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MILITARY MESSAGE EXPERIMENT

Quick Look Report

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The Military Message Experiment (MME) is designed to evaluate the utility of user-oriented message processing systems in a military environment and to aid in determining the features useful in such a system. The experiment is a cooperative effort between the Commander-in-Chief, Pacific, the Navy, and the Defense Advanced Research Projects Agency. To conduct the experiment, a PDP-10-based system has been installed at CINCPAC Headquarters for use by a portion of the Operations Directorate. The message processing functionality is provided by SIGMA, a program

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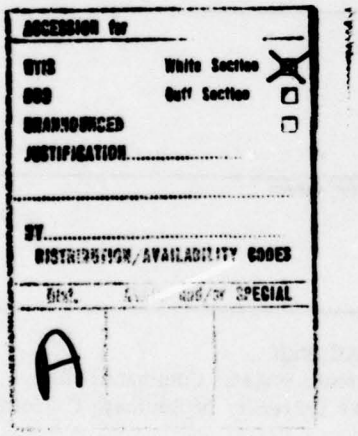
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20. Abstract (Continued)

written by the Information Sciences Institute of the University of Southern California. It is supported by the TENEX operating system, and the user terminals are modified HP-2649A CRTs. The Staff began limited experimental use of the system in July 1978. This interim report discusses the impressions gained during this period; two additional reports are planned, the final to be published in December 1979.

The MME system is designed to give the user the capability to handle his message traffic (both incoming and outgoing, formal and informal) on the system. The system enforces multilevel security rules based on a modification of the security kernel model developed at Mitre. The rule enforcement is not rigorous enough for certification, but it is sufficiently rigorous to determine the effects on the users' interactions with the system. Most of the functions needed for a user's message-related tasks are provided (or will be provided before the end of the experiment) by the system: message distribution and redistribution, "electronic readboard" construction, message filing, message replies, message commenting and "chopping", and message release.

The system has not yet been in use by the staff members as an integral part of their day-to-day activity long enough to justify any conclusions. The general observation is that the system is perceived by the users as useful and that the use of the system will increase as the reliability and functionality of the system increase. As the users transition to the automated system, the data gathering and analyses should provide information that will be useful in assessing the utility of the systems and in determining the appropriate set of functions needed in a user-oriented military message processing system.



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MILITARY MESSAGE EXPERIMENT
QUICK LOOK REPORT

SECTION 1

EXECUTIVE SUMMARY

This report is the first of three reports (two quick-look and one final) to be prepared during the Military Message Experiment (MME); this first report covers the period from May 1977 to Nov 1978. It reports the objectives of the experiment, the specific system being used by the staff of the Commander-in-Chief Pacific (CINCPAC) to perform the experiment, problems and deficiencies encountered to date, general plans for both future experimental efforts and system modifications, and observations of the experiment progress to date. No conclusions are drawn at this point because the report period consisted primarily of experiment set up and Limited Experimental Use (LEU) by the CINCPAC Operations Directorate (J3).

The Military Message Experiment is an effort to evaluate in a formal manner the utility of computer-aided message handling in a military environment. It is also designed to aid in the determination of the type of automation needed in message processing within military environments such as that at CINCPAC. The system is based on the message processing systems developed by the Defense Advanced Research Projects Agency (DARPA) that are used to pass informal messages over the ARPANET and on the additional user requirements within a military staff. Features of the message service system being evaluated include the ability to receive, route, file, draft, edit, "chop", and release formal military messages and internal memos at all levels of classification.

In order to establish a framework for the experiment, a formal Memorandum of Agreement (MOA) [reference (a)] was signed between the Director of DARPA; Commander, Naval Telecommunications Command; Commander, Naval Electronic Systems Command; and Commander-in-Chief, Pacific, in December 1975 and revised in September 1978. Under the MOA, DARPA has general responsibility for the development of the MME system; COMNAVTELCOM acts as the single point of contact for the Navy; COMNAVELEXSYSCOM has general responsibility for evaluation of the MME; and CINCPAC has general responsibility for providing facilities, services, personnel, and support functions.

The MOA identifies the following specific objectives:

(a) determine and demonstrate the usefulness of automated message capabilities and the necessary features to support a military message handling system in an operational environment;

(b) determine the effect of an automated message handling system on operational procedures, manpower, and logistics in an operational environment;

(c) determine the training requirements associated with automated message handling systems;

Note: Manuscript submitted March 8, 1979.

(d) determine the characteristics of an acceptable user interface for an interactive automated message handling system;

(e) determine multi-level security design characteristics and their impact on the user interface;

(f) obtain the data necessary to assist in the future design and development of a family of automated message handling systems for DoD use.

The experiment consists of (a) the installation at CINCPAC Headquarters, Camp Smith, Hawaii, of a fully automated message handling system linked directly to the military AUTODIN communications system via the Local Digital Message Exchange (LDMX) and providing service to selected divisions within the Operations Directorate (J3); (b) on-site operational and maintenance support; (c) on-site training and training facilities; and (d) an evaluation team made up of users, on-site technical specialists, and personnel from NRL, NAVSEA, NAVELEX, MITRE, and CTEC. Information is obtained from machine-compiled user statistics, user surveys, controlled exercises, and the monitoring of staff exercises. The determination of military utility, however, ultimately will depend on a subjective judgment of the value of improved message handling efficiency versus expense and whatever other shortcomings are discovered during the experiment.

The system installed at CINCPAC for the experiment consists of a message processing computer program, SIGMA, and an operating system, TENEX, resident in a Digital Equipment Corporation (DEC) PDP-10 computer with one million (1,048,576) words of memory and a KL central processing unit (CPU). The user terminals are commercial Hewlett-Packard HP-2649A CRTs. They have additional firmware written by ISI and have been modified to meet the TEMPEST requirements for handling classified information. The computer and most of the terminals are located within the CINCPAC security-controlled blockhouse and operate "system high"; external remote terminals are interfaced via encrypted lines. Because of the limited number of terminals to be used in the experiment, it was decided to concentrate them within a selected number of J3 divisions rather than spreading them thinly among all the divisions. At the end of November, 1978, there were 16 terminals installed in the J3 spaces. Current plans are to install additional terminals as available (a minimum of 25 total terminals).

The experiment started at CINCPAC in May 1977 with the installation of the system and the start of a prolonged shakedown and training period. The first version of SIGMA did not provide adequate responsiveness to the users. While some of the problems in responsiveness were caused by inefficiencies in the software and were expected, it appears that the user services provided by SIGMA require more processor power than the developers and evaluators originally estimated. The installation of SIGMA Resease 2.0, in June 1978, and general improvements to the hardware, led to a period of Limited Experimental Use (LEU) by the J3 staff commencing in July. The system at that time was able to support concurrently up to 10-15 users with slow, but generally adequate response, under light loading. SIGMA Release 2.1 in September 1978 further upgraded the responsiveness. In October, 1978, the

original KA Central Processing Unit was replaced with the more powerful KL, and the final memory increment was installed for an increase from the original 256K to the present one-million word capacity. This upgrade has provided a more acceptable response time for the users and allowed for the expansion of the system. The system now provides a basis for a realistic experiment, and no further major upgrade of the hardware is planned.

Three additional software releases (upgrades) are planned:

SIGMA 2.2, January 1979, will provide the improved capabilities needed for the coordinate/release function and increased responsiveness.

SIGMA 2.3, April 1979, will provide discretionary access controls and some additional user features.

SIGMA 2.4, July 1979, is the last planned upgrade and is intended to provide improved file archiving capabilities and some additional user features.

Requests for additional changes will be carefully reviewed to ensure that a sufficiently stable baseline is maintained in order to derive reliable experiment conclusions. During the final evaluation of the experiment, the impact of changing experimental parameters on the result will be investigated. In addition, user-requested changes provide an important input during the evaluation of the experiment.

Of considerable importance to the development of military message systems is the handling of messages and information with different security classifications (the multi-level security problem) and messages with various restrictions on the distribution (discretionary access controls that depend on a particular command's policy). The security policy is intended to ensure that only those with both the requisite security clearance and a bonafide "need-to-know" can obtain access to information contained within the system. The emerging security-kernel technology, based in general on the model described by Bell and Lapadula in reference (b), was chosen as the basis for enforcement of the security controls for the MME system. See references (c)-(e) for a discussion of the security considerations. During the development of the MME system, it was decided that implementing a security kernel using the existing hardware and software would result in a high cost and a low probability of successful certification. The security controls, therefore, are not enforced with the rigor necessary for certification for operation in an "open" security environment. (The computer system and all the terminals are in a secure environment for the experiment.) The approach of designing the security controls prior to designing the system software and user interface, however, has resulted in identifying and clarifying many of the important issues that must be resolved in future secure message processing systems. There are no other large-scale military message processing systems having user interfaces that reflect the restrictions imposed by strict adherence to a formal security policy. The preliminary results of the MME indicate that a facile interface can be provided in a security kernel-based system provided certain minor relaxations in the security model described in reference (b) are made. The security issues will be discussed in depth in the final report.

The MME system provides users the capability to handle all message and memo processing functions directly from a CRT (Cathode-Ray Tube) terminal with ancillary printers to provide paper copy where required. The experiment does not include a precept that paper processing of messages is bad. In fact, one of the experiment goals is to determine the proper balance between hard and soft information, i.e., between the use of paper copies and displays.

The terminal screen itself is divided into different areas (or windows) so that more than one message can be viewed simultaneously. A set of security lights keeps the user informed of the security level of the information in each window and of the security level of the information that the user may be typing into the window; another set of security lights indicates the highest level of information in any of the windows.

Incoming messages from the LDMX are stored in a central data base in the MME. Citations (brief identifying summaries) are routed directly to the administrative section of J3 (J301) who, in turn, electronically routes them for action to the various users. These citations are then assigned to the recipient's pending file (an electronic "in-basket"). A pending file is provided for each office code and for each individual. A user may look at a summary of his pending file to determine pertinent information concerning the messages.

The user may then handle the message in any manner he chooses. He may print a copy for distribution to users who are not on the MME system, print a copy if he is building a hardcopy readboard, or continue to use the MME system to:

(a) include the message in an electronic readboard;

(b) file the message in one or more office files (any number of files may be created);

(c) pass it to another code for information or action with or without comments appended;

(d) readdress the message to another activity and release it (or have it released if he doesn't have the proper authority - the command determines which users have release authority);

(e) prepare a reply with automated aid from the MME system; this aid may include extracting from the original or referenced messages, preparing address lists based on the original message, and formatting the draft reply:

(f) pass a draft message to other J3 codes for chop and comment and then rewrite the message based on appended comments that are returned;

(g) pass a final draft message to the releaser for release and automatic transmittal to the AUTODIN system; or

(h) prepare an internal memo in a manner similar to (e) above, chop it, and "sign" it out in a manner similar to that for a message.

All of these functions may either be performed personally by the action officers at the CRT terminals, or with various degrees of assistance from clerks, where typing or routine matters are involved. Supplemental paper for handwritten drafts or hard copy distribution can be used as desired.

During the period of Limited Experimental Use (LEU), the J3 staff has been replicating the established paper-processing procedures with the MME system. With only limited exceptions, however, the MME system has not yet been used as the primary method of message handling, and only test messages have been released from the MME system to the LDMX. Most of the potential users have taken advantage of this LEU period to develop familiarity with the Automated Message Handling concept and functions. Some, of course, have adapted to it well while others have found it difficult to use. The specific comments of all the users, however, are important to the experiment in determining both the overall utility of the concept and the value of individual functions. Section 8 contains the comments provided directly by CINCPAC on the system's use to date.

The efforts of the developers to date have been directed to installing and providing a system that, as a minimum, will be able to support a sufficient number of users to test the concept of handling information within a major segment of the staff and will provide the users with enough confidence that the system will be used as the primary mode of message processing. Until these levels of use and acceptance are reached, there can be little confidence in any preliminary results of the experiment. The hardware and software upgrades described previously are addressing the speed of response, the capacity of the system, and CINCPAC's minimum functional requirements. In addition, there are installation and terminal problems that also require resolution before these minimum levels can be achieved. In particular, there have been numerous "abnormal terminations" of individual jobs (almost 15% of all jobs in October and November).

The scheduled relocation of the CINCPAC Command Center has required moving terminals and has resulted in a lack of terminals for use by the affected codes during much of the LEU period. Problems encountered in the transmission of the encrypted data to terminals outside the blockhouse have also caused serious problems to certain high-volume users.

It is expected that the minimum requirements for the start of Full Experimental Use (FEU) by CINCPAC (as specified in the test plan [ref (f)]) will be met after the installation of SIGMA Release 2.2 and the resolution of the abnormal termination problems in January 1979. The period of FEU will extend through the end of the experiment in September 1979, and during this time CINCPAC J3 will rely on the MME system to the fullest extent possible. The evaluation team will continue to monitor the system's use and compare it with baselines developed from the earlier paper system. The team will also monitor and review the use and contribution of the MME system during command center exercises and will periodically survey the users to determine the evolution of new procedures within the staff. The team, in close cooperation with CINCPAC J3, will evaluate the general utility and specific functional benefits of the MME system.

The following summarizes the observations that have been made.

(a) The hardware and software have been undergoing significant changes. Neither the users nor the evaluators as of yet have a baseline system to judge; neither has J3 built up sufficient confidence in the system to rely on it for full message-handling support.

(b) A great deal of the information (e.g., operational plans, memos, reports) needed by a user in preparing a message is not available on the MME system. This limitation must be considered when extrapolating the results of the MME to other staff environments.

(c) The system has been in only a limited experimental use (LEU) phase. During the period, there have been occasional system failures that caused users to lose data. Further, there have not been enough terminals available. As a result, many users have not converted all of their message-processing tasks to the MME system.

(d) Step-by-step user guides for various functions (releasing messages, reading incoming messages, composing and sending notes) appear to be effective in encouraging system use.

(e) The features most used to date have been message routing, filing, and retrieval. The routing of messages to those users who have terminals has become an almost automated routine. J301 initiates a series of machine instructions to route the traffic, waits for the MME system to complete the work, and then, still using the MME system, routes any remaining messages. Using this procedure, the time for routing messages can be decreased from approximately four hours with the manual system to approximately one hour using the MME system. The major problem is that all the users served by J301's routing do not have terminals; hence, the manual system cannot be replaced completely. When filing, information copies of messages can be retrieved by users directly from the file by means of various message selectors. Thus, the information copies of messages need not be routed explicitly by J301; rather, he can rely on the users using their own specialized retrieval criteria for the messages. In addition, the users utilize the file-building and message-retrieval capabilities for their personal and organizational files.

(f) The command center and joint reconnaissance center (JRC) watch teams are using the MME system to review their traffic and to create files that reflect particular areas of concern. They then file relevant messages in them for use in creating readboards and preparing sections of the morning brief.

(g) Some action officers are using the MME system to review incoming traffic; to retrieve referenced messages; to create text objects as bases for sections of reports, memoranda, and messages; and to maintain large files relevant to their duties.

(h) The clerical personnel are using the MME system mainly for message retrieval because the traffic is routed directly to the staff officers for their disposal; they also utilize the informal note capability.

(i) The strict enforcement of a security policy using the concept of a security kernel does not appear to have added undue restrictions on the user interface.

It is interesting, although not surprising, that the functions generally considered most desirable at this time (filing and initial message distribution) are the only ones which have been exercised to any great extent during the LEU period. The transition to primary use of the automated system should lead to a better understanding of the advantages and disadvantages of the concept and allow a more thorough evaluation of its utility.

In conclusion, all of the objectives outlined in the MOA are being addressed by the experiment. However, with the exception of multi-level security where most studies have been completed, the use of the system as CINCPAC J3's primary message building tool is necessary to substantiate the observations and fully determine the impact of the MME concept.

The remainder of this report provides more detail on the experiment set up, training, statistical survey results, and user comments. More information is also provided in the referenced documents and reports.

SECTION 2

BACKGROUND

The military message experiment (MME) was conceived to determine the need for and type of further automation in the handling of military messages. The parallels between the user services provided by the message processing systems being developed by the Defense Advanced Research Projects Agency (DARPA) contractors and the user requirements within military staffs led to a Memorandum of Agreement [reference (a)] between the Director, Defense Advanced Research Projects Agency; the Commander, Naval Telecommunications Command; the Commander, Naval Electronics Systems Command; and the Commander in Chief, Pacific. The original MOA was signed in December 1975, and the current version was signed in September 1978. Under the MOA, DARPA has general responsibility for the development of the MME system; COMNAVTELCOM acts as the single point of contact for the Navy; COMNAVELEXSYSCOM has general responsibility for evaluation of the MME; and CINCPAC has general responsibility for providing facilities, services, personnel, and support functions.

The basic elements of the MME include the following:

(a) a PDP-10 computer with the TENEX operating system has been installed in a TOP SECRET facility at CINCPAC and dedicated to running message-handling software for the MME evaluation; it has an on-line connection to the AUTODIN system via the Local Digital Message Exchange (LDMX);

(b) DARPA contractors have developed and installed a message service system on the PDP-10, a terminal interface processor (PDP-11), and a set of user terminals;

(c) members of the Operations Directorate (J3) at CINCPAC Headquarters, Camp Smith, Hawaii, are using the terminals and computer system for receiving and filing messages. With the installation and checkout of revised coordination and release procedures, the system will be used for generation, release, and transmission of messages; this use will continue through September 1979; and

(d) the results of the MME evaluation will be used to influence the specification and design of production hardware and software for future message handling systems in DoD.

GOALS

The primary objective of the MME is to determine the utility of an interactive message service in a major military headquarters. As a part of this determination, alternative features and capabilities must be identified. These requirements will be used as a baseline for developing Automated Message Handling Systems for military use. Accordingly, the following specific objectives have been identified in the MOA:

(a) determine and demonstrate the usefulness of automated message capabilities and the necessary features to support a military message handling system in an operational environment;

(b) determine the effect of an automated message handling system on operational procedures, manpower, and logistics in an operational environment;

(c) determine the training requirements associated with automated message handling systems;

(d) determine the characteristics of an acceptable user interface for an interactive automated message handling system;

(e) determine multi-level security design characteristics and their impact on the user interface; and

(f) obtain the data necessary to assist in the future design and development of a family of automated message handling systems for DOD use.

During the period covered by this report, the MME system has been used only on a limited basis. Full experimental use of the system will begin after the minimum requirements listed in the test plan [reference (f)] are met. Even though the experiment has not yet started, it may be useful to review the objectives against the information gained during the LEU. Any strong inference concerning objective (a) would be premature. The system is certainly being used, but it is too early to claim that the usefulness has been demonstrated. The same is true of (b) and (c); although a substantial training effort has been expended, the results aren't certain until the trained users begin to use the system as a part of their day-to-day routine. The security design appears to have provided an effective user interface (objective (d) and (e)), but this observation, like all others, is subject to confirmation during the experiment. During the selection of the message system for the MME, the design of the security interface, and specifications for the changes to SIGMA, much of the information needed to assist in the development of future message systems (objective (f)) has been obtained. The value of this information, however, is dependent on the determination of the usefulness of the MME concept at CINCPAC.

EXPERIMENT HISTORY

The impetus for the MME was an observation by Congress that there were numerous, apparently uncoordinated, message center developments by the Military Departments. This resulted in a memo from the Director, Telecommunications and Command and Control, OSD, on 26 June 1975, directing that techniques needed for secure interactive message systems be developed. As a result, the principals involved with the MME signed a Memorandum of Agreement in December 1975, leading to the development of an experiment to validate the message processing requirements for all services.

At the time the MOA was signed, there were two efforts funded to develop a military version of an ARPANET message system. Bolt, Beranek, and Newman of Cambridge, Massachusetts, was working on a system that led to HERMES, and the

Information Sciences Institute of the University of Southern California (ISI) was working on what was to become SIGMA. An additional message system had been developed by MIT under other ARPA funding, and it, also, was considered as a candidate for the experimental system.

Preliminary designs for the "militarized" versions of the message systems were generated and discussed during the Spring of 1976. During a design review meeting at CINCPAC in the Summer of 1976, it was concluded that the implementations of the security policy were resulting in an unacceptable user interface. The rigid enforcement of some rules was eased, and the three organizations redesigned the security enforcement mechanisms. From 22 February 1977 to 3 March 1977, a formal evaluation of the three systems was conducted at BBN, Cambridge.

The evaluators concluded that the performance of HERMES was good, but that it lacked the features needed in the military environment, that SIGMA presented the user with an interface and features that would allow the most useful data to be derived from the system, and that the performance of the MIT system, DMS, was too marginal at the time of the evaluation to risk installation in a military environment. The evaluators recommended that SIGMA be chosen as the experimental system, but noted there was a considerable risk in upgrading the performance of SIGMA to an acceptable degree. The selection procedures are documented in references (c)-(e) and (g)-(i).

SIGMA was chosen as the message system, and a plan was developed to correct the known SIGMA deficiencies. An additional 256K of core memory was ordered for the PDP-10. SIGMA was installed for use at CINCPAC in May 1977. The performance was unacceptable, and a group was formed to examine SIGMA and recommend changes to improve the performance. During this study, an updated SIGMA was installed in December 1977, and it also resulted in a system that was not operationally useful.

The entire experiment was reevaluated, a configuration control system for SIGMA releases was devised, another hardware upgrade (KL processor and additional 512K words of memory) was defined, and a new schedule with acceptance critieria was developed.

SIGMA Release 2.0 was installed in June 1978. A period of limited experimental use which supported 10-15 users on-line began in July 1978; the response was generally acceptable under light user load. Changes to increase responsiveness and functionality were made to the software, and SIGMA 2.1 was installed in September 1978. The hardware was upgraded from a KA to a more-powerful KL processor in October 1978. The memory was increased from the original 262,144 words to 786,432 to the final million-word (1,048,576) system in October 1978.

The following software upgrades are planned for the remainder of the experiment.

SIGMA 2.2, January 1979, will provide the improved capabilities needed for the coordinate/release function, increased responsiveness, and the addition of a few user functions.

SIGMA 2.3, April 1979, will provide discretionary access controls and some additional user functions.

SIGMA 2.4, July 1979, is the last planned upgrade. It will provide improved file archiving capabilities and some additional user functions.

The only additional hardware upgrade planned is to complete the installation of all the terminals. The addition of better-quality printers is being considered.

SECTION 3

MANUAL MESSAGE HANDLING

The manual message processing methods in use within the Operations Directorate (J3) prior to the introduction of the MME System are documented in the Baseline Data Report [reference (j)]. This section is a summary provided by the author of reference (j). The information was obtained by questionnaires, checksheets, observation, interviews, and examination of records. The bulk of the data was collected between March and April 1977, and in April 1978.

OVERVIEW OF MANUAL PROCEDURES

Incoming Messages

Messages are sent to CINCPAC via the AUTODIN system. They are received by the Local Digital Message Exchange (LDMX) in the Telecommunications Center. Messages of immediate or higher precedence are routed immediately by the LDMX to a printer in the Command Center. The LDMX identifies an action Directorate for each message. At the Communications Center, copies of the messages are made and sorted for pickup by clerks from the Directorates designated to receive the messages. During duty hours, the Communications Center notifies the Adminstrative Section of the action Directorate when a message of immediate or higher precedence is received.

Within the Operations Directorate, the Administrative Section (J301) sorts the messages and assigns responsibility for each action message. If a message deals with a topic in which an office is known to have special interest or expertise, the message is assigned directly to that office. Copies of action and some information messages are put on readboards for the Director and his Deputy. Messages are held for pickup by some divisions and delivered to others.

In some divisions, messages are reviewed by the division chief, who assigns an action branch or office to each of that division's action messages. In other divisions, action responsibility is almost always assigned by J301; then these messages are delivered to the people responsible for them. In some divisions, message copies are also kept on readboards in the division office for review by the officers.

