BROWN,	CHESTER,L.	COL	USAF	SAC	18-20	OCT.	1965	* NEXT SECT	
#21	BUEL,	JOSEPH,G.	COL	USAF	TAC	19-20	OCT.	1965	* PREV SECT	
#22	BUTLER,	HENRY,F.	COL	USAF	STRIC	18-21	JAN.	1965	* NEXT PAGE	
#23	CAMPBELL,	FRANCIS,H.	COL	USAF	AFLC	21-23	JUNE	1965	* NEXT PAGE	
#24	CABELL,	WILLIAM,L.	COL	USAF	AFCS	18-21	JAN.	1965	* NEXT SECT	
#25	CASTLE,	VERNON,H.	COL	USAF	AFLC	17-19	MAY	1965	* NEXT SECT	
#26	CRAVEN,	SAMUEL,C.	COL	USAF	HO-AP	18-20	AUG.	1964	* DISP LINE	
#27	CRISBY,	JOHN,N.	COL	USAF	AFSC	09-11	JUNE	1964	* DO	
#28	CULBERTSON	WILLIAM,H.	COL	USAF	SAC	18-21	JAN.	1965	* PRINT	
#29	CAPIRELLI,	EDMOND	COL	USAF	ATE	18-20	AUG.	1964		
#30	DAVIS,	JAMES,H.	COL	USAF	MSG S	09-11	JUNE	1964		

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Figure 2a. Page 1 Section 1 of a File Dealing with Visitors



Figure 2b. Lightgun Firing on Marginal Command NEXT PAGE

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PAGE 02 OF 02  
SECTION 01 OF 07

VISITOR		VISITOR REGISTER				VISITOR DATA			
LN	SURNAME	FIRSTNAME	RANK	BR	ORG	DATES	OF	VISIT	
						DAYS	MONTH	YEAR	
#21	DEMLING,	PAUL, L.	COL	USAF	ESD	19-21	JAN.	1965	. TABULAR
#22	DELONGA,	PETER, R.	COL	USAF	AFLC	15-19	FEB.	1965	. TREE
#23	DICKERSON,	ROBERT, H.	COL	USAF	HO-AF	26-29	APRIL	1965	. FILE MANIP
#24	DIOKEY,	THOMAS, P.	COL	USAF	SAC	09-11	JUNE	1964	. ERASE
#25	DONICS,	WILLIAM	COL	USAF	AFCB	22-22	SEPT.	1965	. COPY
#26	DORNEY,	PAUL, A.	COL	USAF	HO-AF	22-23	JUNE	1964	
#27	DOTSON,	HERBERT, F.	COL	USAF	ESD	18-20	AUG.	1964	
#28	DUTCHER,	RICHARD, F.	COL	USAF	NORAD	19-20	OCT.	1965	
#29	EARLE,	WILTON, H.	COL	USAF	ADC	21-24	SEPT.	1964	
#30	HERTZ	ALBERT	COL	USAF	HO-AF	26-29	APRIL	1968	
#41									
#42									
#43									
#44									
#45									. NEXT PAGE
#46									
#47									. PREV PAGE
#48									
#49									. NEXT SECT
#50									
#51									. PREV SECT
#52									
#53									. RESTORE
#54									
#55									. DISP LINE
#56									
#57									. BO
#58									
#59									. PRINT
#60									

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Figure 2c. Page 2 Section 1 of The Visitor File

When the processor has a question, the acceptable set of responses to that question may be displayed to the viewer at his desk, and he, in turn, may indicate his response by pointing out the correct alternative. If he wishes to add messages or data to either a public file or his own private files, he may do so through the use of the simple pointer, pointing his way to a display of letters or words in sequence and thereby building his message. However, in no case should he have to remember the syntax or index necessary for using the system. Communicating with a computer via a prescribed language can present a training problem when there are many users of the computer. To improve this situation in AESOP we have taken the syntax of the primary subset of the input language and presented it to the user on the display scope in the form of a tree. This tree structure allows an operator to see the legal forms of an input message by going down one of the various paths or limbs of the tree. A copy of this syntax tree is shown in Figure 3. If the communication is more extensive, the manager can always ask his secretary to enter his message by





Let us now look at the way in which some of the more conventional activities of today's world might be performed in the world of the future. Imagine an executive arriving at his office in the morning and sitting down behind his desk. On his desk is a small cathode ray tube display and a lightgun that he uses to interact with his system. Like all managers, the first thing he does is to call up a display showing his appointment schedule for the day. The first display he sees is shown in Figure 4a. It gives the schedule for the first working day of the month. As indicated in Figure 4b, he turns the page in his schedule to get to the schedule for the day in question, January 4. Having examined his calendar, he notes that he has a conference for 11:00 a. m. and it is scheduled to carry through lunch. He further notes that the discussion is going to deal with a specific corporate project. The name of the visitor, Colonel Hertz, strikes a familiar bell to the executive but he cannot quite place the exact context of his remembrance. He, therefore, asks the system for a retrieval from the organization's background files on visitors and other very important people. This file might be one containing information concerning the individual's organization and position, the dates of any past visits, and other significant corporate intelligence necessary to facilitate dealing with the visitor. However, rather than accessing this file directly by himself, the executive may ask his secretary to do it for him.

The secretary may elect to use her typewriter, as shown in Figure 5a. The computer responds to her typed command by displaying the job title, organization, visit dates, and purpose of his past visits, as shown in Figure 5b. While examining this display the manager may note that a particular project leader has been responsible for the previous contacts with this visitor. He then requests from that project leader a complete briefing on the status of the project in question prior to the arrival of the visitor. In order to do so he simply instructs his secretary to send a memo to the project leader with copies to all

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SECTION 01 OF 06

JANUARY CALENDAR FOR JANUARY

LN TIME A B CC D E + TABULAR
001 MONDAY JANUARY 3 + TREE
002 0800 DR. RILEY EXAMINE EXPENSES FOR CURRENT + FILE MANIP
003 MONTH + ERASE
004 + COPY
005
006
007 0900
008
009
010
011
012 1000 PRESENTATION MAJ. REED
013
014
015
016 + NEXT PAGE
017 1100 REVIEW OBJECTIVES STAFF + PREV PAGE
018
019 + NEXT SECT
020
021 + PREV SECT
022 1200 LUNCH WITH DR. SMITH + RESTORE
023
024 + DISP LINE
025
026
027 NOTE + DO
028
029 + PRINT
030 TURN TO NEXT PAGE

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Figure 4a. Page 1 Section 1 of The January File

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SECTION 02 OF 06

JANUARY CALENDAR FOR JANUARY

LN TIME F G H I J + TABULAR
001 TUESDAY JANUARY 4 + TREE
002 0800 DR. SHILEY RE JOHNSON BID + FILE MANIP
003
004 + ERASE
005 + COPY
006
007 0900
008 DEPT. HEADS MTG.
009
010
011
012 1000
013
014
015
016 + NEXT PAGE
017 1100 CONF WITH COL. HERTZ RE PROJECT 505 + PREV PAGE
018
019 + NEXT SECT
020
021 + PREV SECT
022 1200 CONF CONTINUED WITH LUNCH AT CLUB + RESTORE
023
024 + DISP LINE
025
026
027 NOTE + DO
028
029 + PRINT
030 TURN TO NEXT PAGE

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Figure 4b. Page 1 Section 2 of The January File