An officer receives a copy of any message for which he has been assigned action responsibility. His copy of the message may include annotations by his Director or his division chief. The action officer may respond by creating another message, by providing information to answer a question, or by filing the message in a project file. The officers may also need to retrieve old messages for use as references to an outgoing message or to serve as background for their decision making.

At the division and branch level, the clerks and administrative clerks distribute, file, and retrieve incoming messages.

Outgoing Messages

An officer with responsibility for preparing an outgoing message from CINCPAC carries out whatever research is necessary by consulting files of related messages and documents. He drafts the message and usually has it typed by a division clerk. After proofreading and correcting the message, he coordinates the draft with his colleagues and his immediate superior. The initial coordination will often be done face-to-face. Several retypings may be necessary if changes are recommended by each coordinator. Coordination of the final OCR-readable copy of the message is carried out by each coordinator initialing the first page of the message.

When the message is ready for release, the final copy, with a staff summary and/or copies of relevant backup material, is given to the releasing officer for his signature. If he approves transmission of the message, the final copy is carried to the Communications Center. A comeback copy of the transmitted message will later be returned to the originating office and to other directorates designated in the drafter distribution field on the form sent to the Communications Center.

Command Center Message Handling

At the same time that messages are going through the normal routing process, the Duty Director of Operations (DDO) in the Command Center monitors all messages received by CINCPAC. If he receives an important message during duty hours, he may notify the appropriate office immediately as a back-up or follow-up to the Communications Center procedure. After duty hours, the DDO notifies the appropriate Directorate duty officer of a high precedence message. The DDO also selects some messages for the Director's readboard.

A build-up of activity in a sensitive area of the PACOM, whether signaled by high precedence messages or telephone calls, may cause the DDO to recommend that the J3 initiate crisis (or exercise) operations. At these times, the Command Center becomes the center of operations. Special teams are brought in to handle the crisis, while the Command Center Watch Team (CCWT) continues to monitor non-crisis or non-exercise activities and to provide support to the crisis/exercise management teams.

DISTRIBUTION

From the time it is received by the LDMX to the time it is delivered to the division or branch for use by the action officer, an incoming message passes through several phases of distribution. Depending on its precedence and time of arrival, a message may take from one minute to six hours to be processed in the Communications Center. On the average, routine messages are processed in 76 minutes, priority messages are processed in 58 minutes, immediate messages are processed in 24 minutes, and higher precedence messages are processed in five minutes or less. The next step is for the message to be picked up in the Communications Center and processed at the Directorate Administrative Section. Priority messages wait an average of 30 minutes, while routine messages wait an average of 80 minutes to be picked up from the

Communications Center. (Immediate and higher precedence messages are handled by a telephone call by the CCWT, so further processing by the Communications Center is not relevant to the time it takes an officer to see the message the first time.)

Most of the message distribution effort is spent in the Communications Center where message copies are prepared for distribution, and in directorate administrative sections where the initial decisions are made on action assignment and information message routing. Some effort is spent on distribution in the division and branch offices, but this is proportionally less than that spent in the directorate office.

Observation of the staff in J301 showed that they process a batch of messages, on the average, in 25 minutes. This includes time for sorting the batch, assigning action, preparing the messages for pickup or delivery, and preliminary filing. Delivery to the division or branch takes an additional 10 minutes.

The age of the message when it reaches the action officer is related to precedence as well as to the time of day it is printed by the LDMX. Priority messages average two hours from delivery at the LDMX to delivery at the division or branch, and routine messages take an average of three hours to be processed and delivered. Some divisions do not have messages delivered by J301, but send their own runners to the admin section to pick up messages. In these divisions, the messages would be still older upon receipt. See Table 1.

The message load for the J3 Directorate is fairly stable, averaging about 2000 messages a week. At the division and branch level the load is relatively stable for a particular division or branch, but varies considerably from division to division and from branch to branch. Thus, the amount of effort a clerk spends on message distribution depends on the division and branch that he supports.

In the Command Center, the clerk spends some of his time monitoring the printer and distributing these messages to the duty officers. He spends a higher proportion of his time on message distribution than do the division and branch clerks.

MESSAGE REVIEW

A message provides information for action officers, who may need to respond to the message or to save it for future reference. The amount of time spent on message review varies according to the message load. Officers in branches with heavy loads review an average of 11 action messages and 39 info messages daily; they spend about 45 minutes on this review. Officers in some of the other branches receive very few action messages. They spend about 25 minutes daily reviewing an average of 50 info messages. In branches with light loads, only a few action and info messages are received, and about five minutes are spent reviewing incoming messages.

Table 1. Manual Message Processing

	Routine	Priority	Immedidate	Higher Precedence
Communications Center Processing	76 min.	58 min.	24 min.	5 min. or less
Waiting Time for Pickup	80 min.	30 min.	Note 1	Note 1
Total Average delay from printout by LDMX to receipt by Action Officer Note 2	3 hrs.	2 hrs		

Note 1 - Notification of receipt of messages of immediate or higher precedence messages is made to the appropriate action officer by the CCWT by telephone.

Note 2 - This depends also on time of day of message receipt in the Communications Center. The delay time includes processing in J301 and delivery to division/branch.

In the Command Center, message review is affected by the personal style of the duty officers, as well as by the assignment, or desk. During the period that baseline data were being collected, the DDOs averaged 40 minutes of message review per shift, the Surface Ops duty officers averaged around 80 minutes, and the Air Ops duty officers averaged 120 minutes. The Air Ops duty officer has the responsibility for creating the Director's readboard; thus, he spends the most time on message review.

MESSAGE FILING AND RETRIEVAL

Messages are kept on disk memory in the LDMX for 12 to 15 days, are retained on magnetic tape in the Communications Center for 90 days, and are stored in the J304 vault in microfilm files for several years. In the admin section (J301), xerox copies of the messages are kept in file boxes for 30 days. When a message is needed but cannot be found in division or branch files, a copy is requested from J301. If the message is more than 30 days old, it is requested from the Communications Center, if more than 90 days old, from J304.

In J301, preliminary filing is done in conjunction with the message sorting for distribution. Final filing (by minute of the message's date-time-group) is done on the night shift. During the regular workday, filing takes only a few minutes of the day. J301 clerks receive only a few requests each day for messages in their files. These can usually be satisfied in five minutes or less.

In the divisions and branches, the clerical personnel handle most of the filing for the officers. Although filing may not be done every day, it generally takes about half an hour of the clerk's time when it is done. Filing may accumulate over several days, or occur as a project is finished. Relatively less retrieval is done, since messages of current interest are kept at the officer's work place, and do not need to be retrieved from the branch files. In addition, the action officers do relatively more retrieval than filing, which suggests that when they need something they find it for themselves. For example, on days when retrieval occurred, officers in branches with heavy incoming message loads spent an average of 30 minutes retrieving messages; in branches with moderate loads they spend 15 minutes; and in branches with light loads, they spent 10 minutes.

The pattern in the Command Center is similar, with the clerks doing most of the filing and relatively little retrieval. Although the duty officers do some retrieval, they also keep messages of current interest at hand, and hence, do not usually need to retrieve messages from long-term storage. When they do need such retrieval, they often recall the message from the Communications Center, a task thay can accomplish with a telephone call. The message is delivered directly to the Command Center via a pneumatic tube.

MESSAGE CREATION

Messages are formal record communications. They are drafted in response to other messages, in response to non-message communications, or in order to initiate an action or project. Letters, memos, etc. may be drafted instead of formal messages.

The number of messages, letters, etc., which are drafted by action officers does not vary greatly among branches with varying incoming message loads. Although the data do suggest that officers in branches with light incoming message loads create more outgoing communications than the other officers, even these officers create only about two items per day, and often have days when no message, letter, or memo creation occurs.

Creation is a relatively time-consuming task. The originator must gather background information and organize the material in addition to composing the message. Although some messages, letters, and memos are routine requiring little effort, and some are difficult lengthy items taking several hours to write, most take about an hour of the officer's time.

Typing these communications is also a relatively time-consuming task for the clerical personnel. Because each clerk supports several action officers, the clerk handles a higher number of outgoing items. Overall, clerks type (and retype) an average of four outgoing items daily. The amount of time taken depends on the length of the items; but on the average, the clerks spend 75 minutes daily on typing tasks.

Fewer outgoing messages, letters, and memos are sent from the Command Center; some of the messages are transmitted over the WWMCCS system to the LDMX and AUTODIN. On the average, Command Center duty officers send a total of about four outgoing items per shift, and they spend an average of 40 minutes on creation tasks. The clerks, perhaps because they are using the WWMCCS terminals which provide on-line editing capabilities, spend an average of only 18 minutes a day typing and retyping outgoing communications.

COORDINATION AND RELEASE

Before a message can be released and transmitted, it must be coordinated to ensure accuracy and completeness. After all interested parties have approved the message, it is sent to the Director or a designated representative for formal release. Only after the message has been released can it be transmitted. Most messages are seen by three to five coordinators before they are sent for release.

The number of messages that action officers receive for coordination varies considerably from position to position. Some officers may receive only one message a week, others receive one or two a day. Branch chiefs typically receive the most messages; they may review these themselves or they may give them to a member of the branch to review.

On days when messages are received for coordination, the time spent reviewing and commenting on the message may range from five minutes for a routine message to an hour or more for a long complicated message. On the average, around 25 minutes are spent coordinating messages. Officers who receive the greatest number of incoming messages are the least involved in coordinating outgoing messages, letters, and memos.

Fewer messages are received by Command Center duty officers for their coordination. When they do receive messages, they average around ten minutes on coordination tasks.

Messages are released by the J3, the Director of Operations, or by his representative: the J3 Deputy, a division head, or the DDO. Message release is usually a routine task which takes only a few minutes for each message. The releaser relies on the preparation and review already done by the originator and the coordinators.

TRANSMISSION AND POST-TRANSMISSION

Once released, the outgoing message is sent to the Communications Center for transmission over AUTODIN. (Memos are circulated within CINCPAC; letters are mailed.) At the Communications Center the message is checked for format, addressee list, releaser's signature, etc. Flash and immediate messages are processed directly. Priority and routine messages are put in a tray for processing as soon as a clerk has time.

The average processing time for priority messages is 76 minutes from time of receipt in the Communications Center to time of transmission. For routine messages, the average processing time is 131 minutes. These times vary, of course, according to the time of day and the outgoing message load. Comeback copies are processed and delivered along with the incoming messages.

COMMENT

In J3, a person's message-handling activities vary according to his position and to his division or branch. Activities also vary from day to day, depending on current assignments. It would be possible for a clerk to spend all of a day distributing, filing, and typing messages. It would be possible for an action officer to spend all of a day reading, retrieving, creating, and reviewing messages. This is not usually the case; on most days personnel spend less than half their day on message-handling activities. In fact, on many days, many officers are not involved in handling outgoing messages at all. Incoming messages far outnumber outgoing messages; however, in a message-by-message comparison, outgoing messages take relatively more time to handle.

It is important to note that messages are only one form of written communication used in J3. Letters, memos, and other documents are also used. Thus, to help personnel with their complete job, the MME should examine the role of automation in the total communication system of the staff.

SECTION 4

AUTOMATED MESSAGE HANDLING

There are clear parallels in the automated and the manual system. Some of the parallels are deliberate - the automation of existing successful manual procedures; some of the parallels are necessary because the manual system will remain as a backup and because all the divisions in the Operations Directorate will not be automated during the experiment.

INCOMING MESSAGES

As with the manual system, formal messages for CINCPAC are received at the Communications Center LDMX. The LDMX routing algorithm sends a copy of the messages destined for the Operations Directorate or the Command Center to the MME system via the electrical interface. Thus the waiting time for the messages distributed to J3 to arrive in the Directorate Administrative Section (J301) is reduced from the average 156 minutes for routine (88 minutes for priority and 24 minutes for immediate) to a fraction of that time. The messages are delivered to J301's electronic in-basket for proper assignment to J3 action officers.

The MME system provides the person performing the J301 distribution function with a number of aids. These are discussed more fully in the next section describing the MME system software functions. By using these aids, J301 sorts out, collects, and distributes messages electronically to those divisions participating in the experiment. The handling of multiple paper copies of messages is reduced, and the J301-routing function is performed in a fraction of the time required for the manual system.

The action assignment by J301 results in the message being delivered to the electronic in-baskets for the action officers and watch officers. In addition to being routed to J301 for further distribution, messages are also filed in what is called a datefile that currently is accessible by any authorized MME system user with the proper clearance. With the implementation of SIGMA release 2.3, discretionary access controls will be provided so that any J3-decreed need-to-know restrictions can be enforced on the datefile.

In addition to acting on the action messages assigned to them by J301, many action and watch officers have created sophisticated selectors (retrieval aids) with which they search the datefile for messages of interest. Once the action and watch officers receive messages (either by assignment of messages from J301 or by screening the datefile), they take appropriate action. This action includes filing the message in a user file, forwarding the message, generating a reply (at this point in the experiment, outgoing messages are handled manually), or deleting the message from the action officer's file (he cannot delete it from the master file).

MESSAGE REVIEW

The MME system presents messages for action officer review on the terminal. In addition to the capability of reading message text, the MME system allows the user to look at files of message citations. The proper content of a message citation is still the subject of experimentation (see respondent #8's comments concerning scanning (section 8)). Currently the citation contains the ORIG, DTG, SUBJ, and first line of text.

Because many users believe that scanning messages on paper is faster, consideration is being given to providing printers so that hard copy can be produced for the sole purpose of fast scanning.

MESSAGE FILING AND RETRIEVAL

Formal (AUTODIN-type) messages in the MME are never deleted or destroyed intentionally. Little-used messages are archived to tape, but the only effect on users is an increased retrieval time for these messages. The files in which users "file messages" are not really message files, but are files of citations. Only one copy of each message is retained in the system, and it is in the master file. Thus, many users can "have" a long message in their files, but there in fact exists only one copy of the message.

The users currently make use of the filing and retrieval capability, but the system has not been in use long enough to evaluate the efficacy of the use of the files.

MESSAGE CREATION, COORDINATION, AND RELEASE

The MME system has been used only for generating test messages. The proper coordination facilities were not available in the system described in this report. It appears that such coordination capability is needed to allow action officers the flexibility they desire for coordinating and releasing messages. This capability is scheduled for release 2.2 (Jan 1979).

TRANSMISSION AND POST-TRANSMISSION

After a message is released on the MME system, it is transmitted over the electrical interface to the LDMX. The LDMX provides a "come-back" copy over the link to the MME system after the message is transmitted.

AUTOMATED MESSAGE HANDLING SYSTEM

The system used to provide these automatic capabilities consists of three basic hardware subsystems: the central processor subsystem, the interface subsystem, and the terminal subsystem. The central processor subsystem onsists of a PDP-10 with one million words of memory and a KL-10 processor. The interface subsystem provides the connection between the MME and the LDMX,

and it links the user terminals with the central processor subsystem. The MME terminal is a Hewlett-Packard 2649A with minor physical modifications, TEMPEST modifications, and special firmware developed by ISI. The firmware is contained in programmable read-only memories (PROMs) which mount on special boards that replace the HP control memory. As of 30 November 1978, 16 were available for use.

System Software

Software in the PDP-10 is divided into three major components: the TENEX operating system, the MME/LDMX interface software, and the SIGMA message system software. The users of the system interface directly with SIGMA and their view of the system's utility is dependent primarily on SIGMA. For the most part, they are not concerned with details of the operating system or the MME/LDMX interface software. Thus, the following description of the software includes only SIGMA and describes those features that most affect the user. The message coordination method is being revised; a new coordination method is scheduled for SIGMA Release 2.2 in January 1979.

User Interface

The approach chosen to provide the necessary support for the user who is neither a trained operator nor a computer specialist is to interface him to the message service through an "intelligent front-end process" which is called his "Agent." This Agent makes the service appear consistent to the user. It is designed to handle all control procedures (e.g., editing, help, defaulting, error handling, context mechanisms) with the same code and, therefore, in the same way throughout all phases of the service. Lack of this consistency has been a major source of difficulty in many computer systems. The Agent consists of the Command Language Processor and a Tutor.

Command Language Processor (CLP). This serves as the interpreter for user commands and provides input editing functions and screen control. To support the neophyte, the CLP provides spelling completion and correction for commands and arguments. If the user has any questions about a command or its arguments, a prompt key shows the user what the CLP has interpreted so far about a command and what it yet has to resolve.

Tutor. This provides help to on-line users by explaining commands, reporting errors, and providing tutorial, exercise, and reference documentation. On-line lesson material is provided as an aid in learning to use the service. At any time, the user may enter this tutorial for whatever lesson he wishes. Imbedded within the lessons are exercises which guide the user through execution of system commands to illustrate their functional performance. Exercises operate on a prestored, protected data base, so the user cannot damage real data by mistakenly executing the wrong instruction to the system.

Functional System

The functional aspects of the message service are provided by three modules within each user job (the Functional Module (FM), the Message Access

Module, and the File Access Module) and by seven free-running processes, called daemons, that service all the user jobs (Coordination, Message, File, Citation, Reception, Archive, and Hardcopy).

The FM holds working models of the objects that the user has open. Typically, this is a file, a message, and perhaps a text object. The FM sends data to the terminal in order to display these objects. The FM is driven by a series of instructions passed to it by the CLP whenever the user executes a command or depresses a function key. In addition, as editing changes are made by the user to the objects being displayed, they are passed from the terminal directly to the FM. Before executing any command steps, the FM updates its model of the state of the open object to conform to the terminal's model. The message access module is a separate process which holds the actual file representation of a message. When the FM needs data about a message to build or change its working model, it interacts with the Message Access Module. The File Access Module performs a similar function for user files.

Daemons

Some user instructions cause the FM to send requests to one or more of the daemons. The daemons are background processes shared by all the user jobs. They are driven by requests put into their input queues by user jobs or other daemons.

The message daemon is the only process allowed to actually change the message data base. Changes that user jobs want made to messages are sent to the message daemon in the form of change files. The message daemon updates the message accordingly. This centralized message daemon resolves conflicting user requests. The message daemon processes commands to coordinate, chop, and release messages generating appropriate citations as needed.

The file daemon performs a function similar to that of the message daemon for users' centrally-located SIGMA files.

The sole function of the citation daemon is to build entries for user files. It takes as requests citations which contain the information needed for the entry.

The reception daemon takes incoming LDMX traffic, builds SIGMA messages from it, and sends citation requests through the citation daemon to the appropriate user's pending files.

The archive daemon provides the interface between the user jobs and the TENEX archive system. It builds retrieval requests when a user asks for a message which has been archived. When that message is read from tape by the operator, the archive daemon restores it to the SIGMA message data base and sends a retrieval citation to the user, telling him the message requested is back.

The hardcopy daemon processes user print requests. This allows the user job to continue while the printing is done in the background.

Message System

Message handling may be divided conveniently into two stages: message preparation and message delivery. The former includes the creation of the draft message and the coordination of this draft with other users until it is signed off for release. SIGMA provides special editing facilities which understand message formats and check that the contents of various fields are legitimate.

An originator drafts a message, adds comments associated with fields of the message as desired, fills in the CHOP field with user names, and then sends it for coordination. After coordination is complete, the message can be released by any user who has been given release authority on the MME by the Command. If the released message is an AUTODIN message, then it is automatically transmitted to the LDMX. If it is a memo or an informal note for another user on the MME, then it is delivered to the user's pending file.

The delivery stage involves delivering the message to its ultimate recipients, archiving it, and providing aids for the user to sort his messages, scan them, and file them for later retrieval. The first step in this process is to determine distribution for the message. Because all formal traffic flows between commanders of organizations, it is necessary for the message system to aid in determining the individual within the command who should receive the incoming message.

An incoming message is delivered to an action officer's pending file (his electronic in-basket). To see what new messages have arrived, a user asks to DISPLAY his pending file. He is presented with an index to the contents of the file with an entry for each message. Each entry contains enough information for the user to be able to recognize the message, and the entry serves as a reasonably rich context for subsequent retrieval; e.g., the security classification of the message, its DTG, its ORIGINATOR, subject, etc. For convenience, a user may attach comments to a file entry.

An action officer is assigned for each incoming message. He may further delegate the action to a subordinate, "sell the action" to some other more appropriate officer, or act on it himself. The details of how this is done is described in the previous sections; the MME system provides aids that are used by the action officers and by J301. It must keep track of the action assignment until such time as the action has been completed. On the same message, "Information" copies may be distributed to other action officers. Readboards for J3 may be built using the messages.

A user may put messages into personal files for later retrieval. This provides the electronic analog of file cabinets. Because the message service can retrieve messages rapidly, these user files actually store only citations to messages, rather than the messages themselves, thus eliminating multiple copies and reducing the required computer storage.

SIGMA assists in the distribution function by providing the necessary functions as quick and easy-to-use system commands. Several commands are provided. ACTION is used to assign the responsibility for the message and marks the message accordingly; it causes a citation to the message to be

delivered to the action assignee informing him of his responsibility. In addition, a record of the assignment is made in a special Action Log. In a similar manner, FORWARD is used to distribute information copies. The names of ACTION and INFO recipients are appended to appropriate fields in the message itself. SIGMA also allows users to combine multiple ACTION, FORWARD, and FILE operations with a single ROUTE command.

To assist the user in finding messages of interest, SIGMA provides the user with functions to identify and retrieve messages of interest. The user can enter his retrieval criteria into what is called a selector. The criteria may include ORIGINATOR, a particular string of text in the subject, PRECEDENCE, classification, etc. These criteria may be used to select a subset of a file for storage into a new file; other selectors may then be applied to the new file to further restrict the messages of interest; in a like manner, other messages may be selected and added to the file. The user may store the selector, specifying the criteria, with an arbitrary name for later use. SIGMA also allows keywords to be added to received messages, which may be used for later retrieval of the messages.

SIGMA divides the screen into three areas (or windows). The top three lines of the first area tell the user the state of the system, including such information as the name of the objects the user is working with, who is logged on at the terminal, the time of day, and the status of the instruction entered. The last line is the instruction window where he enters commands to the system. The two windows below that are the general working space. Messages and text objects are normally displayed there. To the right of the screen are the security lights that indicate the highest classification of the data displayed.

The terminal has a standard typewriter keyboard, a set of terminal control keys, and a set of application-oriented function keys. An overlay labels the function keys. Four lights in the center of the function key area indicate the security level of the information in the window pointed to by the cursor.

PERSONNEL INVOLVED WITH MESSAGE HANDLING

Personnel involved with automated message processing in the MME may be grouped as follows:

those associated with the automated system which transports messages (for example, system operators and Telecommunications Center personnel),

those associated with the distribution and use of individual messages.

Automated system support includes the control and manipulation of messages through the electronic conduit. The Communications Watch Officer (CWO) supervises the operations of the LDMX computer system. In this role, he monitors operation of the LDMX-MME system communications link. It is the CWO's responsibility to aid in the assurance that all required messages have been delivered from the LDMX to SIGMA. If any problems arise, the CWO will coordinate corrective efforts at the LDMX. The only distribution and routing

functions utilized at the Telecommunications Center are those automated routing functions that send the proper messages over the communications link.

MME System Operators ensure that the message processing system is operational and that all messages from the LDMX are accounted for. This is done by monitoring the system status and the system-generated LDMX logs. During the Limited Experimental Use phase, the system was operated on a 24-hour basis primarily as a collateral duty of the WWMCCS Operators.

J301 is involved with distribution of messages to various J3 component units. This office is responsible for distribution processing in both the paper and automated systems. Using the automated system and a series of selectors, a terminal operator is capable of completing action assignments and distribution of information messages in a shorter period of time than an individual operating in the manual systems. Courier functions associated with the manual system required to transport bulk copies of individual messages from the Telecommunications Center to J301 to the component offices for traffic handled by the MME system are used now for the parallel paper system.

In addition to these two groups, the experiment has introduced personnel associated with the introduction, observation, and modification of the automated process including several elements of the MME Staff. These people are unique to the experiment environment and not all would be a part of an operational message processing system.

Users

The user community contains J3 division administrative personnel, action officers, and watch standers. Generally, use of the system by this group may be characterized by the following observations:

forty-four of the ninety action and watch officers have used the system over the past five months. Characteristics of their activity include:

reviewing the incoming traffic routed by J301, filing, deleting, or forwarding as required;

reviewing the datefile for pertinent messages (some officers have created highly sophisticated selectors with which they can reduce the datefile to a handful of relevant messages in a manner similar to that used in J301).

As mentioned previously, the discretionary access controls have not been implemented; when they are implemented in SIGMA Release 2.3, access to messages found via the datefile will be possible only for the users who have proper access.

Fifteen of the sixty-one clerks assigned to J3 offices have used the system. The relocation of offices outside the blockhouse has caused two to be without terminals for the last three months. In general, use of the system by clerks has been supplemental to their use of the paper system. Retrieving and printing messages have been the primary features of the clerks' use of the system. Some use has also been made of the informal note capability by the clerks.

SECTION 5

DATA COLLECTION

The MME is designed to evaluate the utility, design, and organizational impact of a computer-aided message system in a military environment. This section describes the data collection techniques being used to collect the data necessary for this evaluation.

METHODS

Before SIGMA was operational at CINCPAC, baseline measures were collected on manual message handling activities. Questionnaires, checksheets, and observation were the primary methods used to collect these data. The results of this data collection effort are outlined in section 3.

Data on automated message handling activities (use of SIGMA by CINCPAC personnel) are being collected in two different ways. First, data on user sessions are being collected by the message system itself. Additional data will be obtained from interviews with system users and observations of system use made by MME personnel and will be used to augment the data collected on-line.

The data being collected by the message system are sent to MITRE, Bedford, for analysis. In order to have a quicker look at system statistics, additional data are collected and analyzed manually by the on-site team. The data analyzed by MITRE for this report cover the period of 20 July 1978, to 27 September 1978. The KA-10 processor was replaced by the more powerful KL-10 processor on 16 October 1978. Some of the manually analyzed data will be used in this report to identify early trends after the installation of the KL-10. Where appropriate, the source of data is indicated.

Automated

Data collected by the message system are collected primarily from two different on-line sources - the detailed data collection files (the dcf) and session transcripts. Every two weeks, a computer tape containing the dcf and session transcripts for that two-week period is sent to MITRE from CINCPAC for analysis. The dcf are the major source of data; they consist of coded representations of each user's activity and are designed for computer analysis. They identify every kind of instruction entered into SIGMA (including the five break keys, "prompt", "help", "execute", "expand", and "cancel") and the resulting system feedback, such as error messages. For each instruction, the dcf include timing data (real (clock)) time, system processing time, and cpu time) and a unique identifier for each of the objects (file, message, selector, text object, etc.) being acted upon. For errors and break key hits, the dcf include some timing information and identifiers.

To reduce all this information into data which are meaningful for a comparison of manual and automated message handling, data reduction algorithms

were developed for each of the ten task-oriented areas (message distribution, message usage, filing, message retrieval, creation/drafting, coordination, release, transmission and post-transmission, crises and exercises, and message system statistics). Each of these functional areas has its own set of data reduction algorithms and variables, preliminary versions of which are available in the test procedures. These algorithms are the basis for the data reduction programs and, thus are constantly being revised as changes are made both to the format of the dcf and to the scope of the experiment.

In addition to the task-oriented statistics which are collected for each functional area, the dcf provide raw data for two other types of analysis: system usage, and system load and performance. Data on system usage identify the ways in which SIGMA is being used by J3 personnel to accomplish their daily message-handling tasks. This includes the amount of time a user spends on-line during a given day, the types of instructions he executes while on-line, and how difficult he finds the system to use (e.g., how many errors he makes, how often he needs to take advantage of the on-line help facilities).

System load is a measure of both the number of users logged on at a given time and of each user's level of activity; system performance is a measure of the system response time to user-entered instructions. Data on system load and performance represent an additional data reduction capability which is not an integral part of the objectives of the experiment. Response time is included with the other data reduction capabilities because system response influences how (or whether) a user uses the system. For example, a user might avoid using the system during periods of heavy load because response time would be too slow. Data on response time will show periods when the system is unusually slow.

Session transcripts, the second on-line source of data, record the expanded instruction entered by the user and the system feedback (such as errors) in text form. The associated time for each instruction or feedback is included. Session transcripts record user sessions in a format which is human-readable, making them ideal for manual analysis. The data obtained from manual analysis of session transcripts will be used only occasionally to supplement the data obtained from the dcf. The major advantage of the session transcripts is that patterns of system usage which would be difficult to detect with computer analysis can be detected by human analysis.

Manual

While the data collected on-line will demonstrate how the system is being used, they will not show what the user is trying to accomplish while using SIGMA. Thus, there is a need for two types of off-line data collection - interviews and observations.

Interviews will be used to determine how the user accomplishes various tasks on-line. They will also be used to collect suggestions for improvements or changes to SIGMA and to collect information about the users' perceptions of the system's effect on their overall message handling activities. A proposed

outline calls for the following subjects to be covered in each interview: the purpose of the interview, the user's description of a typical SIGMA session, a comparison of message handling with SIGMA and message handling with the paper system (faster, slower, easier, harder), comments on SIGMA features (which are the most useful, which need modificaton, what new features the user feels should be implemented), and comments on the user interface (items such as the on-line help facilities, function keys, editing capabilities, view and display windows, etc.). Special questions relating to the role or type of the user being interviewed will also be asked. During the interviews, all these points will be covered and the answers categorized for future comparisons.

While some practice interviews have already taken place and a preliminary interview conducted for this report (see section 8), the official interview schedule depends on the installation of different versions of SIGMA and on increased user experience. Not all users will be interviewed each time. Users will be selected on the basis of the amount of system use (including light as well as heavy users) and type of use. All users will be interviewed at least once and at most twice during the course of the experiment.

There are no arrangements for formal observation of automated message handling activities during the experiment. Rather, when questions arise from analysis of the dcf or session transcripts, MME personnel will be asked to clarify or explain these problems, based on their informal observations of CINCPAC SIGMA use. In addition, to augment the list of suggestions for changes and improvements to SIGMA obtained in the interviews, a log is being kept of suggestions made spontaneously during informal interactions between MME personnel and CINCPAC SIGMA users.

PERIODS OF DATA COLLECTION

The data for this section of the report were collected at CINCPAC during the period between 20 July 1978 and 27 September 1978 with the exception of a few days when either a) the data collection facilities had not been enabled after testing, or b) there were problems with SIGMA that day that made it impossible for the system to be used.

SECTION 6

TRAINING

Two MME objectives are a) to develop and document a process for the installation of a military message system into an operatonal command, and b) to determine the nature of training requirements associated with the implementation of a military message system. The training experience is reported in reference (k); the following is a summary supplied by Dave Miller of MITRE.

The training program designed for MME users has four main components: an introductory lecture, on-line lessons and exercises, printed documentation, and one-on-one training sessions.

INTRODUCTORY LECTURE

The introductory lecture is the first contact that most users have with the MME. It is an opportunity to indoctrinate users by telling them a little about the background of the experiment, discussing and demonstrating some of the features of the system, and bringing users to the level at which they can log on and start taking lessons. The lecture has four parts: introduction and goals, the SIGMA system, the terminal, and help for the users.

The lectures are given to groups of two to seven people, with five being a typical size. It is given using an MME terminal which contains special electronics that drive a large-screen monitor for easier visibility. The lecture is about an hour and a half; at the end, the attendees are given accounts on SIGMA and a handout with information on logging on and taking lessons.

The lecture seems to have been fairly well received. Reactions, of course, have varied widely among the recipients. A few users asked numerous questions, but most seem to accept what was told them without question. The amount of material covered by the lecture has grown smaller as we continue to indoctrinate new users; the number of major sections has been reduced from six to four.

LESSONS AND EXERCISES

The on-line lessons and exercises are intended for use at the terminal; they are expository in nature and discuss aspects of commonly used instructions. Exercises allow users to practice the instructions that are being taught in the lessons. Lessons currently available in SIGMA include:

Lesson 1:	A General Description of the SIGMA Service
Lesson 2A:	Beginning to Use the SIGMA Service
Lesson 2B:	Beginning to Use the SIGMA Service
Lesson 3A:	The Filing Service-Basic Filing Techniques
Lesson 3B:	Advanced Filing Techniques

Lesson 3C: Special Files
Lesson 4: Message Reception and Distribution
Lesson 5A: Text Objects
Lesson 5B: Editing Instructions for Text Objects
Lesson 5C: Editing Instruction Keys
lesson 6: Message Drafting
Lesson 7: Message Review and Coordination

DOCUMENTATION

Reference Manual

The SIGMA Reference Manual is a compilation of detailed information about SIGMA. It serves more as a place to find out the details of instructions one wants to carry out rather than as a place to find out which instructions to use.

Primer

ISI created a Primer for use by those not needing, or ready for, the detail of the Reference Manual. It is written in a conversational style and is easier to read for those who don't know the system well. The topics in the Primer cover most, but not all, of the SIGMA system.

On-Site Handouts

From time to time, special written material has been generated on-site and distributed to some or all of the users. One example of this is a discussion concerning taking lessons on SIGMA. This handout was produced because of the difficulties some of the early trainees were having remembering all the things they were expected to do in order to log on and start taking lessons.

One-on-One Training

The fourth prong of the training approach involves supplying users with individual training sessions as required. These sessions can be general in nature dealing with all aspects of the system, or tailored to fit the needs of a particular user's job. They may consist only of the training representative watching the user performing his message-handling duties and making occasional suggestions, or they may involve some study of the office functions by the training representative, followed by distribution of handouts and follow-up sessions.

TRAINING EXPERIENCE SUMMARY

Preliminary Period

During the preliminary shakedown and learning period from May 1977 to July 1978, the system was used primarily by project personnel for testing and

debugging purposes. Early in this period, a few "friendly users" were trained - people who were designated by J3 as points of contact, or who were expected to be heavy users. This included several key clerical personnel, both in the operating divisions of J3 and in J301. These users were sympathetic to the system's growing pains. Table 2 summarizes the training during the preliminary period.

Table 2. SIGMA Training During Preliminary Period

Description of Training	Number of Users
Given Introductory Lecture	97
From Other Directorates	13
J3 People Given Lecture	84
From Non-Test Divisions	18
J3 Test People Given Lecture	66
Scheduled to Leave	15
Potential J3 Training Population	51

Because of some problems in collecting data, the statistics in Table 3 understate to some extent the number of lessons taken.

Table 3. J3 Lesson-Taking During the Preliminary Period

Lesson Number	Number of Takers
At Least One	29
Lesson 1	25
Lesson 2A	24
Lesson 2B	10
Lesson 3A	15
Lesson 3B	9
Lesson 3C	7
Lesson 4	8
Lesson 5A	6
Lesson 5B	5
Lesson 5C	5
Lesson 6	7
Lesson 7	6

In Table 3, some lesson-taking statistics are reported. The lesson-taking occurred during the preliminary period, and was done by the 66 J3 users discussed above. Multiple takes of a lesson are not included.

The following are a few factors that explain why the numbers are low. Approximately 15 of the 66 users were scheduled for transfer away from CINCPAC. They may have been less motivated than most to take lessons, in the belief that they would never use the system. Of the remaining 51, six were officers of the O-6 level (Colonel or Navy Captain), who seldom do message handling themselves. Only one showed any lesson activity. Also, in some offices one person seems to have become the one responsible for running the terminal, and others have taken little interest in learning SIGMA.

Limited Use

During the limited-use period, one-on-one sessions have been held with several of the users. In particular, from the 10 May 1978 until 28 June 1978, the trainer conducted eleven J301 message routing sessions for periods of time ranging from one to three hours. Because message routing is an important J301 function, this was emphasized in the training.

Acceptance of the on-line lessons varies widely (as is attested to by the lesson-taking statistics). A few users were quite impressed with the novel (to them) approach of the on-line lessons. Two lieutenant colonels who are very proficient users feel that the lessons help somewhat, but they believe that the novice user must be willing to dig things out for himself, if he hopes to become better. One of these same officers said that he found the SIGMA on-line prompt and help features more useful than the lessons. An examination of the lesson-taking statistics, coupled with personal observation, suggests that many people found the early lessons helpful, but didn't continue with them beyond the bare minimum they needed to do their jobs on the terminal.

TRAINING LESSONS LEARNED SO FAR

On-Line Lesson Not Enough

Although the on-line lessons have proved to be very useful, they have not been accepted to the degree hoped. Statistics presented in the section on training experience show that the lower-numbered lessons received more use than the higher-numbered ones. This suggests that either the users tired after taking a few lessons, or that they learned enough from the early lessons to do most of their tasks. On-site observation suggests that the reason is a combination of the two.

Much Personal Attention Needed

This is a corollary of the previous observation. Several (but not all) of the users seem to respond better to individual instruction than to taking the on-line lessons. This seems to be particularly true for enlisted personnel.

Primers Used More Than Reference Manuals

It has been our observation that the primers are used much more than the reference manuals. There are probably two reasons for this: a) the primer is written in a more conversational, breezy style, and b) at the present stage of the experiment, introductory level material is needed more than the details of features and instructions.

Evolution of Introductory Lecture

The introductory lecture has been given almost thirty times. Using attendee reaction as a guide, the lecture has evolved gradually into its present form. Initially, the lecture was longer, having additional sections on message handling and message composition. It proved difficult to cover all this material in the hour and a half or so that was scheduled for a lecture, and gradually the last two sections were dropped. The demonstration seemed to be the part of the remaining material that was best received, and so gradually the time devoted to it increased, while the time spent on presenting slides and discussing the background of the experiment and fundamentals of the system was proportionately reduced.

System Stability Important

Trainees thrive in an environment of stability and reliability. That is, it is expecting a lot to ask a trainee to use a system which is often unavailable, responds very slowly, or does not respond in the way that the instructional material leads him to expect. Thus far during the MME, there have been periods of system instability, such as system interruptions that require the trainee to log on again and to do some work to get back to the previous point in his work. CINCPAC users have been doggedly patient during these trying periods, but without a doubt some harm has been done to the training program because of the interruptions.

Testing as an Aid to Training

Using people from the user community for system testing, such as the load tests used to measure performance in new SIGMA releases, appears to have had an overall beneficial effect on training. For one thing, during periods of project delay due to hardware and software difficulties, it helps keep user interest up. For another, the scripts that these users were asked to follow during the tests helped make them aware of some system capabilities that they may not have fully appreciated otherwise.

Project Stretch-Out Problems

The limited use phase of the project has suffered from a couple of false starts - that is, there were some optimistic estimates of when it would begin. Since we felt it was necessary to start training people a few weeks in advance of that time, a good many people were given the introductory lecture and urged to commence their lesson-taking as much as five or six months in

advance. Not all users suffered from this delay, but certainly for some, the momentum developed during lesson-taking was dissipated before the limited use phase began. It seems reasonable to conclude that the project suffered some loss of credibility with these users.

Access Difficulties

One aspect of the MME environment that has caused more problems than anticipated is that of lack of free access to some of the work spaces in which the terminals are installed. This comes about because of the high security level at which some of the offices operate. Although some project personnel have the necessary clearances, others do not, and on occasion someone not completely familiar with a problem may be the one who has to respond to it. Requests for advance clearances often require a long processing time.

JOINT MME STAFF - J3 STAFF TRAINING AIDS

Two additional aids to training have been prepared by J341, the J3 branch directly involved with introducing the MME. They are a set of milestones and a user's guide.

The milestones are a series of short scenarios, each covering some message-handling function. The scenarios consist of detailed SIGMA instructions that achieve that particular function, using sample file names, message numbers, etc. Different milestones are presented to different users. For example, action officers have a set of milestones with emphasis on file handling and message reading, while senior officers have a set concentrating on message coordination and release. By looking at session transcripts, J3 is able to monitor the progress of the staff in reaching its milestones. Periodic reports are issued by J3 showing proficiency ratings based on the number of milestones reached, as well as the amount of time spent using the MME.

The purpose of the user's guide is to present a series of very detailed, cookbook-like instructions in the use of the MME to do specific tasks. The projected users of the guide are seen as those who do not have time to learn to use the MME by regular methods, but who must be able to carry out certain narrowly defined tasks from time to time. Sections of the user's guide concentrate on these specific, narrow tasks, and are written at a very detailed level. For example, they include instructions on moving the cursor from one part of the screen to another before the next operation, which is the sort of knowledge most other users are presumed to have learned earlier. Normally this level of detail is omitted from further training. At the time this report is being written, the user's guide is not complete, but sections are being added to it at the rate of about one a week.

SECTION 7

PATTERNS OF SYSTEM USE

Limited Experimental Use (LEU) of the computer-aided message handling system, SIGMA, began in July 1978. During this period selected members of the Operations Directorate (J3) have been directed to use SIGMA for certain tasks, as described elsewhere in this report. The manual system has remained the primary system during LEU.

Data describing SIGMA usage during the intial period of LEU, from late July through late September, have been collected, reduced, and analyzed. The analysis is reported in reference (1); the information in this section has been extracted from reference (1). The results are reported in both a quantitative and qualitative manner. The description of the quantitative use of SIGMA begins on the following page and deals with the amount of use SIGMA has had in terms of time users spent logged on and the numbers of commands executed. The last part of this section deals with the type of use SIGMA has had in terms of the commands and functions executed by different kinds of users.

In early September a new version of SIGMA was installed at CINCPAC. This version included some enhanced functions and changes to improve performance. Therefore, the data from July and August may differ from September data not only as a result of increased user familiarity with the system, but also as a result of the changes made to the system itself. When comparing data in this report with future reports, differences in system use may be attributable to changes in performance (because of the addition of the more-powerful CPU) as well as increased user experience.

In addition, the number and configuration of user terminals have been changing. In July, a terminal for J32 was added making a total of 13 terminals in the J3. In August, J3, J30, J30A, J33, and J332 moved to Wing 3B, reducing the number of terminals in use to 11. In September, a terminal for J313 was added for a total of 12. At the end of November there was a total of 16 terminals available for the experiment.

Throughout this section of the report, users are referred to as belonging to different roles or types. These are related to the functional positions the users hold in the organization. Types include division/branch administrative (DBADM), who are clerical-level personnel with administrative responsibility; J301, the Administrative Section of J3; action officers (DBACT), divided into three categories according to volume of incoming messages; division/branch clerical (DBCL), whose duties are primarily clerical; members of the command center watch team, who are the duty director of operations (DDO), air desk duty officer (AIR), and surface desk duty officer (SUR); and, members of J314 and the Joint Reconnaissance Center (JRC), who are grouped together because they shift between the JRC and action officer positions.

For all of these users, and particularly for the action officers, it should be noted that there is a great deal of individual variability. System use during LEU has been encouraged but not required. Some people may choose to use the system as their primary message-handling tool, others may not. The data presented in this report are therefore descriptive, rather than predictive. They are meant to show how the system has been used during its initial phases of implementation and to serve as a basis of comparison for future system use.

The data do not yet permit one to draw conclusions about system utility in an operational environment

AMOUNT OF USE

The amount of system use during initial LEU will be reported from two orientations. The amount of use per hour shows the time of day that the system is loaded, regardless of the identity of the users. Usage by user type shows the amount of load placed on the system by different kinds of users. (The actual functions being used by these people are discussed in the next section.)

HOURLY USE

Hourly system use is described by two measures: user-hours per hour and commands per hour. User-hours represents the amount of time users spent logged on during an hour. It does not necessarily represent the total number of users who were logged on that hour. For example, a value of two for user-hours might account for two users logged on throughout the hour, but it might also account for one user logged on throughout the hour and two users logged on for one-half hour each. Furthermore these users might be logged on concurrently or consecutively.

Users may be logged on but not actively using the system. Thus, commands-per-hour gives a somewhat better measure of system load. This measure shows the number of commands executed during an hour, regardless of the number of users. A value of 40 could represent one user executing 40 commands or several users executing a total of 40 commands.

Together, these two measures provide information about the amount of usage the system receives throughout the day.

The mean number of user-hours per hour and mean number commands per hour were calculated for four periods between 20 July and 27 September 1978. Throughout the entire period, patterns of use were similar, so overall means were calculated, and are presented in Figures 1 and 2. (Although patterns of use were similar, the four periods do show a trend for increased usage as the LEU progressed. The detailed data are shown in appendix A. Also, see section 8 of this report.)

The mean number of user-hours, Fig. 1, shows what one would expect in a staff environment. There is a sharp rise in the number of user-hours at 0700, a modest dip at 1200, a post-lunch rise followed by a decreasing number of users logged on until 1800, when the command center watch teams change. There is a low level of activity overnight.

The pattern of use shown in the number of commands executed, Fig. 2, is quite similar. During the day, use peaks between 0800 and 0900 and again between 1400 and 1500. The relationship between users logged on and users actively using the system is shown by the contrast between the stable number of user-hours during normal off-duty hours and the variable number of commands executed during these hours. Most, if not all, of this off-hour usage can be attributed to CCWT and JRC watch officers.

USE BY TYPE

As discussed earlier, users have been divided into several types, based on their position in the organization. Figures 3 and 4 show system use by type, measured by mean on-line time and mean number of commands daily. Taken together, these measures show different styles of use as well as different levels of use by the different user types.

Division and branch administrative personnel (clerical personnel with primarily administrative duties) tend to log on in the morning and leave the terminal on most of the day. This is shown in Fig. 3, where the mean daily on-line time for an administrative user is slightly over five hours. Actual use, however, is quite low. In Fig. 4 we see that an administrative user executes an average of fewer than 20 commands a day. Presumably these users, who often need to respond to requests from their chiefs, are keeping the terminals on so they can respond quickly.

It is interesting to compare this style of usage with that of J301, the administrative section responsible for distributing messages within the directorate and for retrieving older messages on request. The J301 user spends an average of 2.25 hours on-line daily, but executes an average of 80 commands. These users log on, distribute messages, and when the job is finished, log off. Their on-line time is less than half that of the division and branch administrative personnel, but a J301 user executes more than four times as many commands.