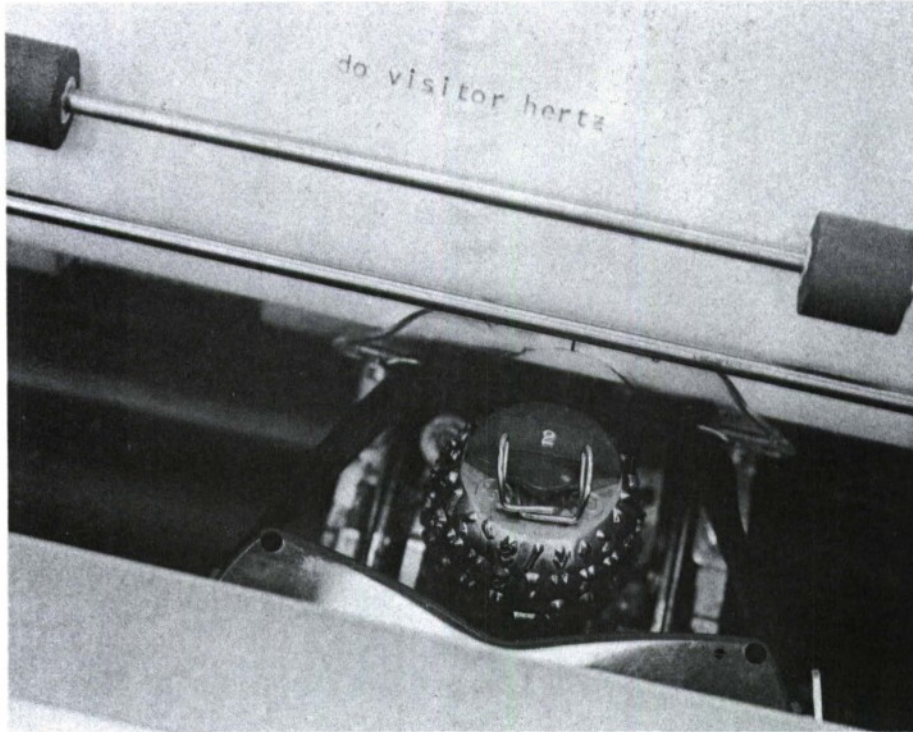


Figure 5a. Typewriter Input Requesting Visitor Information

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PAGE 04 OF 17
SECTION 01 OF 04

TEXTATE
LF A B CC D E F
091 RANK NAME VISITOR ID
092 COLONEL ALBERT J. HERTZ 0002
094
095 JOB TITLE DIRECTOR OF COMPUTER EDUCATION USAF
096
097 ORGANIZATION HEADQUARTERS-USAF
098
099 VISIT DATES 26-29 APRIL 1968
100
101 PURPOSE
102
103 REVIEW NITRE CORP. EXECUTIVE ORIENTATION PROGRAM C
104
105 VISIT LEADER J. SPIEGEL
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120

NEXT PAGE
PREV PAGE
NEXT SECT
PREV SECT
RESTORE
DISP LINE
DO
PRINT

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```

Figure 5b. Visitor Index Card



interested parties telling him that he wants to see him and that he wants to find out more about the visitor and about the project in question. The secretary then indicates to the processor that she wishes to construct an interoffice memo, as illustrated in Figure 6a.

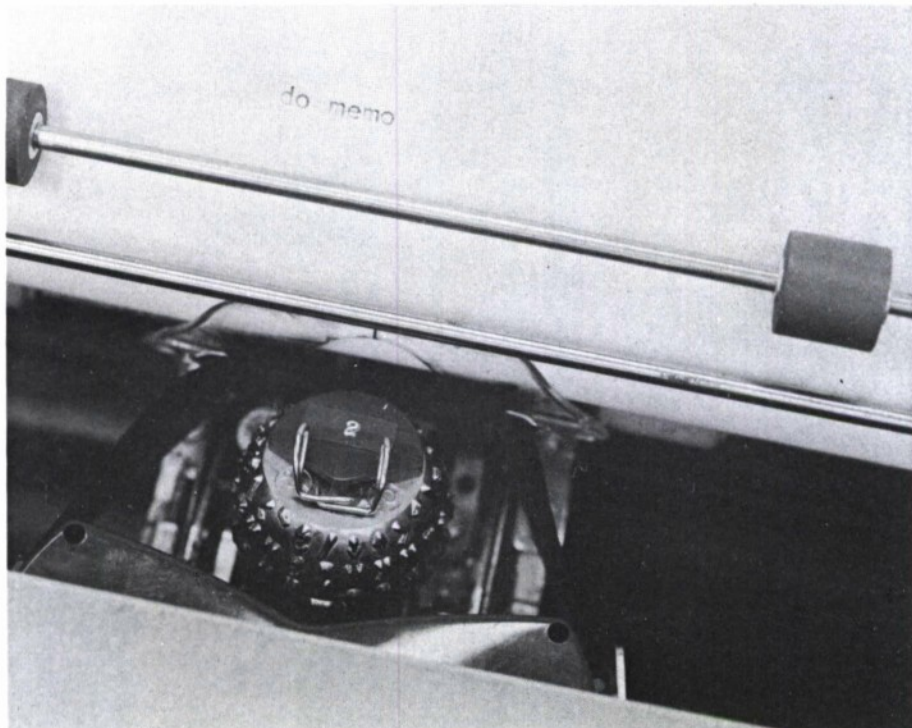


Figure 6a . Typewriter Input Requesting Interoffice Memo Processing

The computer responds to her by giving her the blank form shown in Figure 6b, which she then proceeds to fill in. When it is finished, as in Figure 6c, she may then show it to the manager for his approval prior to transmittal. To transmit this memo to the project leader is nothing more than transferring the message from the file in which the message was constructed to the file that constitutes the electronic in-basket of the particular project leader. At the same

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PAGE 05 OF 17  
SECTION 01 OF 05

TEXTDATE

LN	A	B	CC	D	E	F	
001		TO.				DATE.	+ TABULAR
002		FROM.					- TREE
003		SUBJECT.					- FILE MANIP
004		MESSAGE.					- ERASE
005							- COPY
006							
007							
008							
009							
010							
011							
012							
013							
014							
015							
016							- NEXT PAGE
017							
018							- PREV PAGE
019							
020							- NEXT SECT
021							
022							- PREV SECT
023							
024							- RESTORE
025							
026							- DISP LINE
027							
028							- DO
029							
030							- PRINT

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Figure 6b. Blank Interoffice Memo Form

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PAGE 05 OF 17  
SECTION 01 OF 05

TEXTDATE

LN	A	B	CC	D	E	F	
001		TO, SPIEGEL				DATE, 1-4-79	+ TABULAR
002		FROM, E.M. BENNETT					- TREE
003		SUBJECT, PROJECT 895					- FILE MANIP
004		MESSAGE.					- ERASE
005							- COPY
006							
007							
008							
009		PLEASE GIVE ME A COMPLETE FINANCIAL BRIEFING					
010		ON PROJECT 895 PRIOR TO VISIT FROM COL. HERTZ SCHEDULED					
011		FOR 1 1 AM TODAY.					
012							
013							
014				E.M. BENNETT			
015							
016							- NEXT PAGE
017							
018							- PREV PAGE
019							
020							- NEXT SECT
021							
022							- PREV SECT
023							
024							- RESTORE
025							
026							- DISP LINE
027							
028							- DO
029							
030							- PRINT

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Figure 6c. Completed Interoffice Memo

time that she does this, the secretary may also enter the project leader's appointment with the manager in the manager's electronic appointment book.

Now let us turn our attention to the project leader's desk. He may be using his display to do project scheduling, forecasting or other activities until the priority instruction of his supervisor forces the message to his display. Figure 7a shows his empty electronic in-basket which is soon filled by the priority interoffice memo, as in Figure 7b. As a result of reading the message, he undertakes to prepare the review requested by his manager by calling up various status displays and ending up with the budgetary report shown in Figure 8a. Once again we see that the normal record and paper products of management life appear on this display in a form not very different from the way that it probably would be typed on paper today. In fact, one might well view a display data base as many vast notebooks, handbooks, and files of records available whenever needed and to whomever the organization allows to see the information. In fact, many of today's files that are now maintained on paper are also maintained in the computer.