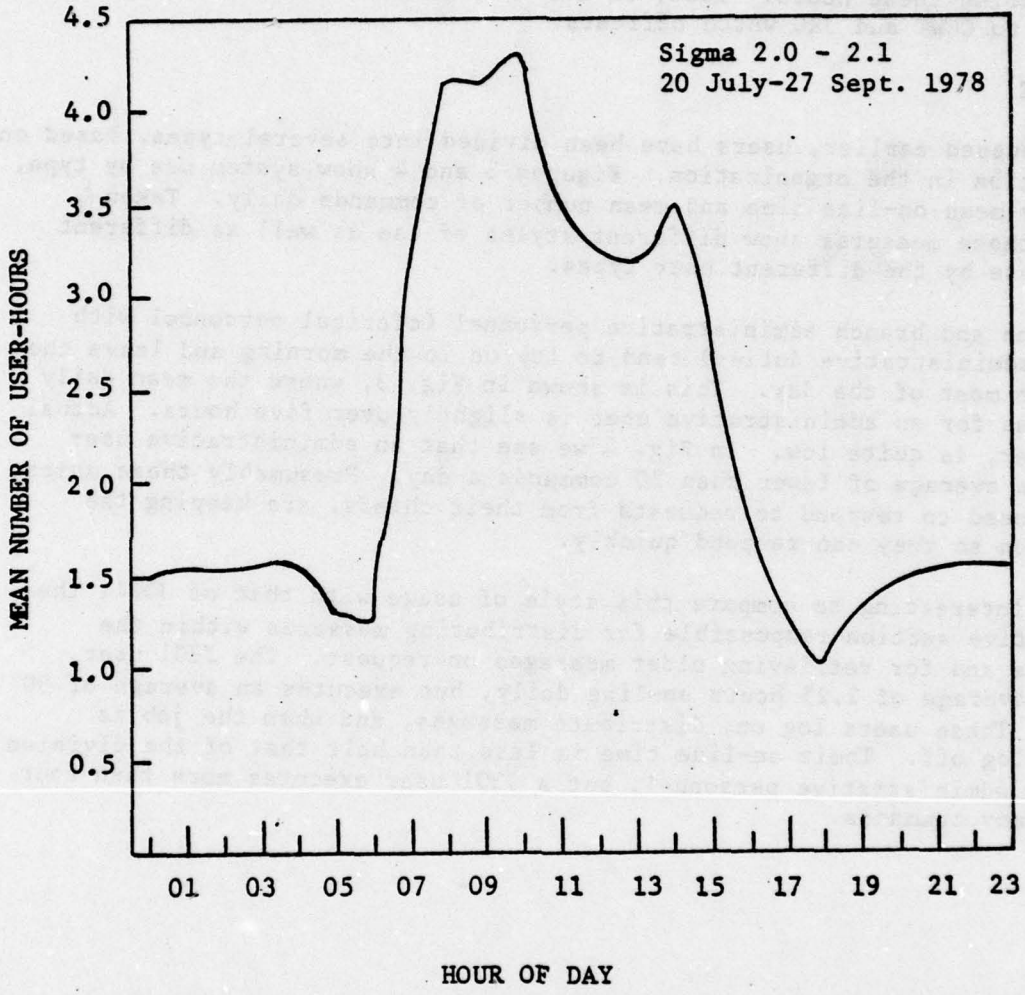


Figure 1. Mean Number of User-Hours per Hour

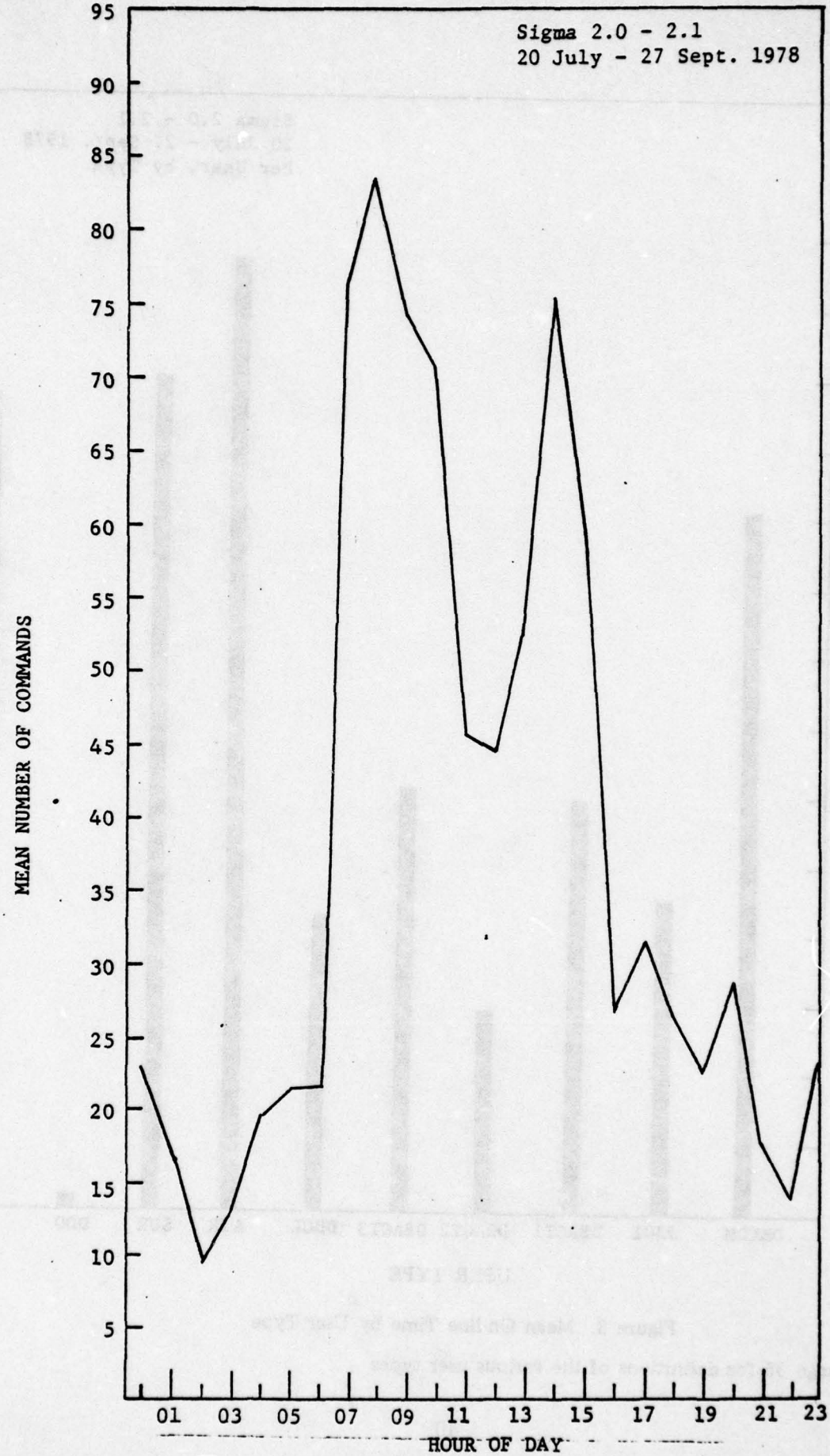


Figure 2. Mean Number of Commands per Hour

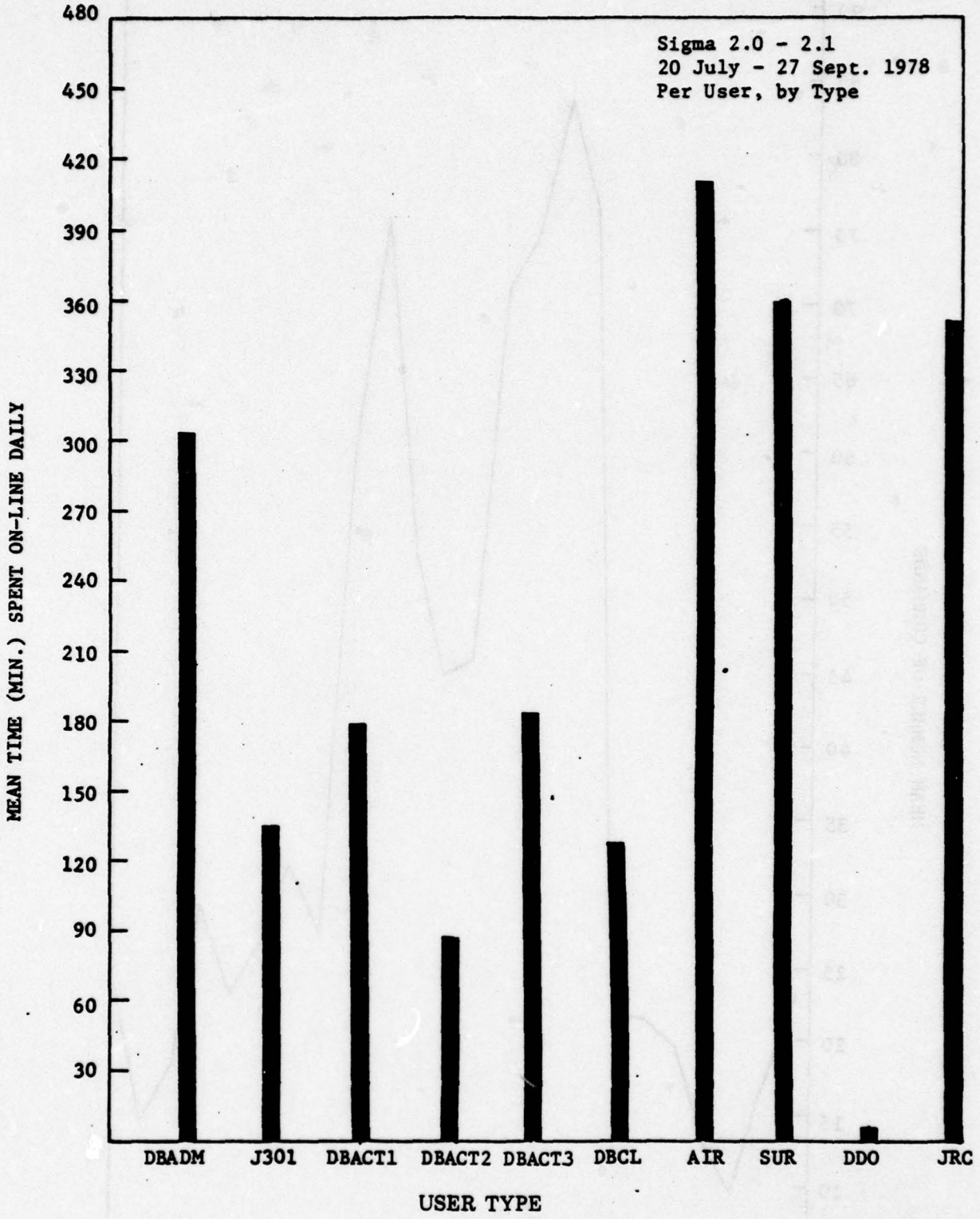


Figure 3. Mean On-line Time by User Type

Note: See page 35 for definitions of the various user types

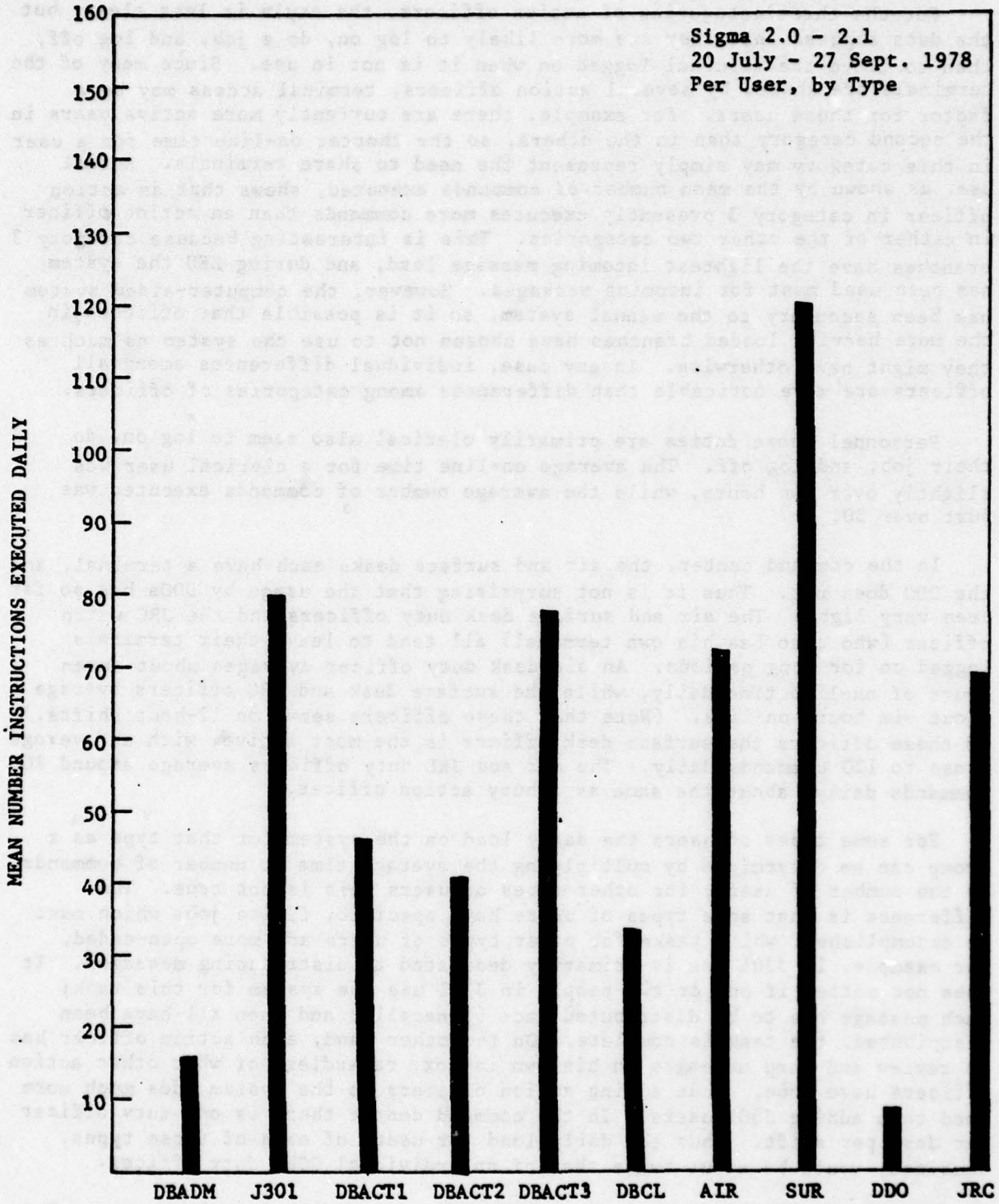


Figure 4. Mean Number of Commands (Daily) by User Type

For the three categories of action officers, the style is less clear, but the data suggest that they are more likely to log on, do a job, and log off, than to leave the terminal logged on when it is not in use. Since many of the terminals are shared by several action officers, terminal access may be a factor for these users. For example, there are currently more active users in the second category than in the others, so the shorter on-line time for a user in this category may simply represent the need to share terminals. Actual use, as shown by the mean number of commands executed, shows that an action officer in category 3 presently executes more commands than an action officer in either of the other two categories. This is interesting because category 3 branches have the lightest incoming message load, and during LEU the system has been used most for incoming messages. However, the computer-aided system has been secondary to the manual system, so it is possible that officers in the more heavily loaded branches have chosen not to use the system as much as they might have otherwise. In any case, individual differences among all officers are more noticable than differences among categories of officers.

Personnel whose duties are primarily clerical also seem to log on, do their job, and log off. The average on-line time for a clerical user was slightly over two hours, while the average number of commands executed was just over 30.

In the command center, the air and surface desks each have a terminal, and the DDO does not. Thus it is not surprising that the usage by DDOs has so far been very light. The air and surface desk duty officers and the JRC watch officer (who also has his own terminal) all tend to leave their terminals logged on for long periods. An air desk duty officer averages about seven hours of on-line time daily, while the surface desk and JRC officers average about six hours on line. (Note that these officers serve on 12-hour shifts.) Of these officers the surface desk officer is the most active, with an average close to 120 commands daily. The air and JRL duty officers average around 70 commands daily, about the same as a busy action officer.

For some types of users the daily load on the system for that type as a group can be determined by multiplying the average time or number of commands by the number of users; for other types of users this is not true. The difference is that some types of users have specific, finite jobs which must be accomplished, while tasks for other types of users are more open-ended. For example, in J301 use is primarily dedicated to distributing messages. It does not matter if one or two people in J301 use the system for this task; each message has to be distributed once (generally) and when all have been distributed, the task is complete. On the other hand, each action officer has to review and read messages in his own in-box, regardless of what other action officers have done. Thus adding action officers to the system adds much more load than adding J301 users. In the command center there is one duty officer per desk per shift. Thus the daily load for users of each of those types, combined, would be about twice that of an individual CCWT duty officer.

Figures 5 and 6 show the average daily load for all users in a type. Note that in terms of on-line time (Fig. 5), modest increases in time are shown for J301, division/branch clerical, and DDO types. Moderate increases are shown for division/branch administrative and category 1 and 3 action officers. Large increases are shown for category 2 action officers, the JRC, and the air and surface desk duty officers. For the action officers, this large increase is due to a high number of users; for the CCWT duty officers, the large increase is due to the lengthy sessions each officer has.

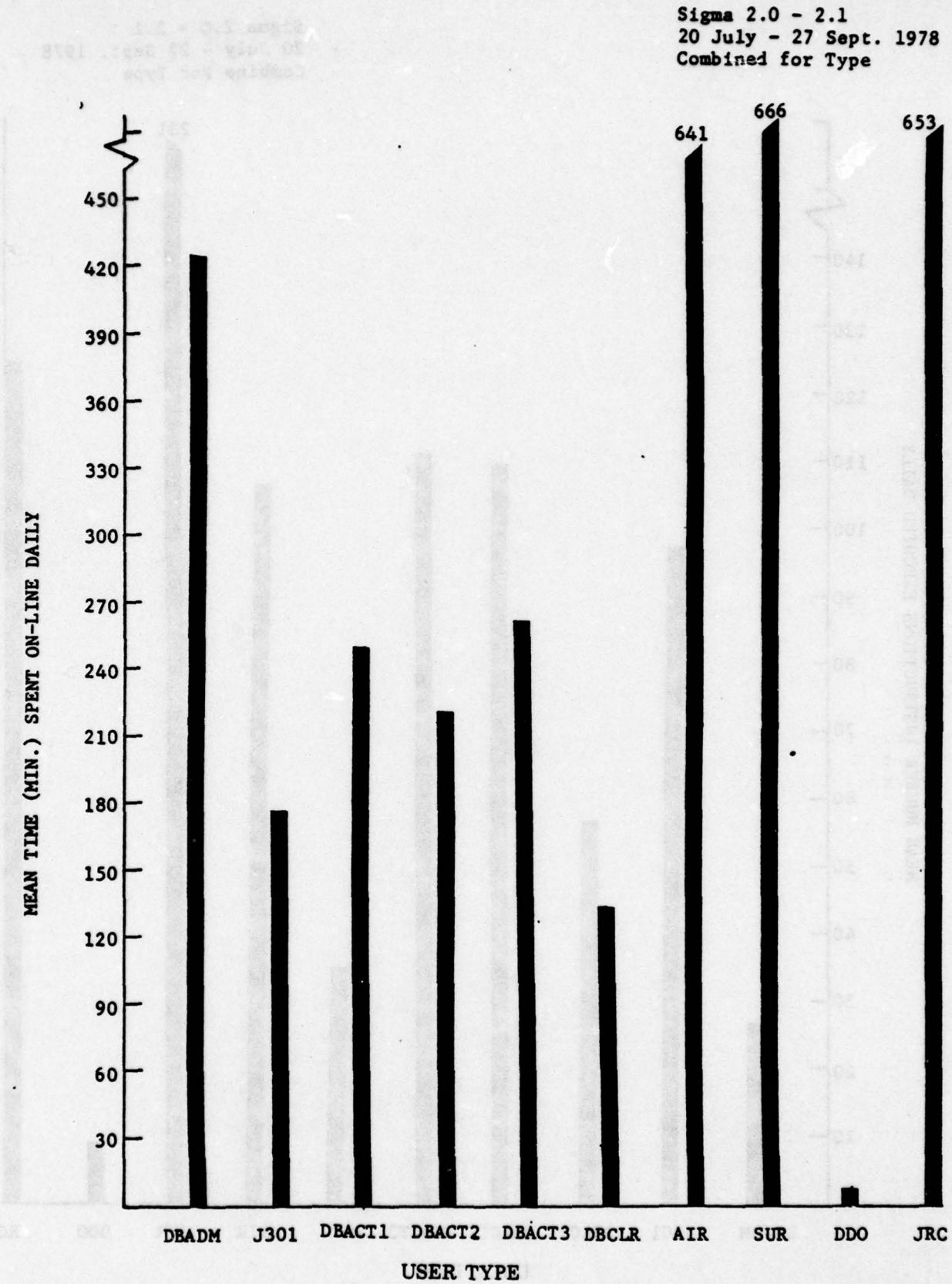


Figure 5. Mean Time On-line by User Type

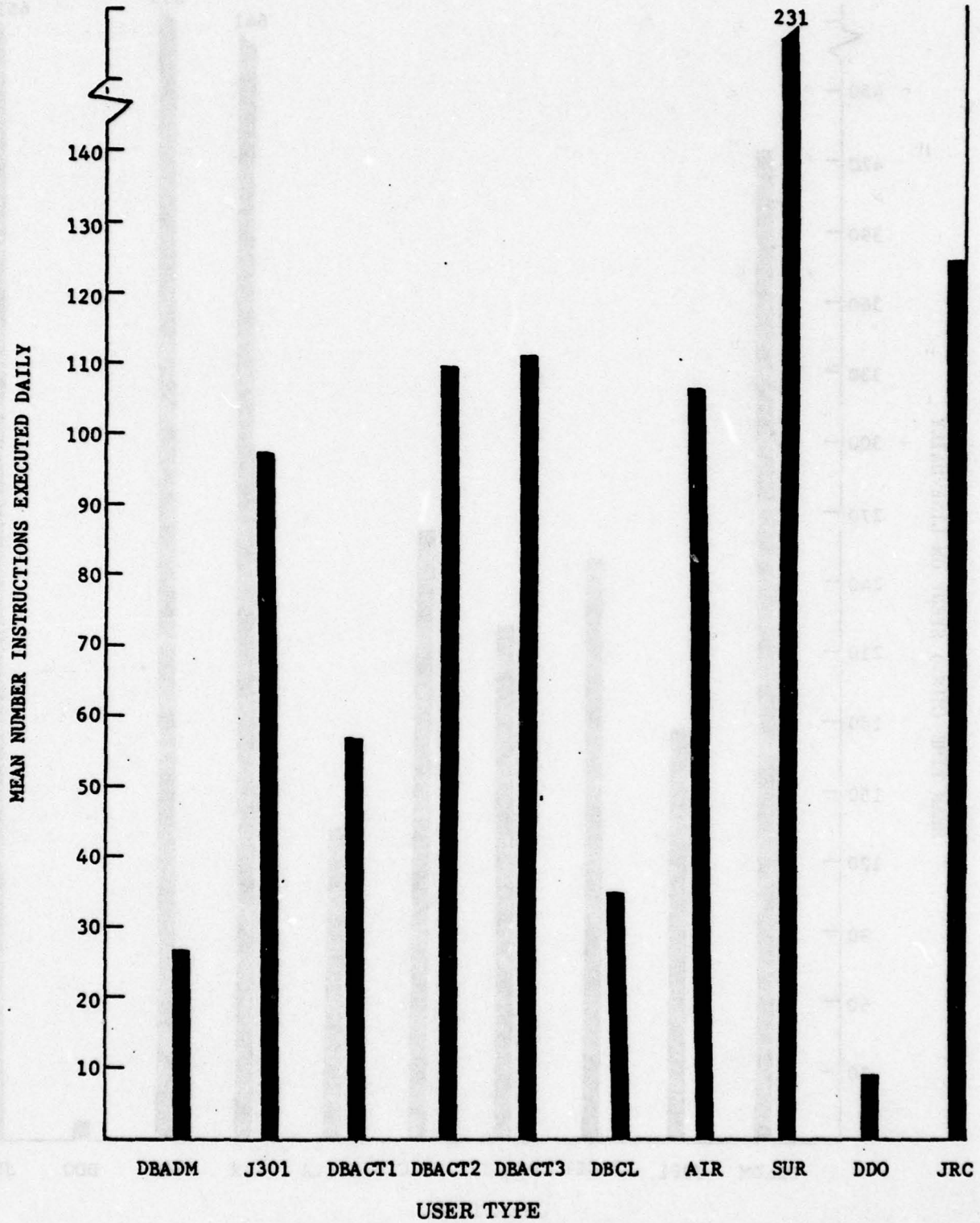


Figure 6. Mean Number of Commands (Daily) by User Type
(This sums the commands for all users acting in the role)

Of somewhat more interest are the increases shown in numbers of commands (Fig. 6). Modest increases are shown by the division/branch administrative, division/branch clerical, J301, and action officers in category 1. (There is no change for DDO, who does not have his own terminal.) Moderate increases are shown by action officers in category 3 and by air desk duty officers. Large increases are shown by action officers in category 2 (where many officers share a few terminals), surface desk duty officers, and JRC.