To continue with our story, the project leader, having reviewed the budget figures, will use his lightgun to copy certain portions of the records into what can be called an electronic vu-graph. The copy message superimposed on the budget display is shown in Figure 8b. After indicating what he wishes to copy into the vu-graph file (Figure 8c) he switches to the vu-graph file and indicates where he wants the information to go, as shown in Figure 8d. The information is then transferred as shown in Figure 8e. This vu-graph file can then be called up later when he wishes to brief his manager. In glancing over this particular vu-graph, the project leader recognizes that line 19 has no data on it and so he erases it as shown in Figures 9a, 9b, 9c, and 9d.

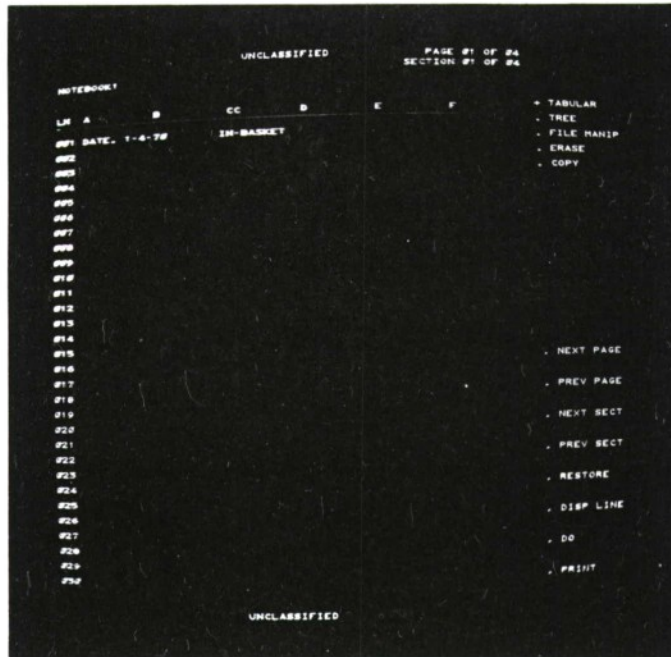


Figure 7a. AESOP Version of Executive In-Basket

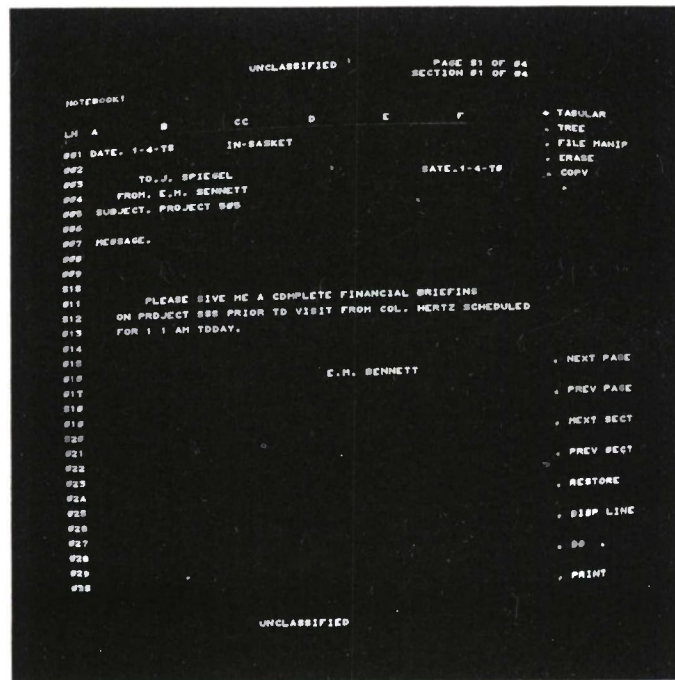


Figure 7b. AESOP In-Basket With Interoffice Memo



UNCLASSIFIED PAGE #1 OF #2  
SECTION 12 OF 12

PROJECT	39	40	41	42	43	44	
				CURRENT YR-TO-DATE		ANNUAL	
				MONTH	TO-DATE	BUDGET	
001 EXPENDITURES.....							+ TABULAR
002 PROGRAMS							- TREE
003 DEPARTMENT OPERATING EXPENSE							- FILE MANIP
004 TECH STAFF DIRECT LABOR				2.472	12.354	29.537	- ERASE
005 TECH SUPPORT DIRECT LABOR				1.637	6.959	20.070	- COPY
006 TRAVEL				100	303	4.455	
007 OVERHEAD				3.275	14.667	39.627	
008 SUBCONTRACT + OTHER DIRECT						1.720	
009 RDT+E FACILITIES							
010 OPERATING CENTERS							
011 1410 COMPUTER						3.420	- NEXT PAGE
012 7050 COMPUTER							- PREV PAGE
013 DISTRIBUTED SUPPORT COSTS				2.220	11.840	23.625	- NEXT SECT
014 ELECTRONIC STORES							- PREV SECT
015 ENGINEERING SERVICES				22	50	000	- RESTORE
016 TECHNICAL INFORMATION				1.097	5.720	20.000	- DISP LINE
017 DATA PROCESSING				119	277	3.000	- DO
018 TOTAL EXPENDITURES							- PRINT
019 PURCHASE ORDER OBLIGATIONS				11.022	51.475	146.000	
020 PURCHASE REGR. IN PROCESS							
021							
022							
023							
024							
025							
026							
027							
028							
029							
030							

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Figure 8a. Budget Report

UNCLASSIFIED PAGE #1 OF #2  
SECTION 12 OF 12

PROJECT	39	40	41	42	43	44	
				CURRENT YR-TO-DATE		ANNUAL	
				MONTH	TO-DATE	BUDGET	
001 EXPENDITURES.....							+ TABULAR
002 PROGRAMS							- TREE
003 DEPARTMENT OPERATING EXPENSE							- FILE MANIP
004 TECH STAFF DIRECT LABOR				2.472	12.354	29.537	- ERASE
005 TECH SUPPORT DIRECT LABOR				1.637	6.959	20.070	- COPY
006 TRAVEL				100	303	4.455	
007 OVERHEAD				3.275	14.667	39.627	
008 SUBCONTRACT + OTHER DIRECT						1.720	.COPY
009 RDT+E FACILITIES							.COPY WITH OBJECTNAMES
010 OPERATING CENTERS							.COPY WITH PROPNAMES
011 1410 COMPUTER						3.420	.COPY WITH OBJECT+PROPS
012 7050 COMPUTER							.COPY WITH OBJECTS ONLY
013 DISTRIBUTED SUPPORT COSTS				2.220	11.840	23.625	.ALLPROPS
014 ELECTRONIC STORES							.THRU
015 ENGINEERING SERVICES				22	50	000	.MOVE
016 TECHNICAL INFORMATION				1.097	5.720	20.000	.BACKUP
017 DATA PROCESSING				119	277	3.000	.NEXT PAGE
018 TOTAL EXPENDITURES							.PREV PAGE
019 PURCHASE ORDER OBLIGATIONS				11.022	51.475	146.000	.NEXT SECT
020 PURCHASE REGR. IN PROCESS							.PREV SECT
021							.COM
022							
023							
024							
025							
026							
027							
028							
029							
030							

UNCLASSIFIED

Figure 8b. Skeleton Message to Allow On-Line Data Manipulation Via Lightgun

```

UNCLASSIFIED
PAGE 01 OF 02
SECTION 12 OF 12

PROJECT
L01 39 40 41 42 43 44 - TABULAR
                                CURRENT YR-TO-DATE ANNUAL
001 EXPENDITURES..... MONTH TO-DATE BUDGET
002 PROGRS DECEMBER
004 DEPARTMENT OPERATING EXPENSE
005 TECH STAFF DIRECT LABOR 2.472 12.354 29.537
006 TECH SUPPORT DIRECT LABOR 1.637 6.259 20.070
007 TRAVEL 180 323 4.433
008 OVERHEAD 3.275 14.667 39.627
009 SUBCONTRACT + OTHER DIRECT 1.720
010
011 RDT+C FACILITIES
012 OPERATING CENTERS
013 1410 COMPUTER
014 ANALOG COMPUTER 3.420
015 7030 COMPUTER
016 DISTRIBUTED SUPPORT COSTS 2.220 11.840 23.625
017 ELECTRONIC STORES
018 ENGINEERING SERVICES
019 TECHNICAL INFORMATION 22 99 600
020 DATA PROCESSING 1.097 5.720 20.680
021
022 TOTAL EXPENDITURES 119 277 3.000
023 PURCHASE ORDER OBLIGATIONS 11.022 51.475 140.690
024 PURCHASE REQS. IN PROCESS
025
026
027
UNCLASSIFIED

```

Figure 8c. Skeleton Message With Partially Completed Parameter Insertion for Copy Message

```

UNCLASSIFIED
PAGE 01 OF 10
SECTION 01 OF 01

VUGRAPH
L01 10 20 30 40 50 60 - TABULAR
                                SPONSOR, ESD
001 THE CORPORATION VUGRAPH NO.
002 RDT+C SUBJECT. DATE.
003 PROJECT.
004
005
006
007
008
009
010
011
012
013
014
015
016
017
018
019
020
021
022
023
024
025
026
027
028
029
030 SOURCE.
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```

Figure 8d. Completed Message for Copy Instruction

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PAGE 21 OF 10  
SECTION 01 OF 21

001	10	20	30	40	50	60	70	80	90	00
001	THE						SPONSOR, ESD			• TABULAR
002	MITRE									• TREE
003	CORPORATION									• FILE MANIP
004	PROJECT, 999						SUBJECT	BUDGET	1-4-78	• ERASE
005										• COPY
006										
007							CURRENT YR-TO-DATE	ANNUAL		
008	EXPENDITURES.....						MONTH	TO-DATE	BUDGET	
009	PROGRAMS									
010	DEPARTMENT OPERATING EXPENSE									
011	TECH STAFF DIRECT LABOR			2,472	12,354	29,537				
012	TECH SUPPORT DIRECT LABOR			1,637	6,059	28,070				
013	TRAVEL			188	303	4,433				
014										
015	OVERHEAD			3,275	14,667	39,027				• NEXT PAGE
016										
017	SUBCONTRACT + OTHER DIRECT					1,728				• PREV PAGE
018										
019	RD+R FACILITIES									• NEXT SECT
020										
021										• PREV SECT
022										
023										• RESTORE
024										
025										• DISP LINE
026										
027										• DR
028										
029										• PRINT
030										

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Figure 8e. Result of Copy Instruction

In much the same way any number of vu-graphs can be prepared, edited and re-formatted on-line, until they are exactly as he may want them.

This has been a very brief introduction into the future world of the manager, in which electronic information displays have started to replace paper as the primary vehicle for organizational life. Of course, this is not really all there is to the management system of the future. As we will see, much of the power of such a system lies in its ability to give a manager direct access to forecasting devices, scheduling tools, and other quantitative methods of modern management which, at the present time, must and can be accessed only through specialists and the intervention of operations analysts and programmers.

An AESOP-like on-line management system must operate for the benefit of many members of an organization. There must be capabilities suitable for use by higher level executives, and at the same time, there must be capabilities



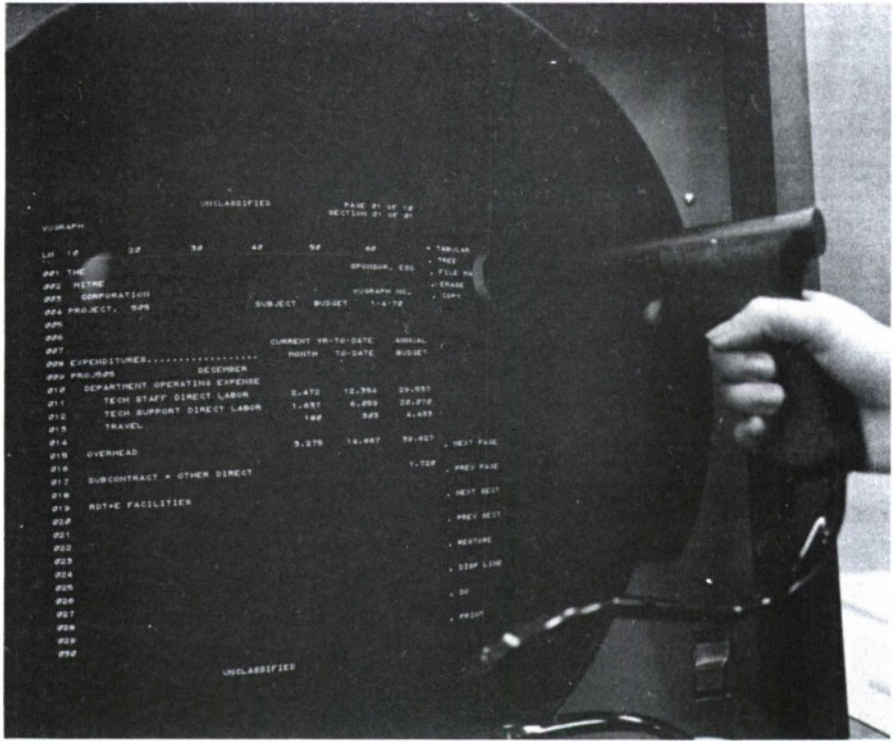


Figure 9a. Lightgun Firing on Marginal Command, ERASE

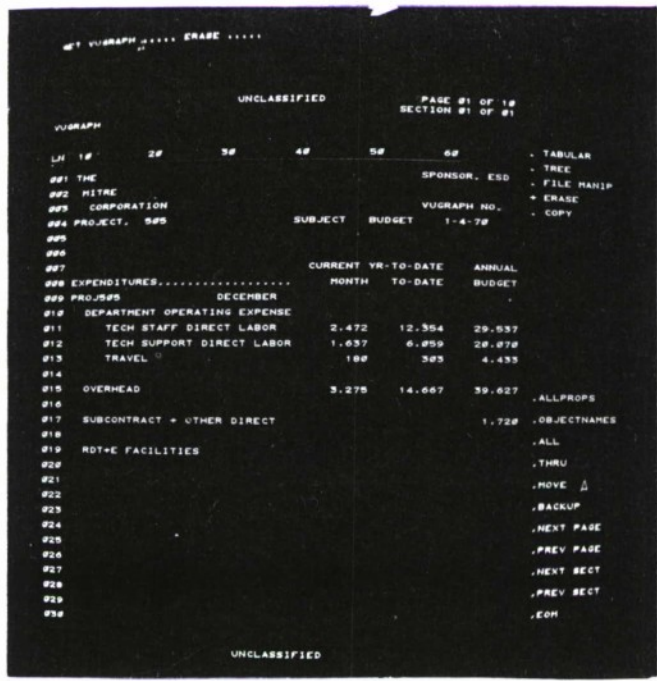


Figure 9b. Skeleton Message to Allow On-Line Data Manipulation

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PAGE 01 OF 10
SECTION 01 OF 01

VUGRAPH
LN 1# 2# 3# 4# 5# 6#
#01 THE SPONSOR, ESD
#02 HITRE
#03 CORPORATION VUGRAPH NO.
#04 PROJECT, SMS SUBJECT BUDGET 1-4-70
#05
#06
#07 CURRENT YR-TO-DATE ANNUAL
#08 EXPENDITURES..... MONTH TO-DATE BUDGET
#09 PROJ.SMS DECEMBER
#10 DEPARTMENT OPERATING EXPENSE
#11 TECH STAFF DIRECT LABOR 2.472 12.354 29.537
#12 TECH SUPPORT DIRECT LABOR 1.637 6.859 20.070
#13 TRAVEL 180 303 4.433
#14
#15 OVERHEAD 5.275 14.667 39.627
#16
#17 SUBCONTRACT + OTHER DIRECT 1.720
#18
#19 ROT+E FACILITIES
#20
#21
#22
#23
#24
#25
#26
#27
#28
#29
#30