It is too early to draw any useful conclusions from these comparisons of loading by type. However, the data do suggest that in order to determine load by type, these kinds of comparisons should be made in the future, after the users have increased experience with the system.

OBSERVATION

The pattern of hourly system use which has developed is consistent with the normal workday. There appear to be different styles of use by different types of users, influenced in part by terminal availability. It is too early to draw any conclusions about the level of use which can be expected from these different user types.

DEGREE OF INTEGRATION INTO NORMAL OPERATIONS

The J301 staff is using the automated system as its secondary source for message routing. Increasing usage of the system by J301 has been noted. Initially, J301 would log-on in the morning, route the message traffic, and log-off for the day. The staff is using the system increasingly during the day to route traffic.

The Command Center and Joint Reconnaissance Center Watch Teams have been observed using the automated system. Some teams log-on to review their traffic when they come on watch; then, some stay logged-on and review their traffic on a periodic basis while others log on and off as they review traffic. They create files on relevant areas of concern and file messages into the files. They have experimented with the creation of readboards, but have problems because the data they require is not all on the MME system. They also have prepared sections of the morning brief on-line as text objects.

Many action officers observed use the automated system to retrieve referenced messages; to review incoming traffic; to create text objects which later become sections of reports, memoranda, and messages; and to maintain extensive files relevant to their jobs. Some have developed rather precise selectors to reduce the date file to the few messages relevant to their jobs, thus allowing them to review the traffic rapidly and efficiently each day.

The clerical personnel have been using the automated system mainly as a source for message retrieval since the traffic is now routed by the system to the staff officers who generally file their own traffic as they review it. The clerical personnel have also been observed utilizing the informal note capability.

CHANGES IN STAFF OPERATIONS

Little change has been observed in staff operations during the initial phase of the experiment. The major contributions to this lack of change are felt to be:

(a) The automated system does not provide all of the functions required to perform a user's required job.

(b) There are insufficient user terminals on-line to allow the system to interface each user to every other possible user. This not only limits the number of users on-line, but requires those users on-line to resort to the manual system to interface with the users and organizations not yet on-line.

(c) During the period covered by this report, the coordination and release capabilities for outgoing messages were untested.

TYPE OF USE

Data for this section were selected from data on SIGMA use at CINCPAC during the months of August and September 1978. This section describes the type of use made of the system by users in different roles. Activity is summarized in graphs representing data for four time periods: 19 July-2 August, 3 August-16 August, 17 August-30 August, and 6 September-27 September. SIGMA version 2.1 was installed at CINCPAC in early September; prior to that date, version 2.0 was in use.

The graphs (see Appendix A) on user activity show the various types of instructions SIGMA users executed while on-line. Because of the number of SIGMA instructions, it was necessary to group instructions into the 32 functional categories that appear on the two vertical axes of each graph. Similar instructions are grouped together. For example, the "display message" category includes all instructions and function keys which cause a message to be displayed such as "display entry (number)", "redisplay (or show) open message", "display message (message-id)", etc. Some of the categories combine two or more distinct instructions which perform similar functions, such as "restrict/augment", "file/move", and "copy/put/pickup/move text".

Each graph represents the activity of one SIGMA user in a specified role over an entire time period (four graphs for each role). The graphs show for each instruction category the percent of the total number of instructions executed from that category. They also show the percent of the total processing time associated with the instructions for that category.

These percentages are represented by the bars on the graphs. The striped bars represent the number of instructions and the solid bars represent machine processing time. For example, say that for a given user, 30% of his total instructions were from the "display message" category and the processing time associated with these instructions was 20% of the total processing time for

all instructions. In this case, the striped bar at the "display message" mark would extend to 30%, the solid bar to 20%. In addition, after each striped bar the total number of instructions executed from that category is included.

On each graph, the instruction categories are divided into two distinct groups: the categories in the left hand group represent activities which are usually associated with reading and manipulating incoming messages. The categories in the right hand group represent activities usually associated with outgoing messages, such as creation, coordination, etc. The right hand group also includes activities associated with the manipulation of text objects and miscellaneous categories such as "clear view window", "finish", etc.

A representative sample of users was selected from each of the roles: Surface, Air, JRC, J301 and from several of the other J3 divisions and branches for this report. The division and branch action officers were divided into three categories based on their incoming message load. Category 1 users are users with a moderate load of action messages and a heavy load of information (info) messages. For Category 2 users, the action message load is light but the info message load is heavy. The action and info message loads are both light for users in Category 3 . These categories were created to determine what effect a user's incoming message load has on his use of SIGMA, for example, to determine if users with heavier incoming message loads use the system more than users with lighter incoming message loads. Two users from each category are included in our sample so that comparisons among the three categories can be made.

Comparisons are also made between action officers and clerks. Because the total data set included very few clerks, they are grouped together regardless of division or branch. Differences in system usage between these two types of users are noted.

J301

J301 is responsible for the distribution of all incoming messages for J3. Normally, J301 logs on several times a day and distributes the messages. Predictably, "route message", an instruction which distributes messages to users for action and information, is the instruction J301 uses most often (about 25% of the commands).

However, there are several other SIGMA functions which are an integral part of his message distribution task. First, there are text objects. The "route message" instruction takes a special text object as one of its arguments. This text object contains four kinds of information regarding a message to be distributed. It identifies who the message should be sent to for action, who it should be sent to for info, whether it should be filed in one of J301's files (other than his Pending file), and whether or not it should be deleted from his Pending file. (Ordinarily, these criteria have been determined prior to a distribution session and stored in these routing text objects.) Some of J301's time is spent creating and editing these text objects. All four actions are executed by SIGMA whenever a "route" instruction is executed.

Second, there is the use of selectors. Often, several sets of messages will arrive which have the same routing criteria. To route these messages, J301 uses the "restrict" and "augment" instructions (usually with stored selectors) to create the subsets of messages with common routing criteria. He then routes all the messages in the subset using a single "route" instruction, referencing the appropriate text object. Then, using the "backup" instructions, he returns to the full Pending file and repeats the same procedure on another set of messages.

J301 cannot always determine how a message should be routed by looking at its citation in the Pending file; he needs to look at the text of the message. When this is the case, he puts the message on the screen, using "display message" or "view message". Usually he can determine how the message should be routed after reading the first few lines of the text field. Most of the time, though, the routing criteria can be determined from the message's Pending file citation, as the graphs demonstrate; "display message" and "view message" instructions constitute only a small percentage (2-3%) of all of J301's activity.

Action Officers

Action officers are grouped into categories based on their division or branch incoming message load (see introduction to this section). For Category 1, data from J311 and J313 were selected. For Category 2, J34 and J342 were selected, and for Category 3, J315 and J32 were selected. Category 1 users have the heaviest incoming message loads, followed by Category 2 and Category 3, which has the lightest load.

Because the time period selected for this report was the intial period of limited experimental use of the system, users of SIGMA operated at different levels of proficiency. In other words, some users were very familiar with the system, executing a wide variety of instructions, while other users executed only a few basic instructions, such as "display message" and "display file". This fact was particularly true of action officers, making it difficult to make comparisons between the three categories. Often, within a category, users from one role appeared to be active, experienced users, while users from another role executed a small variety of instructions. Because of this, it is impossible to generalize the characteristics of SIGMA users in a single category. As the system becomes familiar to all the users, we might expect users in a given category to have similar patterns of use which might differ to some extent from patterns of use observed in users from other categories.

Action officers, as a group, have some similarities in the way they use SIGMA, despite the discrepancies in their degrees of proficiency. All of them read their incoming messages by displaying their Pending files (15-20% of their total commands) and then reading the messages of interest. Some action officers prefer to use the display window for reading their messages while others prefer the view window. These preferences are consistent; users used one window or the other almost exclusively. In this mode of operation, the advantage of using the view window is that the Pending file can be displayed

simultaneously. The advantage of the display window is that the message replaces the file as the only object on the screen (assuming that there is nothing in the view window at the same time), and it is displayed in brighter video. Other frequently used instructions, such as "restrict", "augment", "backup" and "find entry", are aids to a user trying to read his incoming messages (15-20%).

Most action officers with at least a moderate level of activity do some file maintenance such as filing, moving, and deleting messages. Instructions in the "create file", "comment message" and "keyword message" categories might also qualify as file maintenance. In addition, a small amount of message creation activity was observed in the data from these action officers. Most likely, the messages were informal, internal notes to other CINCPAC users, as, at the time these data were collected, formal coordination and release of outgoing messages had not yet been implemented.

Clerks

There was not much data from clerks during the time period these data were collected, and not each category was represented in the group of clerks, so all the clerks were grouped together, regardless of category. There were many similarities among the activities of all the clerks, so we are justified in grouping them together. In fact, in several cases, one clerk was logged on as more than one role, so that in grouping clerks over roles, we were often grouping data from the same clerk.

The clerks' activities did not differ significantly from those of the action officers, although they did seem to execute fewer commands in general. Their primary activity was displaying or viewing messages in their message-files, followed by file maintenance ("file/move" and "delete message" instructions). As with the action officers, the clerks used "restrict/augment" and "backup" instructions as an aid to reading their messages. There was a small amount of message creation done as well.

In the future, clerks may be expected to use SIGMA differently than action officers, and these differences would reflect the differences that exist between a clerk's duties and an action officer's duties. However, the data collected for the two groups during this period of limited experimental use of SIGMA do not reflect those differences.

Surface and Air

The Surface and Air roles are users who are duty officers in the Command Center at CINCPAC. These two roles receive copies of almost all the incoming messages for CINCPAC. On SIGMA, these users receive these messges in their Pending files. They scan the message citations in this file daily looking for reports of situations and events requiring immediate action and/or the attention of designated action officers. Messages of importance are displayed or viewed and sometimes forwarded to the appropriate person. Most other messages are deleted, one at a time as the user scans his file. This fact is

reflected in the graphs. There are a fairly substantial number of "display message" or "view message" instructions (10-20%) and an even greater number of "delete message" instructions (40-60%). This indicates that a Surface or Air user is most likely scrolling through his Pending file, displaying (or viewing) messages, then filing and/or deleting them, based on the information contained in the message's citation. Since "delete message" is overwhelmingly the most-used instruction, it is likely that Surface and Air get a great many messages that are of little interest to the CCWT. A large variety of other instructions are executed by Surface and Air users, but those instructions make up only a small part of their overall activity. These activities include message and file creation, printing, and message forwarding.

JRC

Users in the JRC role work in the Joint Reconnaissance Center at CINCPAC; JRC is responsible for seeing that reconnaissance missions are carried out correctly. Their use of SIGMA is much like that of Surface and Air users. They receive most of the incoming messages for J3, but are primarily concerned with those messages which relate to their jobs. Therefore, "delete message" is a commonly used instruction (20-50%) followed by "view message" and "display message" (15-25%). Presumably, the mode of operation is to display the Pending file ("display file" instructions make up about 15-20% of the total) and then scroll through it, reading messages of interest to JRC and deleting messages which are not of interest. "Restrict/augment" instructions (about 5%) are used to aid JRC in his file scanning.

OBSERVATIONS

From these observations, it is obvious that a user's job does influence the way he uses SIGMA, what instructions he executes, what SIGMA functions he takes advantage of. J301, whose primary job is message distribution, uses the system quite differently than a user from, say, the Command Center Watch Team.

There are many differences between individuals in the same role which can be attributed to two facts. One is that different users have different degrees of proficiency with the system. The second reason is that the paper system is still the primary message handling system in use at CINCPAC. While users are encouraged to make use of the computer-aided system for the daily message traffic, many may still rely on the paper system. Once the official experiment begins, it is expected that these individual differences may be minimized and that users with similar work loads will be using SIGMA in similar manners.

SECTION 8

OBSERVATIONS

It is important to reemphasize that the data collection to support this analysis was done very early in the experiment; therefore, the users' impressions must be measured very carefully against their experience, the system capability, the system reliability, and the system load. For instance, the time covered by the questionnaire was one in which there was not a heavy load on the system. Thus, a user's impression concerning the adequacy of the response time may change when the system use increases. Also, the system is still undergoing changes; thus, a user's impression that the message archive facility is inadequate is valid for the time of the survey, but may not be valid after a new archiving procedure is implemented. There exists a problem in either the hardware or software that causes a user's terminal to be disconnected abruptly from the message service system. This can result in loss of the work that has been accomplished during the session. This is a major problem for the users, and a solution is being pursued vigorously by the system developers. When the solution is found, the users' perceptions of the system reliability probably will change.

The subjective evaluation of the MME is based on:

(a) the replies to the survey questionnaire (polled J3 users the week of 13 November 1978 concerning their use of the system);

(b) observations, conversations, and interviews with the users; and

(c) the data collected that are described in Section 5.

A sample of the survey questionnaire is included in this section. The application of the questionnaire and the tabulation of the results was a joint effort by the on-site team including personnel from the J6 and the J3 directorates. The purpose of the questionnaire was to characterize each user's use of the MME system (frequency and functions), to determine each user's perception of the system, and to identify those functions that each user sees as constraining. J341 categorized the users' responses to the survey into three groups. The details of the questionnaire and a discussion of the results are contained in the section of this report prepared by the CINCPAC personnel.

The following observations summarize the information derived from all the sources cited in this report.

(a) The hardware and software have been undergoing significant changes. Neither the users nor the evaluators as of yet have a baseline system to judge; neither has J3 built up sufficient confidence in the system to rely on it for full message-handling support.

(b) A great deal of the information (e.g., operational plans, memos, reports) needed by a user in preparing a message is not available on the MME system. This limitation must be considered when extrapolating the results of the MME to other staff environments.

(c) The system has been in only a limited experimental use (LEU) phase. During the period, there have been occasional system failures that caused users to lose data. Further, there have not been enough terminals available. As a result, many users have not converted all of their message-processing tasks to the MME system.

(d) Step-by-step user guides for various functions (releasing messages, reading incoming messages, composing and sending notes) appear to be effective in encouraging system use.

(e) The features most used to date have been message routing, filing, and retrieval. The routing of messages to those users who have terminals has become an almost automated routine. J301 initiates a series of machine instructions to route the traffic, waits for the MME system to complete the work, and then, still using the MME system, routes any remaining messages. Using this procedure, the time for routing messages can be decreased from approximately four hours with the manual system to approximately one hour using the MME system. The major problem is that all the users served by J301's routing do not have terminals; hence, the manual system cannot be replaced completely. When filing, information copies of messages can be retrieved by users directly from the file by means of various message selectors. Thus, the information copies of messages need not be routed explicitly by J301; rather, he can rely on the users using their own specialized retrieval criteria for the messages. In addition, the users utilize the file-building and message-retrieval capabilities for their personal and organizational files.

(f) The command center and joint reconnaissance center (JRC) watch teams are using the MME system to review their traffic and to create files that reflect particular areas of concern. They then file relevant messages in them for use in creating readboards and preparing sections of the morning brief.

(g) Some action officers are using the MME system to review incoming traffic; to retrieve referenced messages; to create text objects as bases for sections of reports, memoranda, and messages; and to maintain large files relevant to their duties.

(h) The clerical personnel are using the MME system mainly for message retrieval because the traffic is routed directly to the staff officers for their disposal; they also utilize the informal note capability.

(i) The strict enforcement of a security policy using the concept of a security kernel does not appear to have added undue restrictions on the user interface.

Training Lessons (summarized from Section 6)

(j) Although the on-line lessons have proved to be very useful, they have not been accepted to the degree that we had hoped.

(k) Much personal attention is needed by the trainees.

(l) The primers are used more than the reference manuals. There are probably two reasons for this - the primer is written in a more conversational, breezy style, and at the present stage of the experiment, introductory level material is needed more than the details of features and instructions.

(m) The lack of system stability has had a deleterious effect on the training of the users.

(n) Having users participate in system testing, such as the load tests, has had a beneficial effect on training.

(o) User training suffered from a number of "false starts" for the experiment. Some users commenced their lesson-taking as much as five or six months in advance. Not all users suffered from this delay, but certainly for some, the momentum developed during lesson-taking was dissipated before the limited use phase began.

(p) One aspect of the MME environment that has caused more problems than anticipated is that of lack of free access to some of the work spaces in which the terminals are installed. This comes about because of the high security level at which some of the offices operate. Although some project personnel have the necessary clearances, others do not, and on occasion someone not completely familiar with a problem may be the one who has to respond.

Inferences from User Questionnaires (discussed in detail on pages 56 through 59).

(q) Those who most frequently use the message distribution function have a generally good perception of it.

(r) Most users generally achieve their desired results and perceive very little limitation in the use of the message reading and filing capability. Members of the command center watch team (CCWT) report problems with this function and have a noticeably less-favorable perception and foresee limitations (possibly unacceptable ones).

(s) The users generally are able to retrieve the messages that they need, but many report problems in the retrieval of archived messages.

(t) The capabilities for text preparation and message drafting have been used almost exclusively by the Group A users who were fully trained. The users rate these functions highly and perceive no system limitations in their use.

(u) The informal note function has had limited use; it is liked by the users.

(v) The coordination and release functions have not been used.

(w) Some users see the slow response time as a problem (reported "some limit"); some viewed it as usually satisfactory.

CINCPAC's EVALUATION OF THE MME SYSTEM

The remainder of this section was written by the CINCPAC staff to describe the user's perception of the MME system.

Summary

This section provides CINCPAC's evaluation of the MME system during the period July 1978-November 1978, during which time approximately half of the potential J3 users utilized the system either to support their assigned duties or for training and familiarization. At the conclusion of this period, they were asked to report their preliminary observations and perceptions of the system through a user questionnaire. Their overall evaluation of the system was that the MME was satisfactory in most aspects. Corrections of problems and limitations identified by the users are, for the most part, scheduled for future system releases. Since the number of users and scope of their use were limited, these initial observations need to be confirmed during Full Experimental Use (FEU) of the MME.

Observation Environment

User population

Ninety-nine members of the J3 staff have been identified as candidates to participate in the experiment as users of the system. Forty-four of these had sufficient MME training and experience at the time the user questionnaire was distributed. A detailed outline of the polled population is provided in this section.

Type of use

During the observation period, J3 personnel used the MME in parallel with existing manual message handling procedures. This phase of system development was entitled Limited Experimental Use (LEU) and directed certain minimal use of the system for applicable J3 users. The objective of the LEU was to develop J3 procedures for eventual use of the MME as the primary message handling system, and to provide practice in using several different system capabilities. Several users voluntarily intensified their usage during LEU and came to depend upon the MME as their primary message handling tool.

System status

There were significant system upgrades in both hardware and software during the evaluation period. The users' observations are, therefore,

oriented to the system as it existed during the latter part of this period which included a new KL processor with over one million words of memory and 14 user terminals.

User Perceptions and Acceptance of MME

Questionnaire

User observations of the system were evaluated on the basis of a questionnaire. A copy is included at the end of this section. The questionnaire was designed to:

(a) Characterize the frequency with which each respondent used the system and each of its major functions;

(b) Determine whether a respondent perceives each major MME function as being helpful to him; and

(c) Identify those functional capabilities which are thought to limit the usefulness of the system.

User sample

During the week of 13 November 1978, forty-four J3 users of the MME were asked to complete the questionnaire. Responses were received from thirty-nine (90%) of the users. The users polled were those who made most frequent use of the MME. The 50 or more potential users who have not used the system, whether from lack of terminals, lack of opportunity, or lack of interest, were not polled. The 44 users are subdivided into the following three groups:

(a) Group A consisted of 18 people judged by J341 as being trained since they had completed all of the milestones established by J341. Seventeen of this group returned the questionnaire. One of the 17 did not respond to most questions since his terminal had been out of service since early August.

(b) Group B consisted of nine persons considered to be partially trained. Of the eight who completed the questionnaire, one did not answer most questions as his use was very limited.

(c) Group C consisted of 17 persons judged as marginally trained. Of the 14 who returned the questionnaire, three did not answer most questions because of insufficient use.

Tabular results

Tables 4, 5, and 6 present the responses for each user broken down by the three groups identified above. In presenting these results, numerical values have been given to responses in sections 1 and 2 of the questionnaire which deal with frequency of system use. These numbers are not scaled valuations of usage; they are simply ranking numbers. The larger values imply more frequent use. Alphabetic coding has been given to responses in sections 3 and 4 which deal with user perceptions and acceptance. These codes are:

E = Excellent

S = Satisfactory

P = Poor

U = Unsatisfactory

Discussion of results

The following discussion summarizes the users' responses for each functional capability and highlights some of the best and least liked features. Quotations from several users have been included to give the reader a more direct impression of their attitudes. Phrases included in square brackets within the quotations have been inserted to clarify the meaning of the comment when taken out of its context. While reading this discussion, the reader should keep in mind that these users were selected as those having most exposure to the MME and that most of their use of the system was ancillary to the manual message system.

(1) Distribution function. Those who most frequently use the distribution capability (primarily J301 and some action officers) have a generally good perception of it. A potential limitation foreseen by a key user is that terminals have not been allocated to J35, J36, and J37. He stated, "Difficult to substitute MME for paper system when all Divisions do not have terminals." Less frequent users of this capability see little limitation to its usefulness. In evaluating the distribution capability, there is little difference among Groups A, B, and C. However, Command Center officers report almost no use of this function. Although action officers use it much less than do NCOs, their perception and acceptance are favorable.

(2) Reading and filing messages. Both frequent and occasional users of the MME achieve desired results and see very little limitation in this capability except for members of the CCWT (command center watch team). They have a noticeably less favorable perception and foresee limitations, sometimes unacceptable ones.

Respondent #8 (CCWT) "...reading all msgs contained in the pending file is a very slow and laborious process and has no advantage over the time honored system of reading hard copies. ...during crisis...the time factor becomes unacceptable."

"Scanning...is very fast, but with disadvantages...it becomes rather risky to decide on the basis of [the message citation] whether to read or delete [a message]."

Respondent #40 (CCWT) "Messages in [readboard] files are filed in random sequence rather than in DTG order."

(3) Retrieval. The retrieval capabilities have been used by all groups. Users report that they can "usually" to "almost always" get the message they

need, but many users report problems and limitations in retrieving from the archive. Their complaints are usually that the time to retrieve such messages is much too long.

Respondent #3 (Considered retrieval a serious limit) "mostly due to message not in files due to classification or comeback copies not filed." (Note: The problem of nonreceipt of comeback copies will be corrected by a new procedure in early December.)

Respondent #5 "Multi-part messages not fully retrieved."

Respondent #6 "Need TS [messages]."

"A good action officer feature is the date file for immediate retrieval."

Respondent #19 "a wait of over 5-10 minutes is unacceptable as you don't need that much time to find a message in the [manual] filing cabinet."

Respondent #8 "retrieving from the datefile, by either DTG, originator or subject is a superb feature...of considerable use to me." "retrieving from text is outstanding." "the majority [of my] files are created for long term usage, which is incompatible with the 30-day rapid access file." (because retrieval from archive was so slow)

Respondent #40 "frequently referenced messages cannot be located in the MME datefile."

Respondent #27 "very good for retrieving messages, don't have to call comm. ctr."

(4) Preparation of text and drafting messages. These capabilities have been used almost exclusively by Group A users; they were rated highly by them and seen as no limitation.

Respondent #8 "drafting...is another strong feature...associated capability for internal routing and chopping is outstanding."

"editing...is rather simple and far superior to the standard typewriter."

"a weakness...is printing! ...MME system often refuses to retain or accept the format."

Respondent #40 "ability to make rapid corrections...is a major advantage."

Respondent #15 "formatting routine gives problems thru reformatting of the text."

Respondent #18 "...biggest irritant to me is the reformatting" (but he did not view preparation as a limitation).

Respondent #30 (sees preparation as an unacceptable limitation) "for non-clerk typist."

(5) Sending notes. Based on limited usage, this capability is well perceived and seen as no limitation.

(6) Coordination and release. During the period covered by this report, J34 asked J3 users to do some message coordination up to the point of release, but not to release messages on the MME. The capability was given insufficient usage to warrant but few specific comments.

Respondent #3 "message distribution and coordination will function better when more people get terminals"

Respondent #13 "face-to-face is still best"

Respondent #35 (sees a serious limit in coordination and release) "non-sequential chop; release before chop possibility; lack of reference material with message [printed pubs, etc.]."

Respondent #40 "messages sent for chop return to the originator without the chopper's changes having been incorporated. ...very easy to overlook wordsmithing and small changes."

(7) Response time. Experienced users checked that response time to instruction is "usually satisfactory" (50% to 80% of the time) and viewed it to have "some limit" during the experiment. The inexperienced users report more problems and see more limitation. Perhaps experienced users have spent more time on the system and have felt the improvement resulting from the KL installation. Comments concerned with the response time for archive retrievals have been mentioned under Retrieval. The following comments are directed only toward response time to instructions:

Respondent #8 "response time to instructions is generally adequate. I...can discern no appreciable improvement" (from the KL system) "seems to be little correlation between ... responsiveness and the displayed load average. The system can be sluggish with a load average of 2.0, and conversely operate normally with an 8.0 load average."

Respondent #9 "Time delay seems to have increased since new installation even with low LDAV."

Respondent #16 "Response time too long"

Respondent #42 "Response time to instructions is generally satisfactory. During periods of high volume transfer...the MME has serious and unacceptable limitation."

(8) Reliability. Most respondents encountered problems in this area and foresaw some limit on system usefulness as a result.

Respondent #8	"overall reliability is good" "amount of downtime is rather excessive. Taking the system down for periods of eight hours or so (for preventative maintenance) is not realistic and totally unacceptable to users. Downtime for routine maintenance has to be reduced significantly."
	"printer...marginally satisfactory"
Respondent #40 (CCWT)	"before the new processor...system hung and crashed frequently ...will still do you in if you don't take time to do a FINISH every once in awhile to protect work."
	"the current...maintenance schedule requiring 8 hours of downtime every Wednesday afternoon (1400-2200) is not acceptable...a few hours during the day from say 1000-1400, two or three times a week would be better. If a long time is needed, Saturday PM or Sunday morning...if [the MME] is to become a way of life for the CCWT."
Respondent #16	(Called reliability unacceptable) "system crashes too often"
Respondent #27	"poor reliability during a critical time would render the system useless..."
Respondent #31	"until users realize that the MME is not going to go down repeatedly there will continue to be a resistance to using it"
Respondent #34	"1st priority is to improve reliability of MME; we have frequent hangs and crashes."

Summary

(1) Overall, the system is perceived as being useful. There are some limitations, particularly for the functions of archive retrieval, message coordination and reliability.

(2) The system is best received by those who use it most.

(3) The CCWT officers, in consideration of their need to handle large numbers of messages in crisis and exercises, are least accepting of the various groups who were polled. As in other groups, the most experienced were more favorably inclined.

Additional CINCPAC Comments

Most substantive user observations and perceptions are presented in the previous paragraphs. This section includes additional management observations to focus the attention of the MME team on certain capabilities which may limit the usefulness of the system.

a. Suspected shortfalls

(1) Access to the system. At the beginning of the experiment, a decision was made, with the agreement of J3, to concentrate the limited number of terminals available within certain key divisions. Consequently, divisions J35 (exercises), J36 (Special Operations), and J37 (geophysics; i.e., Weather) do not have access to MME terminals and are not users. These divisions receive about 25% of the J3 action messages (source: initial draft of Baseline Data Repaort). Their lack of participation may become a limitation on assessing the overall acceptability of the system.

(2) Limited numbers of terminals. A critical period for message review is in the early morning before staff meetings. Only 24 terminals are currently planned to serve about 100 users and some of these terminals are reserved for one or two users (e.g., J3, J30). There may be an insufficient number of terminals to permit all the users to rely effectively on the MME as their primary message handling tool during these active morning hours.

b. Suggested areas for further analysis

(1) Review of message files. Senior officers and CCWT officers in the Command Center Watch Teams currently thumb through large numbers of messages in a few minutes and quickly select those which appear to be important. Some feel that attempting to judge importance of a message on the basis of the brief MME citation is risky. A more careful examination of a message requires a DISPLAY command and (possibly extensive) scrolling to the text. These tasks take much more time than thumbing through paper copies. This slowness, reported as a problem by CCWT officers, may become critical both for the CCWT and for division chiefs during Full Experimental Use.

(2) Preparation of outgoing messages. The drafting and editing of messages on the MME is reported as satisfactory by most action officers. One senior officer, however, identified a problem likely to be faced by senior officers, few of whom are good typists. Making editorial changes, suggestions and comments (particularly since comments cannot be put exactly where desired) is much slower and involved on a terminal than writing on a hard copy. For this task, it is likely that such officers will often use MME printer output rather than the terminal as the more desirable way to edit draft messages. Since several users have reported problems with the printers (odd-feeling paper, poor quality print, strange reformatting), these characteristics may affect acceptability of the system by senior officers.

(3) Coordination. The coordination function was little used during the report period. However, several users did identify serious problems, not

all of which will be corrected in the January 1979 SIGMA release. Since it is impossible to judge the effectiveness of the revised coordination features at this time, this area needs to be monitored carefully.

c. Conclusion

Some of the problems identified by users and analyzed in the last few paragraphs are already being corrected. An early evaluation of the effectiveness of the corrections is needed so that prompt changes can be made if the early evaluations reveal difficulties more serious during Full Experimental Use.

USER QUESTIONNAIRE

The following is a reproduction of the questionnaire that was distributed to the users.

MME USER QUESTIONNAIRE

Introduction

The MME Program Managers are writing a preliminary evaluation of the MME - a Quick Look Report to help guide the future development of the experiment and to serve as a progress report to the sponsors and to the staff of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence. This is one of only 3 such reports.

An essential section of this report concerns the reactions of the users. The questionnaire below is intended to obtain those reactions in a form that can be readily summarized for top-level management. We are trying to determine how each of you is using the MME, how you perceive its major capabilities as helping (or hindering) your job, and how well you will be able to use it during the next year.

Consequently, your thoughtful responses to the questions below are of considerable importance to us and to the MME program. Please use the Remarks column to include specific gripes, requests, and plaudits (if any).

Name_____

USE OF THE MME

Have you been using the MME since July:

a. to support your regular job?

no____ occasionally____ frequently (over 3 times/wk)____

b. to support the experiment?

no____ occasionally____ frequently (over 3 times/wk)____

If you answered NO to both questions, please indicate why.

too busy____ not trained____ terminal not handy____

other_____

and do not complete the rest of the questionnaire.

HOW DO YOU USE THE MME?

	never	sometimes (less than 3/wk)	often (3/wk or more)	Remarks
- to forward/distribute msgs	____	____	____	
- to scan/read/file msgs	____	____	____	
- to retrieve msgs from your own files	____	____	____	
from the datefiles	____	____	____	
- to prepare reports & working papers	____	____	____	
- to draft msgs/memos	____	____	____	
- to send notes to users	____	____	____	

YOUR PERCEPTIONS OF THE SYSTEM

(if you do not use the capability, please leave that row blank)	never	occa-sionally (less than half the time)	usu-ally (half to 80% of time)	almost always (over 80% of time)	Remarks
Can you distribute the msgs as easily as you need to?	___	___	___	___	
Can you read/file msgs as well as you need to?	___	___	___	___	
Can you retrieve the msg you need?	___	___	___	___	
Can you prepare text/msgs as well as you need to?	___	___	___	___	
Can you send notes, etc. as easily as needed?	___	___	___	___	
Is the response time to instructions satisfactory?	___	___	___	___	
Do you have problems with reliability (hangs/crashes)?	___	___	___	___	

ACCEPTABILITY OF THE SYSTEM FOR THE EXPERIMENT

What features or functions of the MME may, in your view, limit the usefulness of this system during the experiment?

	not a limit	some limit	serious limit or deficiency	unacceptable limitation	Remarks
msg distribution	___	___	___	___	
message retrieval	___	___	___	___	
msg. reading/filing	___	___	___	___	
msg/text preparation	___	___	___	___	
msg coord/release	___	___	___	___	
response time	___	___	___	___	
reliability	___	___	___	___	

Please comment

TABLE 4 (GROUP A)

User Type	NCOs			J301 NCOs			CCWT OFFICERS			ACTION OFFICERS							
USER ID	1	2	3	4	5	6	7	8	40	9	10	11	12	13	14	15	42
job use	0	2	2	2	1	2	2	2	2	2	1	2	2	2	2	2	2
experimental use	0	1	2	2	1	2	2	2	2	2	1	1	1	2	2	-	2
Nature of Use																	
distribution	-	1	2	1	2	2	0	0	0	0	1	1	-	1	0	1	1
read/scan	-	2	2	2	2	-	2	2	2	2	1	2	2	2	2	2	2
retrieval own	-	1	2	1	2	-	2	2	1	2	1	1	2	2	1	2	2
retrieval date file	-	2	2	1	-	2	2	2	2	2	1	-	2	2	1	2	2
prep. test	-	2	1	2	-	-	1	2	2	0	0	1	2	2	1	1	2
draft msgs	-	1	1	2	-	-	2	2	1	1	1	1	2	2	1	1	1
send notes	-	2	2	2	-	2	2	2	1	1	1	0	1	1	1	1	2
Perceptions																	
distribution	-	-	E	E	E	E	-	-	-	-	E	-	E	E	-	S	-
read/file	-	E	E	E	E	-	E	P	S	E	E	-	E	E	E	S	P
retrieval	-	E	P	E	E	E	S	E	S	S	E	E	E	S	E	S	E
drafting	-	E	E	E	-	E	E	E	E	-	E	S	E	S	E	S	E
send notes	-	E	E	E	-	E	E	E	S	S	E	P	E	S	E	S	E
response	-	E	S	S	-	-	E	E	S	S	S	E	E	S	E	S	S
reliability	-	S	S	S	-	S	S	S	S	P	P	S	S	S	P	P	-
Acceptability																	
distribution	-	E	S	E	E	U	E	-	-	S	E	-	S	S	E	S	-
retrieval	-	E	P	S	S	S	P	U	P	P	E	E	P	S	E	S	U
read/file	-	E	E	E	-	-	E	P	S	E	E	E	E	S	E	E	P
drafting	-	E	E	S	-	-	E	E	S	E	E	E	E	E	E	S	E
coord/rel	-	P	S	S	-	U	E	E	S	S	E	-	S	P	E	S	E
response	-	E	S	S	-	S	E	S	E	S	S	E	S	S	E	S	S
reliability	-	-	S	S	-	S	S	S	S	S	S	E	S	S	S	S	S

NUMERICAL CODES:

Use: Never = 0, Sometimes = 1, Often = 2

Perceptions: Excellent = E, Satisfactory = S, Poor = P, Unsatisfactory = U

Acceptability: Excellent = E, Satisfactory = S, Poor = P, Unsatisfactory = U

TABLE 5 (GROUP B)

User Type	NCOs	J301 NCOs	CCWT OFFICER		ACTION OFFICERS AND CIVILIANS			
User ID	16	17	18	19	20	21	41	22
Job Use	2	-	1	2	1	1	2	1
Experimental Use	2	1	2	2	1	2	2	1
Nature of Use								
distribution	0	1	0	0	2	2	1	0
reading/scanning	2	-	1	2	2	2	2	1
retrieval own	2	1	0	2	1	1	1	0
retrieval date file	2	-	1	2	0	1	2	1
preparing text	0	-	0	0	0	0	1	0
draft msgs	0	-	1	0	0	1	1	0
sending notes	1	-	1	0	0	0	1	0
Perceptions								
distribution	-	S	U	-	-	S	-	-
read/file	E	-	P	E	E	S	E	-
retrieval	-	S	E	P	E	P	S	E
drafting	-	-	S	-	-	S	E	-
sending notes	S	-	S	-	-	-	E	-
response	P	-	E	P	S	S	S	E
reliability	S	-	S	S	S	P	P	E
Acceptability								
distribution	-	-	S	S	-	P	E	S
retrieval	-	-	E	U	-	S	P	E
reading/filing	E	-	S	E	-	E	S	S
drafting	-	-	E	-	-	E	E	E
coord/release	-	-	S	-	-	S	E	S
response	P	-	E	S	S	S	S	S
reliability	U	-	S	S	S	S	P	S

Numerical Codes:

Use: never = 0, sometimes = 1, often = 2

Perceptions: excellent = E, satisfactory = S, poor = P, unsatisfactory = U

Acceptability: excellent = E, satisfactory = S, poor = P, unsatisfactory = U

TABLE 6 (GROUP C)

User Type	NCOs	CCWT OFFICERS									ACTION OFFICERS AND CIVILIANS			
USER ID	23	24	25	26	27	28	29	30	31	32	33	34	35	36
job use	1	0	0	2	2	0	2	1	0	-	1	1	0	2
experimental use	1	0	0	1	1	0	2	1	1	1	1	1	2	0
NATURE OF USE														
distribution	0	-	-	1	0	-	1	0	0	1	-	0	1	0
read/scan	1	-	-	2	1	-	2	1	1	1	2	1	2	2
retrieval own	1	-	-	2	1	-	2	1	0	1	1	0	1	2
retrieval date file	1	-	-	2	2	1	2	1	0	1	2	1	1	2
prep. text	0	-	-	0	1	-	1	0	0	0	0	0	0	0
draft msgs	0	-	-	1	1	-	1	1	0	1	0	0	0	0
send notes	0	-	-	1	0	-	1	1	0	0	1	0	0	0
PERCEPTIONS														
distribution	U	-	-	-	-	-	P	-	-	-	U	-	E	-
read/file	P	-	-	-	S	-	P	S	S	-	P	S	E	E
retrieval	S	-	-	-	E	-	S	E	S	-	P	P	E	E
drafting	U	-	-	-	E	-	P	U	-	-	-	-	-	-
send notes	U	-	-	-	-	-	P	P	-	-	-	-	-	-
response	P	-	-	P	E	-	P	S	U	-	U	S	S	S
reliability	S	-	-	S	S	-	S	S	-	S	S	P	S	S
ACCEPTABILITY														
distribution	E	-	-	S	E	-	E	S	-	-	-	-	E	S
retrieval	E	-	-	S	S	-	S	E	-	P	U	S	S	U
read/file	E	-	-	S	S	-	S	S	-	-	-	S	E	E
drafting	E	-	-	E	E	-	E	U	-	-	-	-	E	S
coord/rel	E	-	-	E	S	-	E	S	-	-	-	-	P	P
response	S	-	-	P	E	-	S	S	P	-	U	S	E	S
reliability	S	-	-	S	P	-	S	E	P	P	-	P	E	E

Numerical codes:

Use: never = 0, sometimes = 1, often = 2

Perceptions: excellent = E, satisfactory = S, poor = P, unsatisfactory = U

Acceptability: excellent = E, satisfactory = S, poor = P, unsatisfactory = U

SECTION 9

REFERENCES

a. Memorandum of Agreement between Commander, Naval Telecommunications Command; Commander, Naval Electronic Systems Command; Director, Defense Advanced Research Projects Agency; and Commander in Chief, Pacific, September 1978.

b. D. E. Bell and L. J. LaPadula, Secure Computer Systems Mathematical Foundations and Model, MTR-244, The Mitre Corp., Oct 1974.

c. E. H. Bersoff and S. H. Wilson, Selection Criteria for a Secure Military Message Processing System, NRL Memorandum Report 3568, Naval Research Laboratory, Aug 1977.

d. J. D. Tangney. S. R. Ames, Jr., and E. L. Burke, Security Evaluation Criteria for MME Message Service Selection, MTR-3433, The Mitre Corp., June 1975.

e. S. H. Wilson, S. R. Ames, Jr., J. D. Tangney, and J. R. Bunch, Security/ Privacy Evaluation Subcommittee Report on the Candidate Message Service Systems for the Military Message Experiment, NRL Report 8155, Naval Research Laboratory, Sept. 14, 1977.

f. NAVELEXSYSCOM ltr Ser: 648:310, with enclosure, Subj: Military Message Experiment Master Test Plan, Nov. 28, 1978.

g. N. C. Goodwin, J. Mitchell, and P. S. Tasker, Evaluation of ARPANET Message Handling Systems for Use by the Military, MTR-3096, The Mitre Corp., Aug. 5, 1975.

h. S. W. Slesinger and P. S. Tasker, MME Performance and Design Evaluation, M77-206, The Mitre Corp., May 11, 1977.

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j. N. C. Goodwin, Military Message-Handling Experiment, Baseline Data Report, Test Group, Vol I, MTR-3665, The Mitre Corp., Sept. 19, 1978.

k. D. G. Miller, Military Message Experiment Training Experience, MTR-3644, The Mitre Corp., Aug 21, 1978.

l. S. Hosmer and N. C. Goodwin, Military Message Experiment: Limited Experimental Use of SIGMA at CINCPAC, WP-22087, The Mitre Corp., Jan 15, 1979.

SECTION 10

ACKNOWLEDGMENTS

The authors wish to acknowledge the contribution to this report by the many people associated with the experiment.

Nancy Goodwin, Sarah Hosmer, and Dave Miller of Mitre provided summaries of their reports (references (j), (k), and (l)) for inclusion in the Quick Look Report. Jonathan Mitchell of Mitre provided numerous constructive comments on drafts of the report as well as coordinating with the CINCPAC J3 and J6 staffs in administering and analyzing the user questionnaire. Rob Stotz of ISI provided the information describing the SIGMA operations. Dave Fralick of CTEC helped to organize and polish the materials.

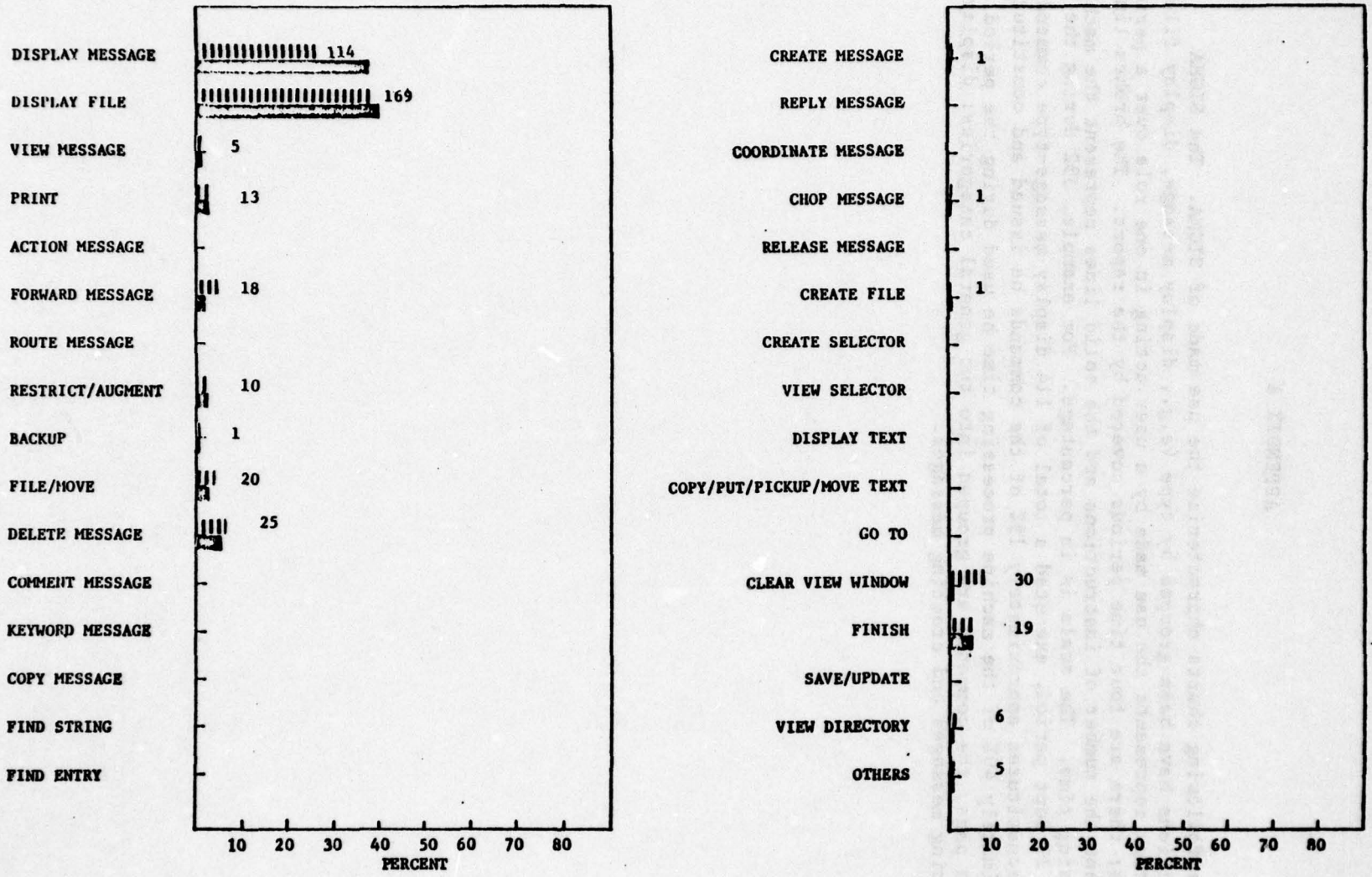
The members of the J3 and J6 staffs under the leadership of Capt. Greenhalgh and Col. Mendonca contributed many hours to the use of the MME and made many useful suggestions and observations. Tally George of the Naval Telecommunications Command provided a coordination service for users, operators, developers, and data collectors that maximized the usefulness of the system to everyone.

Finally, the patience and efforts of Louise Alekna and Janet Stroup in handling the enthusiastic response from the many reviewers are acknowledged.