```

TABULAR  
TREE  
FILE MANIP  
ERASE  
COPY  
ALLPROPS  
OBJECTSHARES  
ALL  
THRU  
MOVE  
BACKUP  
NEXT PAGE  
PREV PAGE  
NEXT SECT  
PREV SECT  
ECH

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Figure 9c. Completed Message Specifying Line and Columns To Be Erased

```

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PAGE 01 OF 10
SECTION 01 OF 01

VUGRAPH
LN 1# 2# 3# 4# 5# 6#
#01 THE SPONSOR, ESD
#02 HITRE
#03 CORPORATION VUGRAPH NO.
#04 PROJECT, SMS SUBJECT BUDGET 1-4-70
#05
#06
#07 CURRENT YR-TO-DATE ANNUAL
#08 EXPENDITURES..... MONTH TO-DATE BUDGET
#09 PROJ.SMS DECEMBER
#10 DEPARTMENT OPERATING EXPENSE
#11 TECH STAFF DIRECT LABOR 2.472 12.354 29.537
#12 TECH SUPPORT DIRECT LABOR 1.637 6.859 20.070
#13 TRAVEL 180 303 4.433
#14
#15 OVERHEAD 5.275 14.667 39.627
#16
#17 SUBCONTRACT + OTHER DIRECT 1.720
#18
#19
#20
#21
#22
#23
#24
#25
#26
#27
#28
#29
#30

```

TABULAR  
TREE  
FILE MANIP  
ERASE  
COPY  
NEXT PAGE  
PREV PAGE  
NEXT SECT  
PREV SECT  
RESTORE  
DISP LINE  
DO  
PRINT

UNCLASSIFIED

Figure 9d. Result of Erase Instruction

suitable for use by others, equally valuable, to support the forward movement of the system design engineers and system programmers who have responsibility for development, maintenance, and improvement of the system capability.

For the higher level executives, the exercising of algorithms built by his staff of operations analysts can be in the mode of parameter insertion that allows him to call up specific routines requiring only the input of key values. To illustrate this management technique, we have chosen a military example where the problem is to determine the availability of aircraft at up to three bases for assignment to a specific target area. Figure 10a shows the work file in which input data has been loaded for use by the routine. The second section of this same file is reserved for the answer as shown in Figure 10b. A list of routines can be called up and from them we will select one called STATUS1 as shown in Figure 10c. STATUS1 tells us how many aircraft are available at what squadrons, from what bases, what the distance is to the target area, and what the one-way flying time is. The parameters for this routine are the line numbers from which the input data is to be taken and the line numbers on which the output data is to go. Once we have filled in the parameters for this routine to operate as shown in Figure 10d, we lightgun the word EVALUATE and examine the data that this routine has generated. The results are given in Figure 10e.

However, this simple kind of parameter insertion is not enough. The management system must also be able to support the work of the operations analysts and functional area experts whose analyses and quantitative methods constitute much of the power and capability of the system itself. These analyses and quantitative methods require an algorithm-building or construction capability. This too, is part of the present AESOP prototype system.

To illustrate how we make use of this capability, we will now set up a simple multiplication. To do this, we call up the same display shown in Figure 10c.

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PAGE 01 OF 02  
SECTION 01 OF 02

WORK1

LN	NAME	COL1	COL2	COL3	COL4	COL5	TABULAR TOEC
001							
002		AREA	AC-TYPE	00-AC	00-AF		
003							
004		5	F100	0	0		
005							
006							
007							
008							
009							
010							
011							
012							
013							
014							
015							
016							. NEXT PAGE
017							. PREV PAGE
018							. NEXT SECT
019		AREA	AC-TYPE	00-AC	00-AF		. PREV SECT
020							. RESTORE
021		1	F00	1	1		. DISP LINE
022		2	F100	2	2		. PRINT
023		3	F100	3	3		
024		4	F100	4	4		
025		5		5	5		
026				0			
027				7			
028				0			
029				0			
030				10			

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Figure 10a. Page 1 Section 1 of Work File Loaded With Data To Be Used By Routine

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PAGE 01 OF 02  
SECTION 02 OF 02

WORK1

LN	NAME	COL6	COL7	COL8	COL9	COL10	TABULAR TOEC
001							
002							
003							
004		SAGE	SDR	NUMBER	DISTANCE	TIME	
005							
006							
007							
008							
009							
010							
011							
012							
013							
014							
015							. NEXT PAGE
016							. PREV PAGE
017							. NEXT SECT
018							. PREV SECT
019							. RESTORE
020							. DISP LINE
021							. PRINT
022							
023							
024							
025							
026							
027							
028							
029							
030							

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Figure 10b. Page 1 Section 2 of Same File Reserved For The Answer



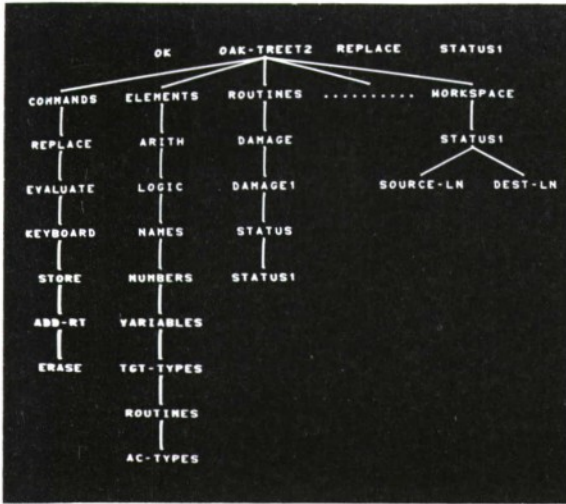


Figure 10c. Algorithm Communication Tree Showing Available Commands, Elements, and Routines

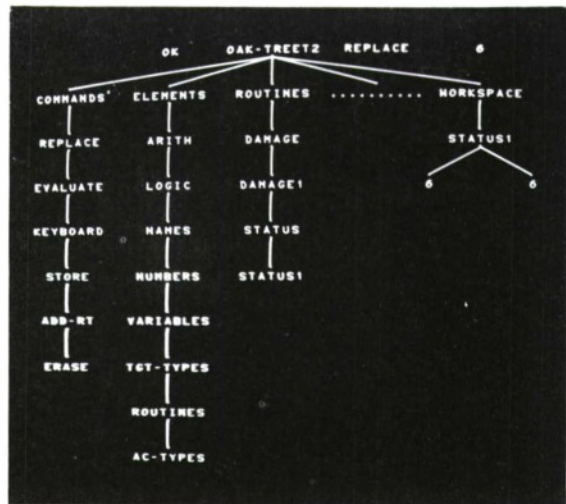


Figure 10d. Inserted Parameters To Be Used With STATUS1 Routine

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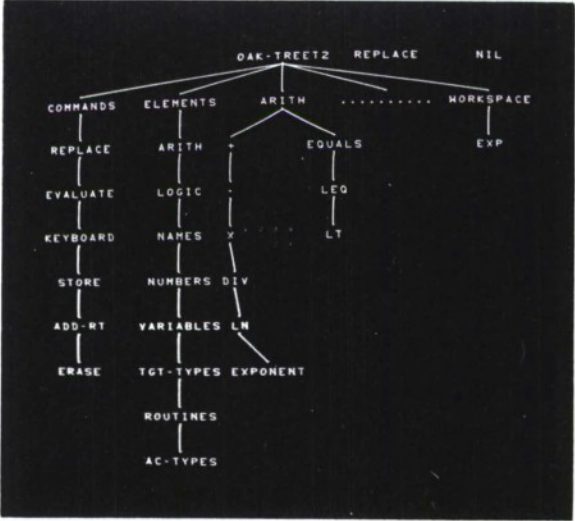
PAGE 21 OF 22  
SECTION 02 OF 02

LN	NAME	COL0	COL7	COL0	CHL0	CHL1	TABULAR
001							. TOCC
002							
003							
004		BASC	0000	00NSR	DISTANCE	710C	
005							
006		ISFAN40	00TFO	15	220	20	
007		SECZFUL	54TFS	15	255	20	
008			55TFS	15			
009							
010							
011							
012							
013							
014							
015							
016							
017							
018							. NEXT PAGE
019							. PREV PAGE
020							. NEXT SECT
021							. PREV SECT
022							. GETPAGE
023							. SIGP LINE
024							. PRINT
025							
026							
027							
028							
029							
030							

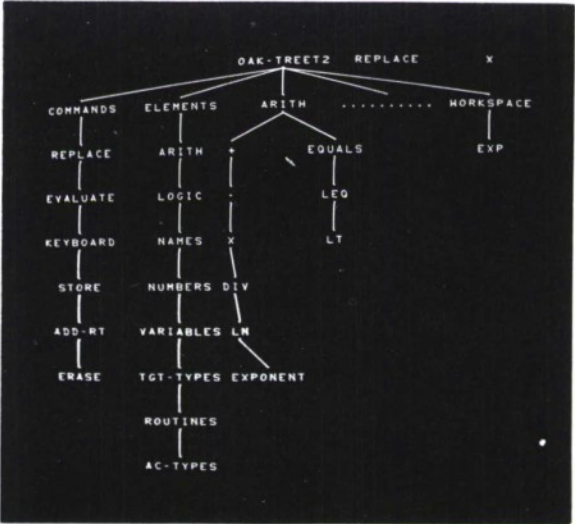
@UNCLASSIFIED

Figure 10e. Result of STATUS1

We then lightgun the ARITH operators in the elements branch. This action causes the display of all of the arithmetic operators available to the user, as shown in Figure 11a. We then lightgun the MULTIPLY symbol in the arithmetic operators, causing it to appear in the upper right of the display indicated in Figure 11b.



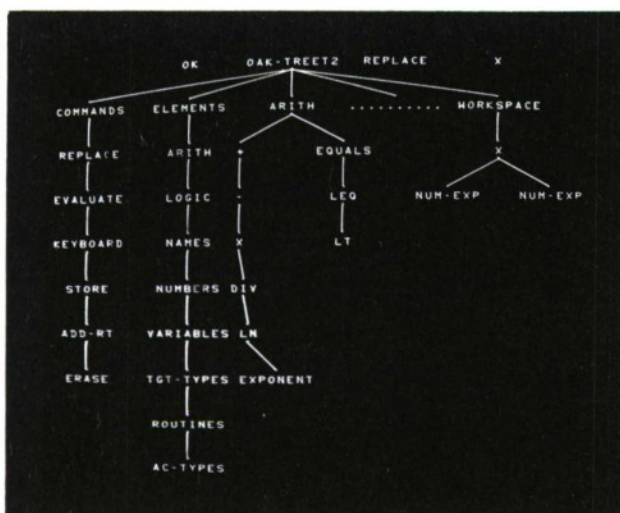
(a)



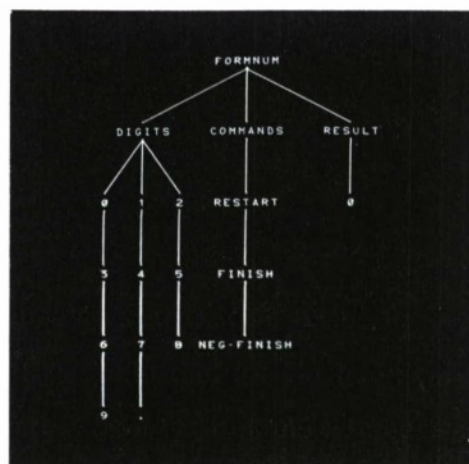
(b)

Figure 11. Steps in The On-Line Construction of a Primitive Procedure to Multiply 30 by 30.

Lightgunning the word EXP in the workspace causes two syntactic limbs to appear under the multiply sign which tell us that we must multiply at least two numeric expressions one by the other, Figure 11c. To obtain some numbers to use in the multiplication, we lightgun the word NUMBERS. The resulting display, Figure 11d, allows us to compose any number we desire by lightgunning the numerals successively from left to right. The constructed number appears under the heading on the right called RESULT.



(c)

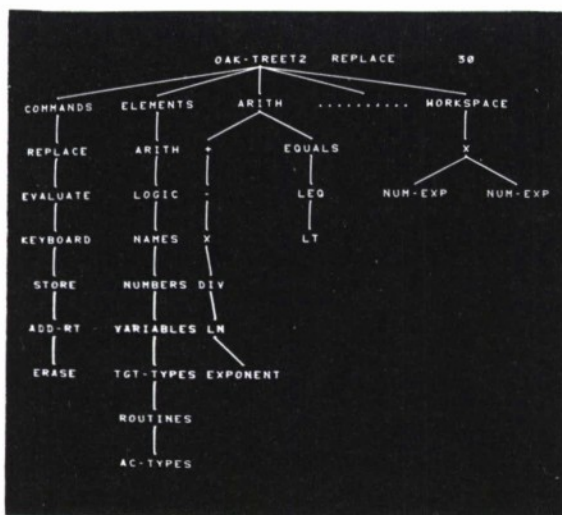


(d)

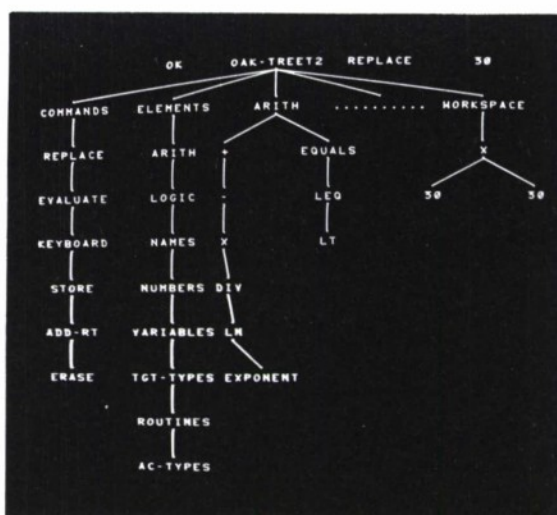
Figure 11. Cont.