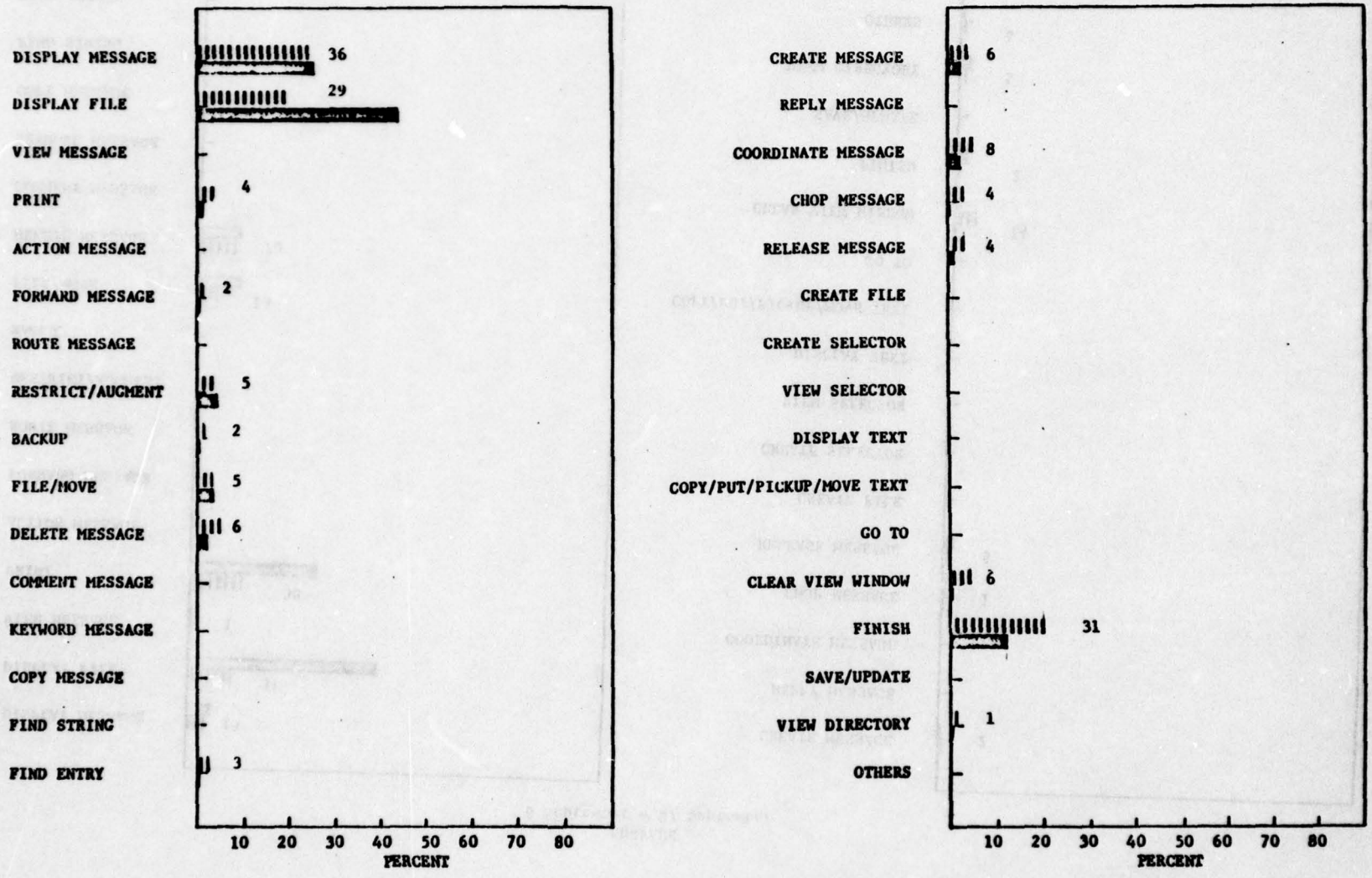
APPENDIX A

The following charts characterize the use made of SIGMA. The SIGMA instructions have been grouped by type (e.g., display message, display file). Each graph represents the use made by a user acting in one role over a period of time; there are four time periods covered by the report. The broken lines represent the number of instructions and the solid lines represent the machine processing time. The scale is in percentage. For example, J32 during the 6 Sept - 27 Sept period, executed a total of 114 display message-type commands; these constituted approximately 15% of the commands he issued and constituted approximately 40% of the machine processing time he used during the period. On each page, the commands are grouped into two general categories: displaying or routing messages and creating messages.

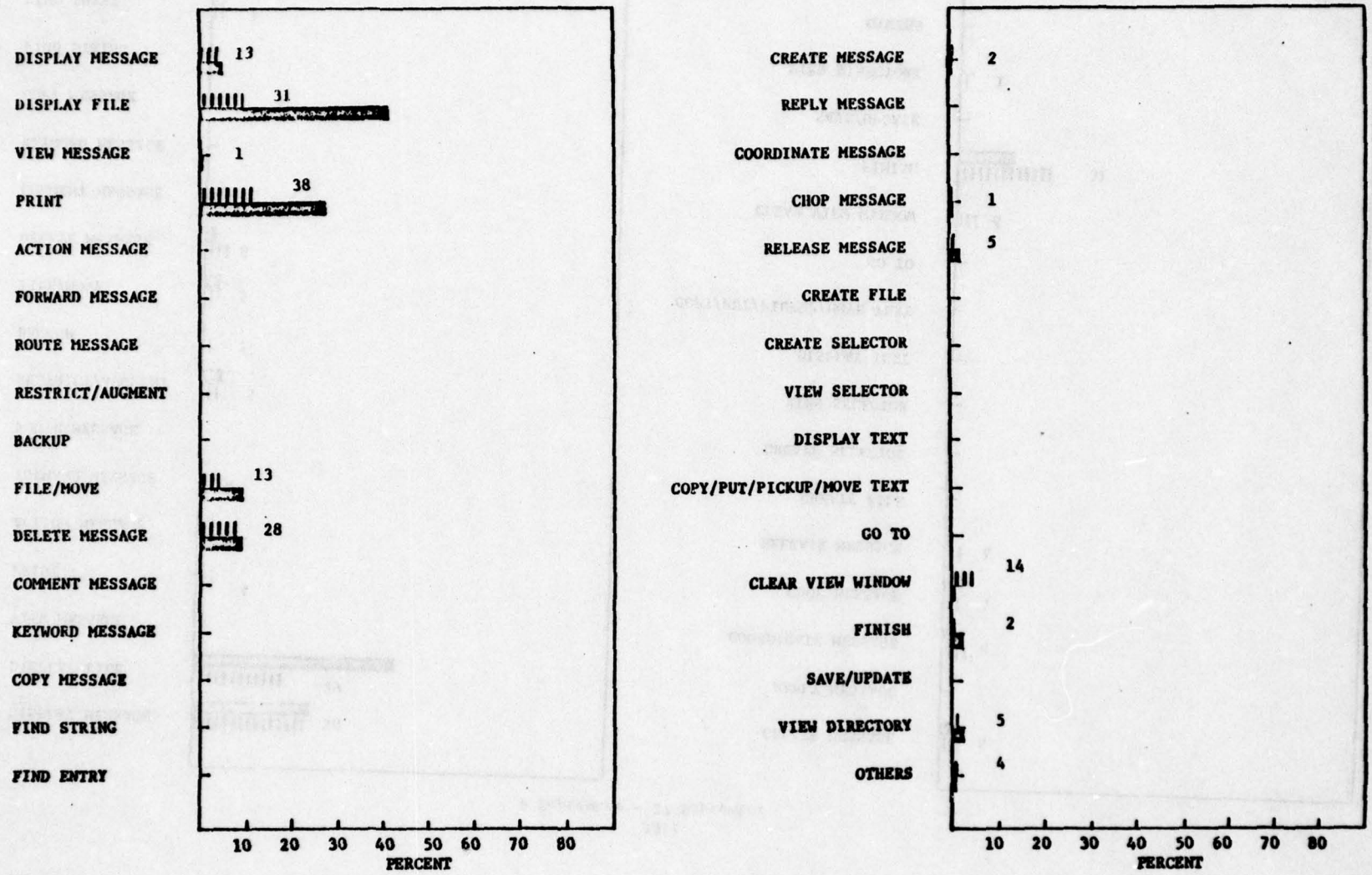
J32
6 September - 27 September



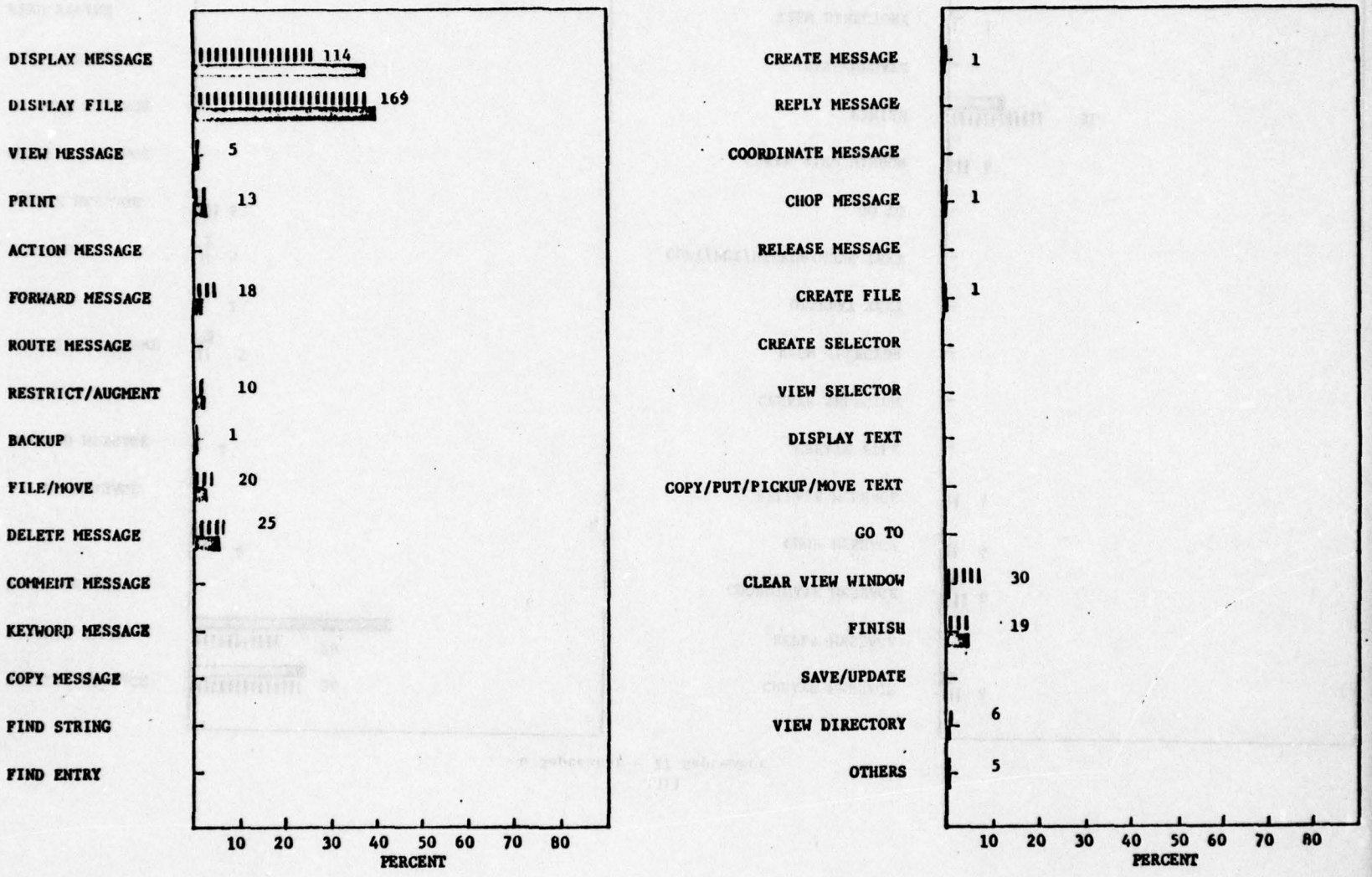
J311
6 September - 27 September



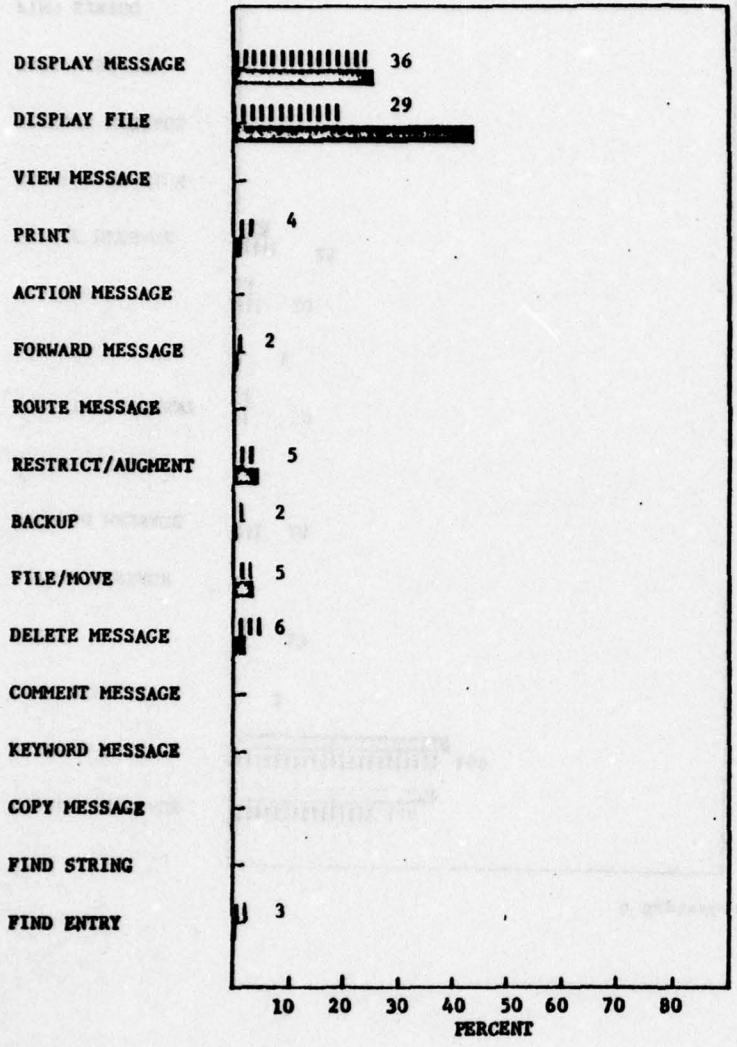
SURFACE
6 September - 27 September

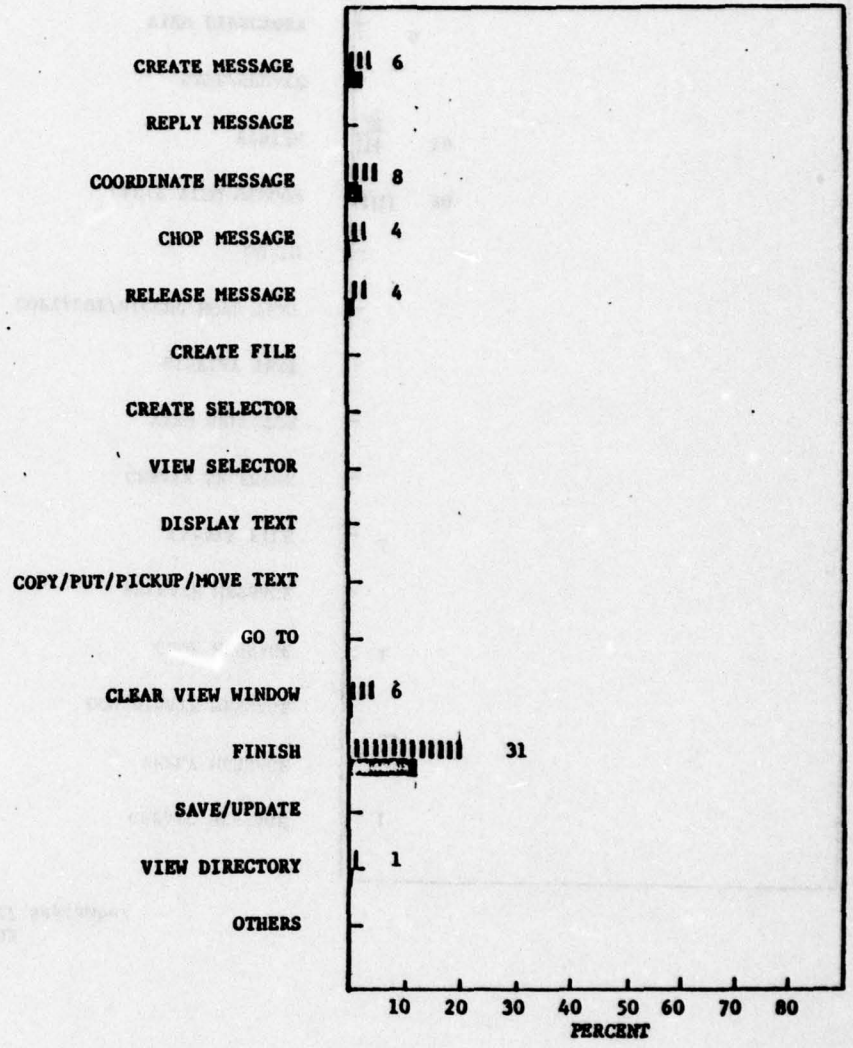


J32
6 September - 27 September

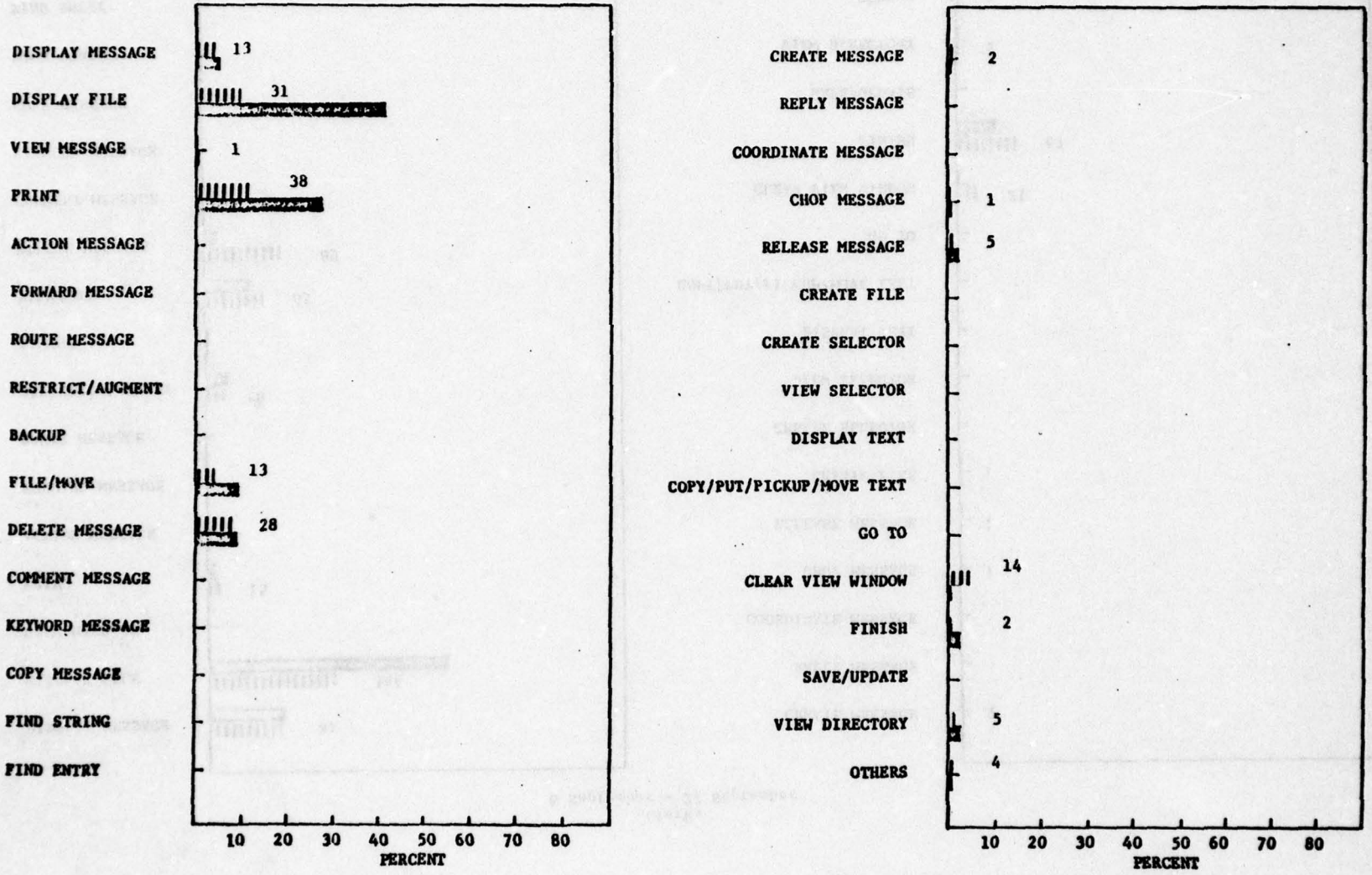


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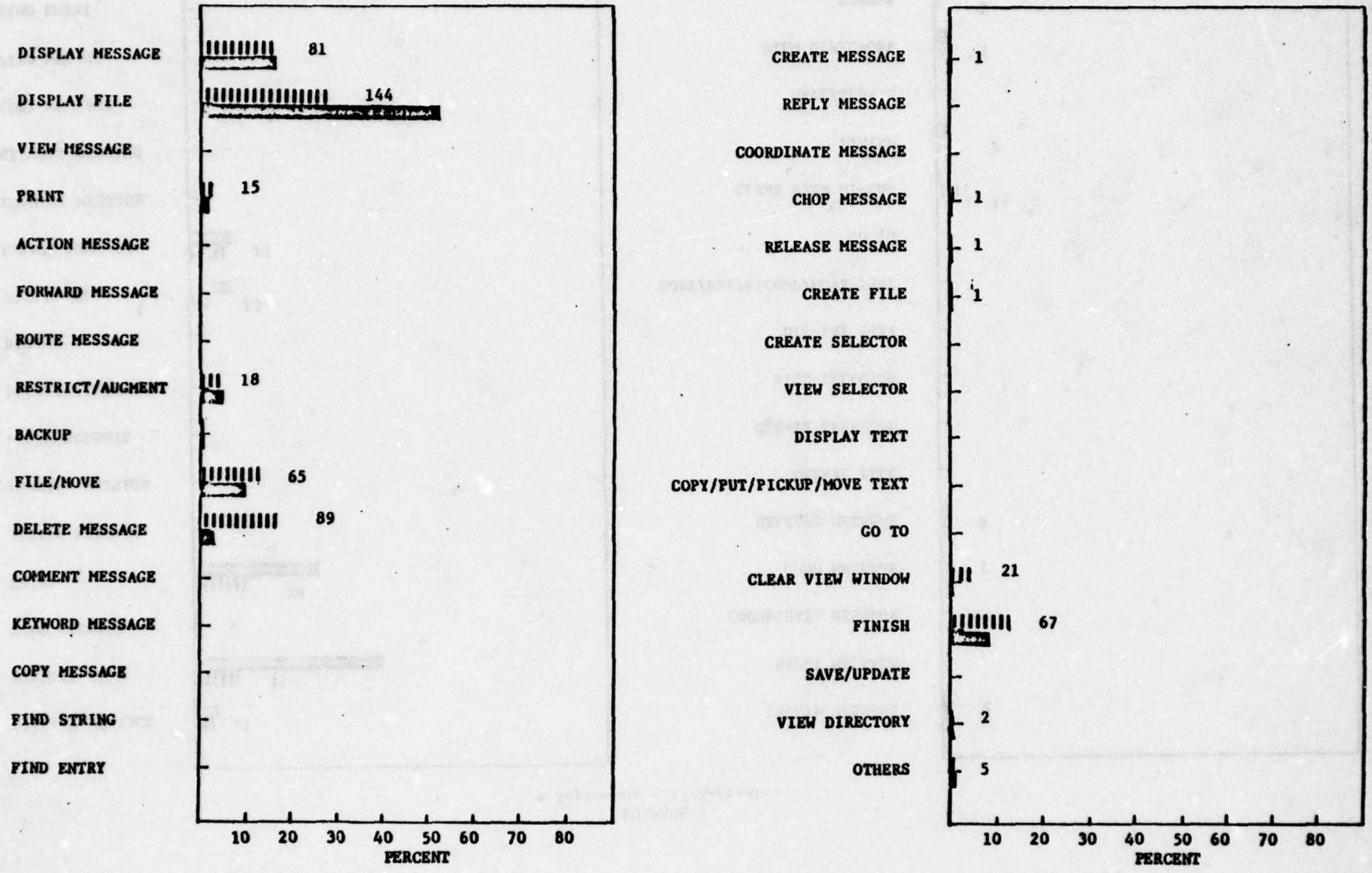