The number 30 is constructed by lightgunning the numbers 3 and 0 in succession. Lightgunning FINISH returns us to our familiar display with the number we constructed in the upper right of the display, in this case 30, as shown in Figure 11e. We now have composed a complete command, REPLACE THIRTY, and we will lightgun EXPRESSION in the workspace twice. Figure 11f shows the operation or algorithm we have constructed, "multiply 30 by 30." Having constructed the simple multiplication, we lightgun the word EVALUATE, causing the answer to be printed out on the console typewriter. Figure 11g.



(e)



(f)

```
(X 30 30)
VALUF .. 900
```

(g)

Figure 11. Concl'd.

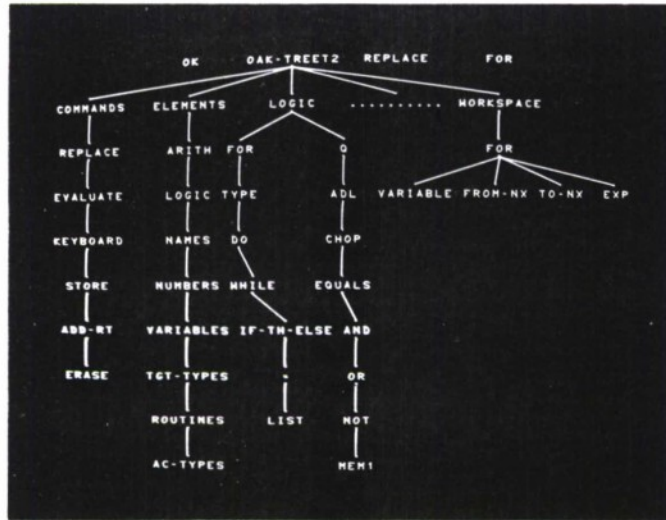
Having shown the principles of use we will now briefly illustrate a logical operation. From the set of logical operators obtained by lightgunning the word LOGIC, we lightgun the word FOR and obtain the display shown in Figure 12a. Once again let us call your attention to the fact that a syntax specification is included. In all cases, wherever an ambiguity could arise or whenever the next action requires a specialized knowledge of the syntax, the system provides this information to the user. In this particular situation, when FOR appears in the workspace it tells us that for some variable from some number to some number we will be executing some expression. From the variable list we pick C, and we will place it in the workspace. We next go to our numbers and construct the number 1. We will place this under the FROM NUMBER in the workspace. In the same way, we construct the rest of the expression until it is in the form we wish as shown in Figure 12b.

The expression now reads, "For C as it goes from one to ten type C, a spacer of four dots and C to the tenth power." We next lightgun the word EVALUATE and again the answer will appear on the console typewriter.

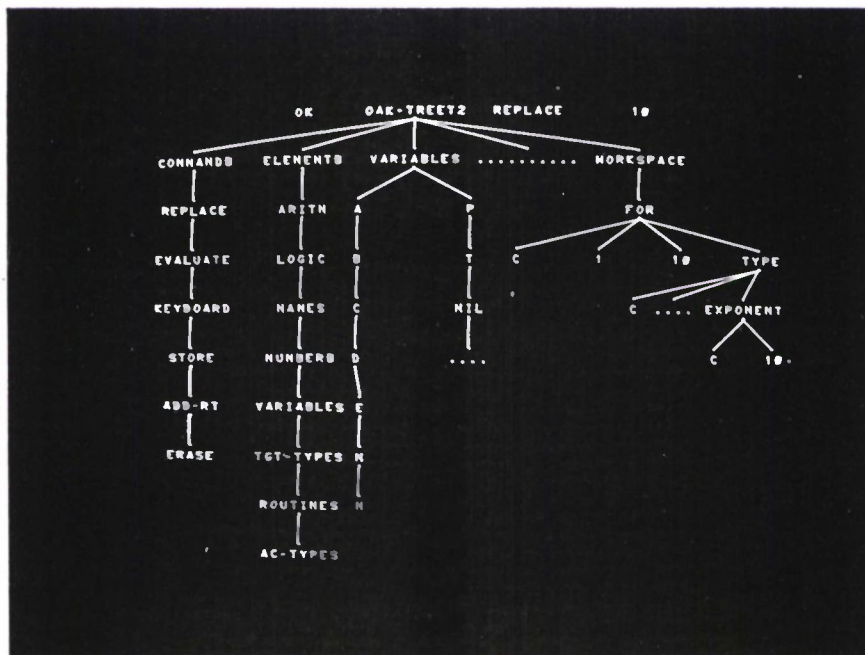
With the two capabilities just illustrated, that is, parameter insertion and analytical method construction, we have a good deal of flexibility, although not enough for real-time management systems.

Essentially, the flexibility of an on-line processing system reflects not only its ability to perform in support of many people at many levels in organization, but also to change on-line, in response to new and changing demands upon it at many different levels and places in the total organization or environment.

When AESOP, or for that matter, any on-line management system, operates in an organizational context, the users of that system have to be able to do more than develop, store, and execute their own job-oriented programs. They must



(a)



(b)

Figure 12. Steps in The Construction of a More Complex Algorithm

also share the common data base, the common data retrieval and updating routines, and the common on-line processing procedures designed to use this data base. At the same time, each of these users must have some ability to modify the system's performance to meet the changing needs of his job, without violating the performance of the system in support of other organizational members whose jobs do not warrant alteration of system capabilities.

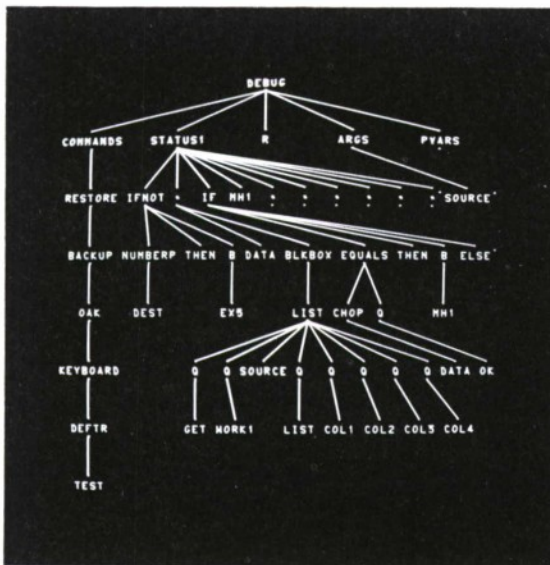
The full flexibility also implies an ability of the system users to change, on-line, the performance of the system, to meet their own changing needs or wishes, while other members of the system are simultaneously using the system in its original form. This implies a design strategy by which the system enables its users to access all of its current capabilities while other users are programming and debugging these changes and modifications. In effect, the system should permit multiple copies of itself to operate simultaneously, thereby making it possible for system supervisors and organizational managers to review alternative forms of system operation in order to agree upon the acceptability of the proposed modifications and extensions.

To aid the on-line programmer faced with debugging problems or with a requirement from higher organizational levels to change given routines, the AESOP prototype has made a provision for this capability. To illustrate this capability we will change the STATUS1 routine utilized earlier, so that we get information on only the closest airfield. To do this we call up a routine called DEBUG. Figure 13a shows the routine code. Note that it is in the same familiar tree structure seen before. On the leftmost limb of the display are some commands to assist us in looking at the routine. When we wish to look through the routine, we can lightgun any node and this node is immediately brought over to the second limb of the tree. Figure 13b shows the statement that we wish to change. Lightgunning the word OAK takes what was in the secondmost limb of

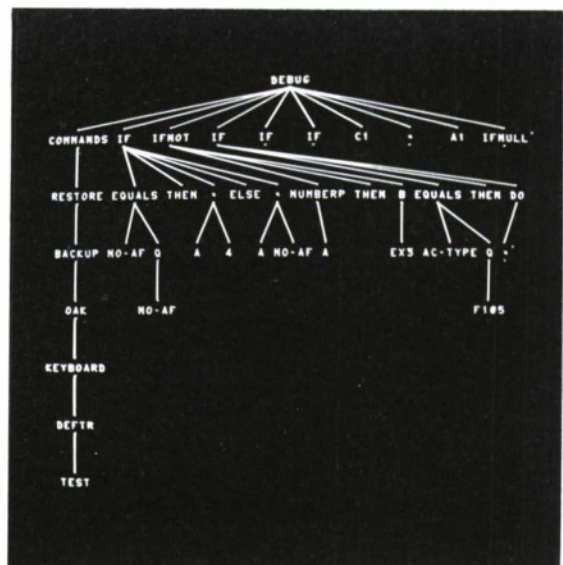
the debug tree into the algorithm format explained earlier, as shown in Figure 13c. This is now available for modification and change. To modify this program we are going to delete the entire expression in the workspace and replace it with the expression  $A = 1$ . The equals tells us that some variable must be set equal to some expression. The expression we are going to use will be simply the number 1, since the variable A controls the number of airfields that are checked. Having modified the expression in the same way we built the earlier algorithms, Figure 13d, we lightgun the command RETURN and the modified expression is placed back in the second limb of the display, Figure 13e. Lightgunning RESTORE brings back the beginning of the routine. Lightgunning DEFTR redefines the routine to include the modifications. The routine can be re-exercised, this time asking that its answer be placed on line 10 rather than line 6. Figure 13f shows the output of both operations.

These three capabilities, parameter insertion, algorithm building, and debugging, together with the capabilities indicated earlier, constitute the AESOP Prototype system. It has something for everyone in the organizational hierarchy. It is this last "something for everyone" that we believe characterizes the management information system of the future.

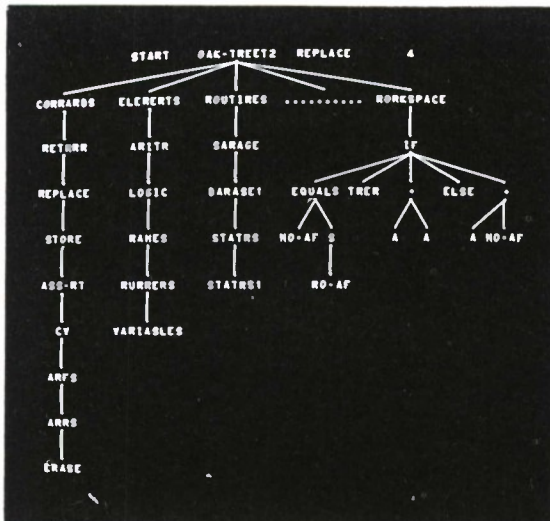




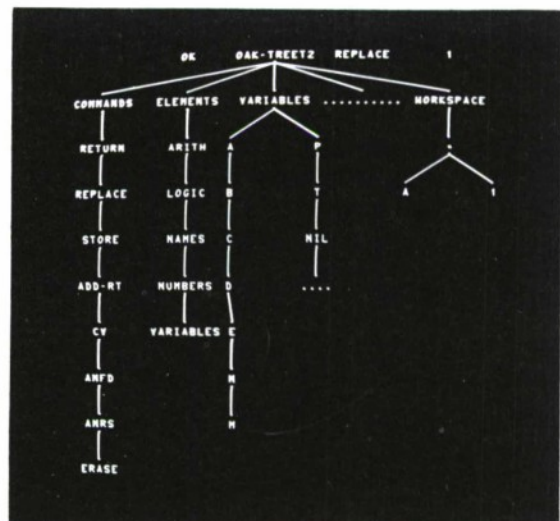
(a)



(b)

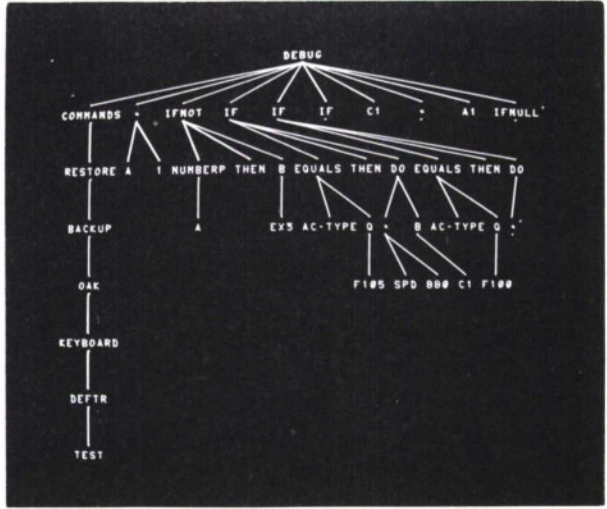


(c)



(d)

Figure 13. Steps in The Modification of an Interpreted System or User Procedure



(e)

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SECTION #2 OF #2

WORK1

LN	NAME	COL6	COL7	COL8	COL9	COL10	TABULAR
001							TREE
002							
003							
004		BASE	SQDN	NUMBER	DISTANCE	TIME	
005							
006		ISFAHAN	56TFS	15	220	26	
007		DEZFUL	54TFS	15	235	28	
008			55TFS	16			
009							
010		ISFAHAN	56TFS	15	220	26	
011							
012							
013							
014							
015							
016							NEXT PAGE
017							PREV PAGE
018							
019							NEXT SECT
020							
021							PREV SECT
022							
023							RESTORE
024							
025							DISP LINE
026							
027							PRINT
028							
029							
030							

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(f)

Figure 13. Concl'd.



## DOCUMENT CONTROL DATA - R&amp;D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) The MITRE Corporation Bedford, Massachusetts		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE AESOP: A GENERAL PURPOSE APPROACH TO REAL-TIME, DIRECT ACCESS MANAGEMENT INFORMATION SYSTEMS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) N A			
5. AUTHOR(S) (Last name, first name, initial) Spiegel, Joseph; Summers, John K.; and Bennett, Edward M.			
6. REPORT DATE June 1966		7a. TOTAL NO. OF PAGES 31	7b. NO. OF REFS 0
8a. CONTRACT OR GRANT NO. AF 19(628)-5165		9a. ORIGINATOR'S REPORT NUMBER(S) ESD-TR-66-289	
b. PROJECT NO. 5050		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) MTP-33	
c.			
d.			
10. AVAILABILITY/LIMITATION NOTICES Distribution of this document is unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Deputy for Engineering and Technology, Directorate of Computers; Electronic Systems Division, L. G. Hanscom Field, Bedford, Massachusetts.	
13. ABSTRACT AESOP, a laboratory-based prototype of a general purpose, on-line, visually-oriented information system, is used to investigate ways of handling many different types and levels of command and management problems spanning organizational levels from the executive suite down through the staff and operations analysts to the actual system designers and programmers. In particular, it deals with those organizational activities that require highly flexible, direct-access capabilities.  The system is configured for easy use by the inexperienced as well as by the sophisticated, and utilizes a variety of user station devices to facilitate such flexibility, including a cathode-ray-tube display, a lightgun, a typewriter, and associated push-buttons. At each station, it is capable of generating, editing, and formatting information on-line, as well as building, executing, and debugging on-line the analytic and mathematical procedures and algorithms of both the users and the system itself, depending upon the organizational area of level of the user. Although the basic prototype system was developed for use in military command and management planning and information systems, its philosophy and concepts are applicable to industrial and academic organizations.			

14.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	<b>COMPUTERS</b> Programming On-line computer systems Time-sharing computer systems Information storage and retrieval Display consoles Management information systems Data retrieval Display control On-line computation Electronic data processing Automatic data processing Military command and management systems Real time systems						

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