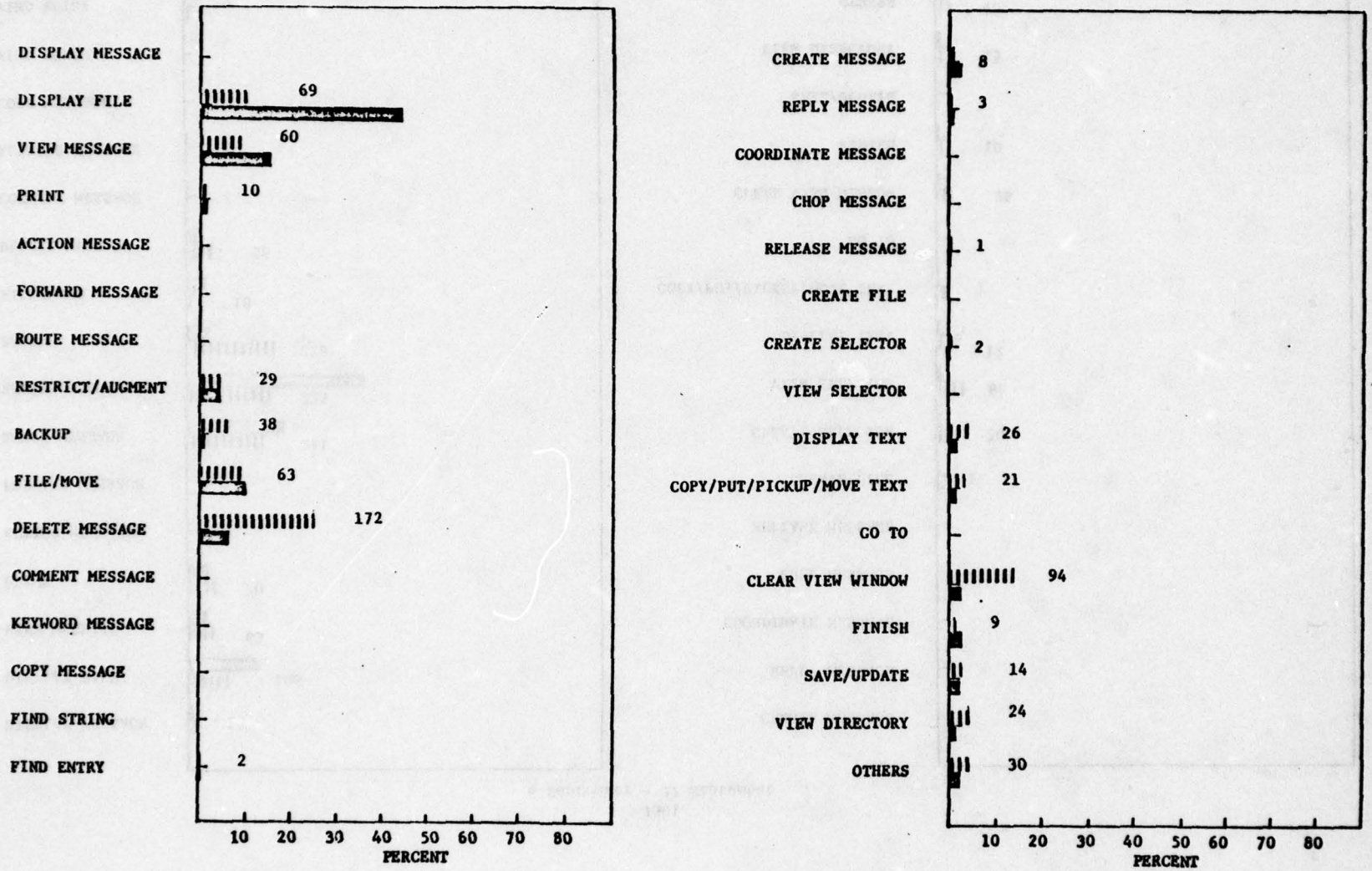
SURFACE
6 September - 27 September



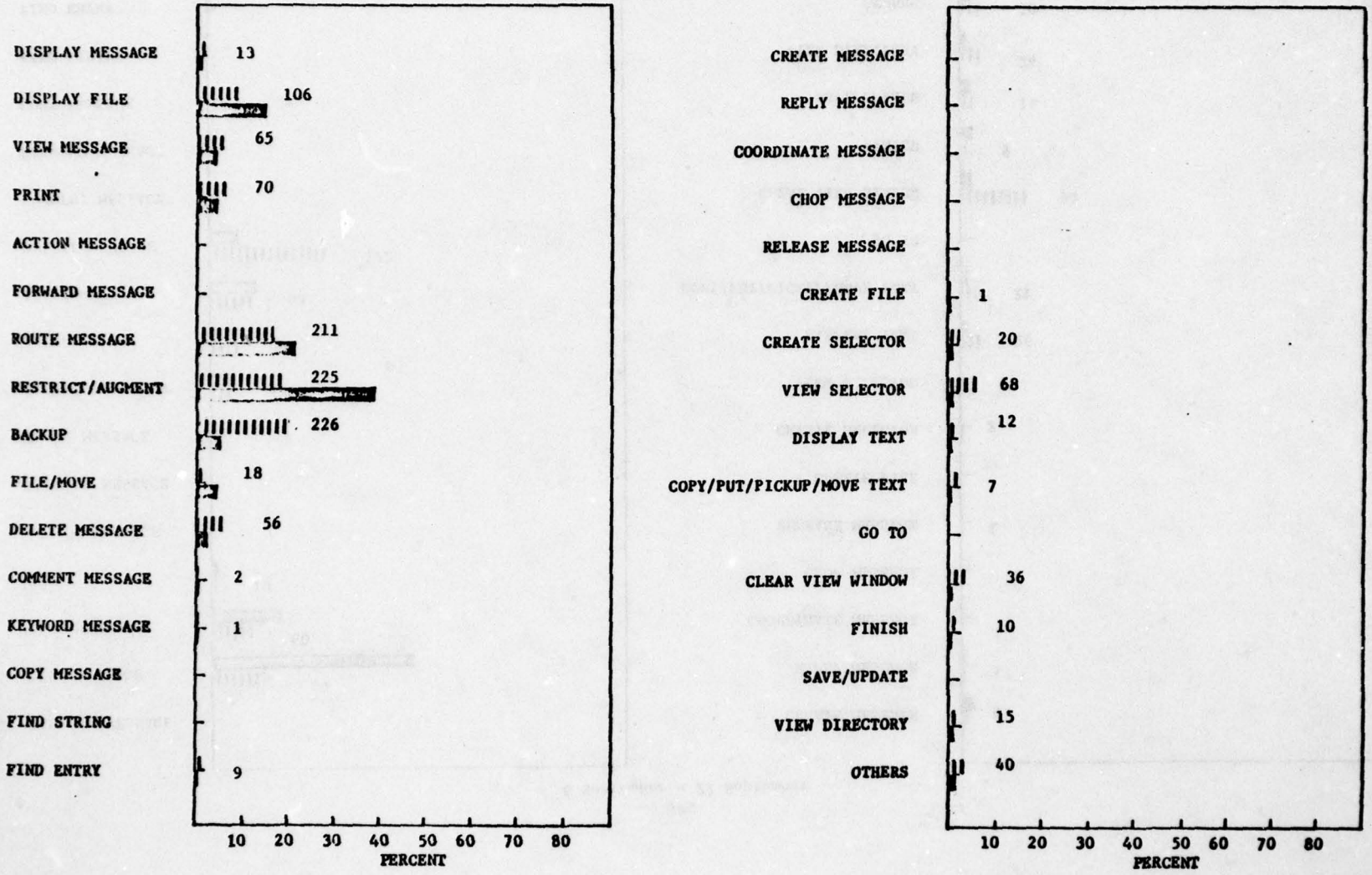
Clerks
6 September - 27 September



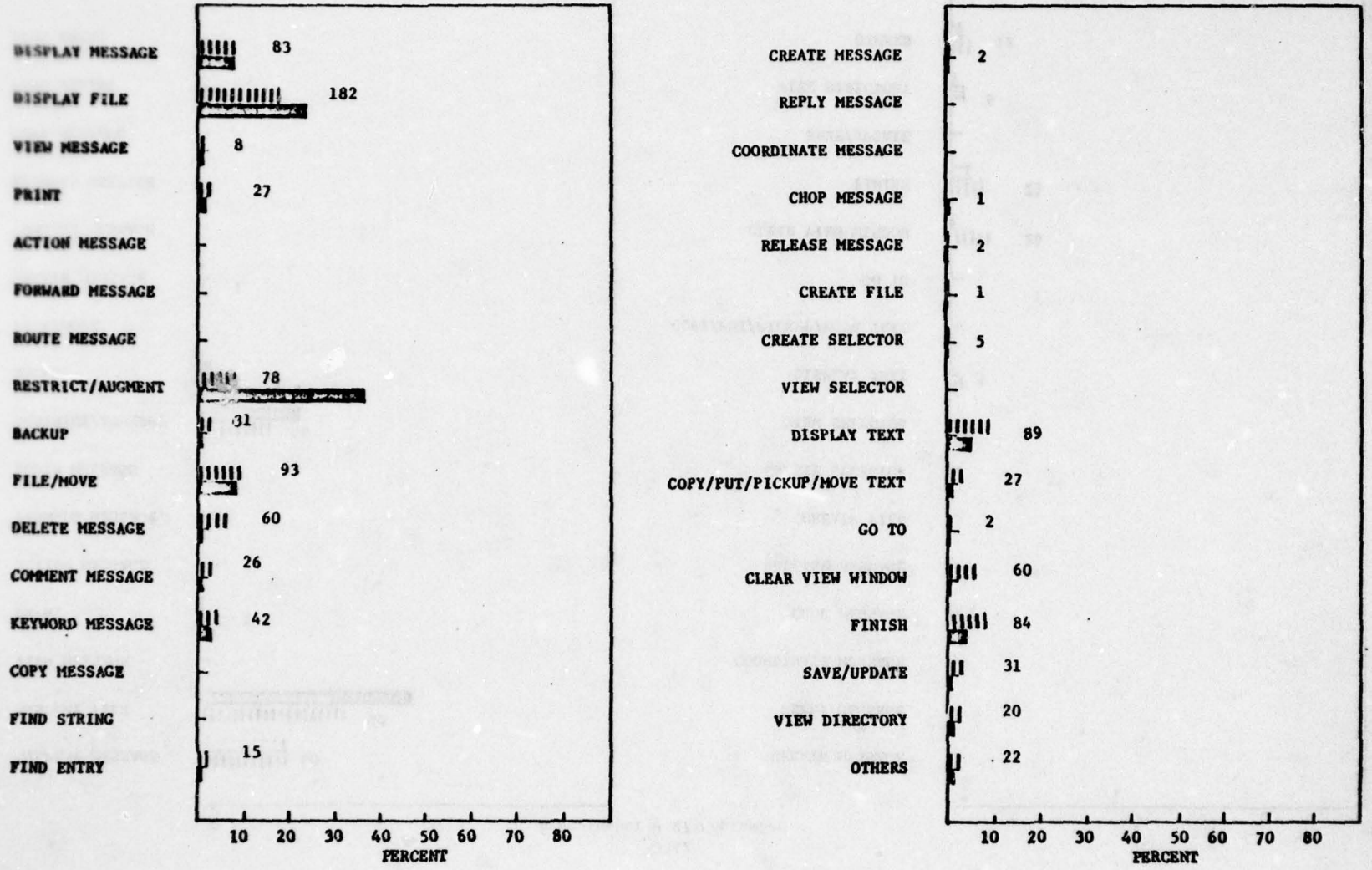
JRC
6 September - 27 September



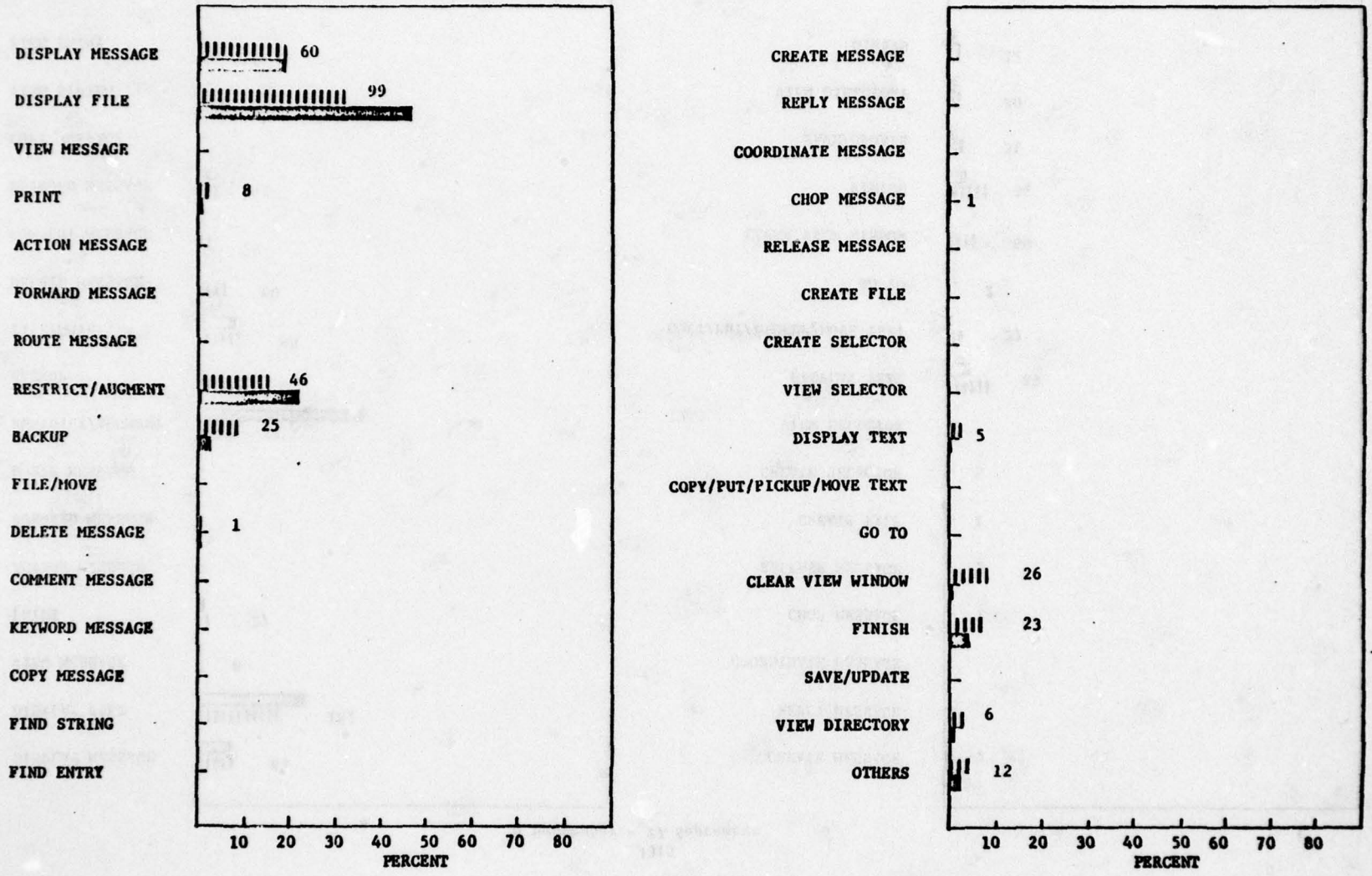
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6 September - 27 September



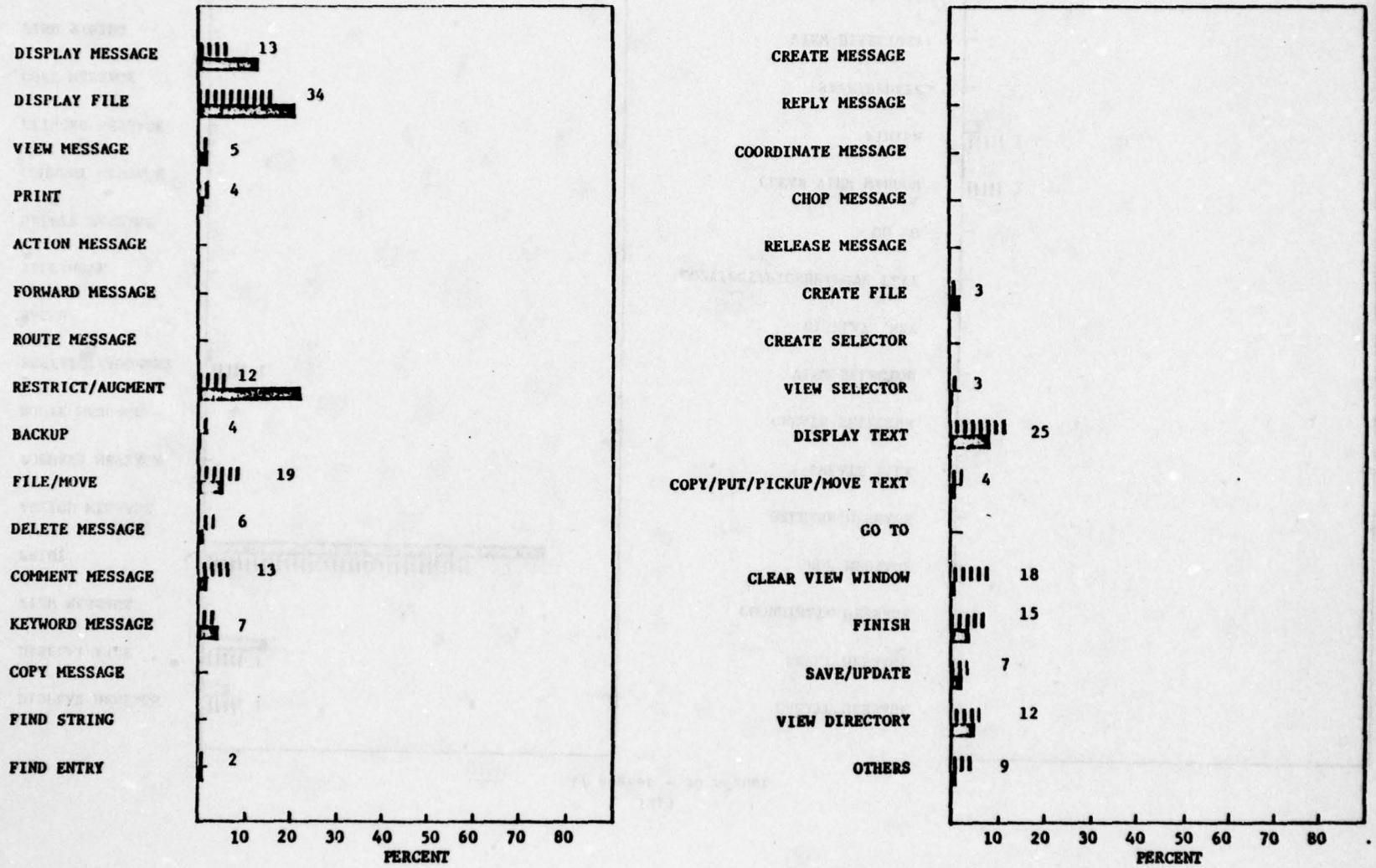
J315
6 September - 27 September



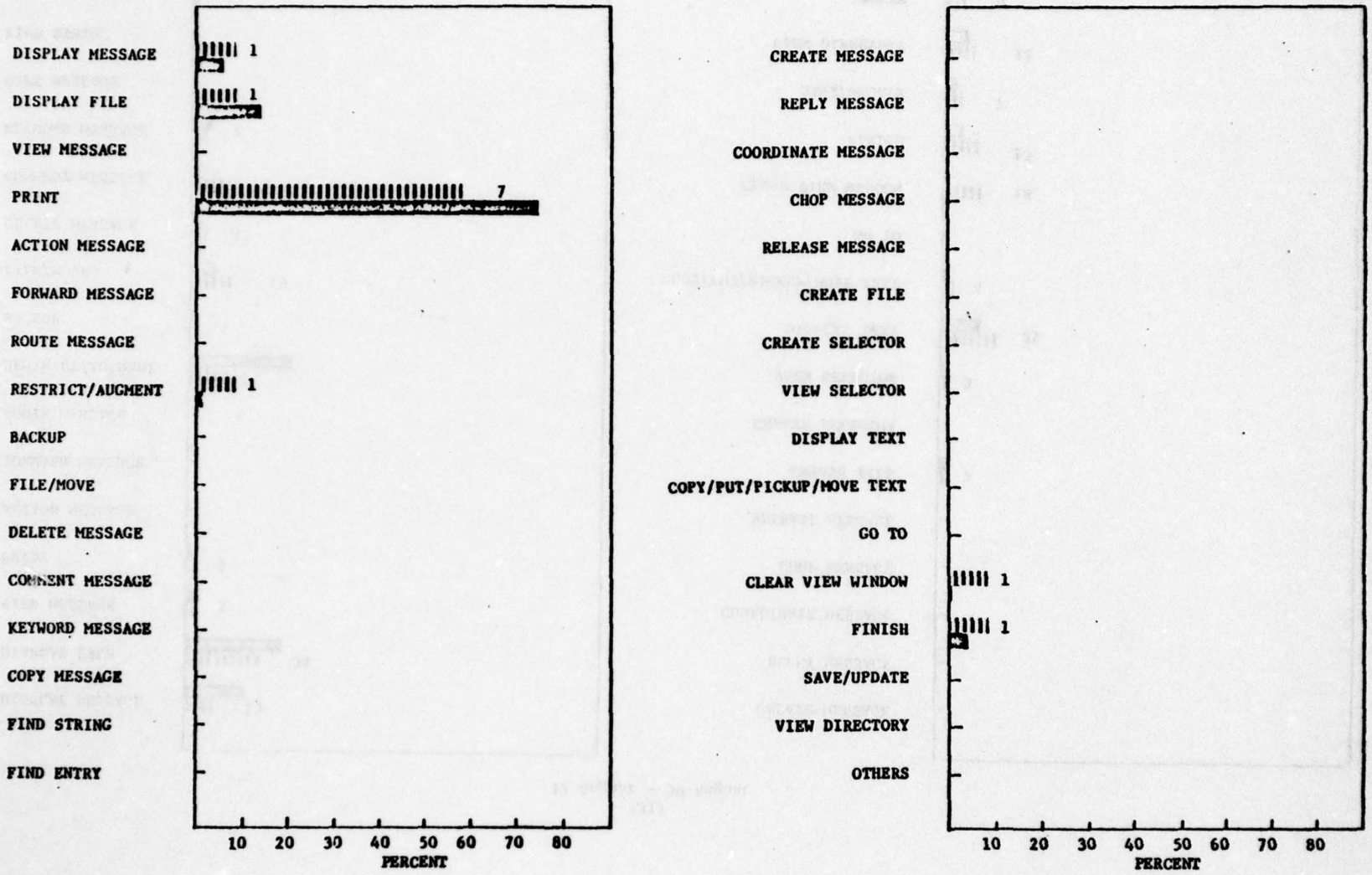
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6 September - 27 September



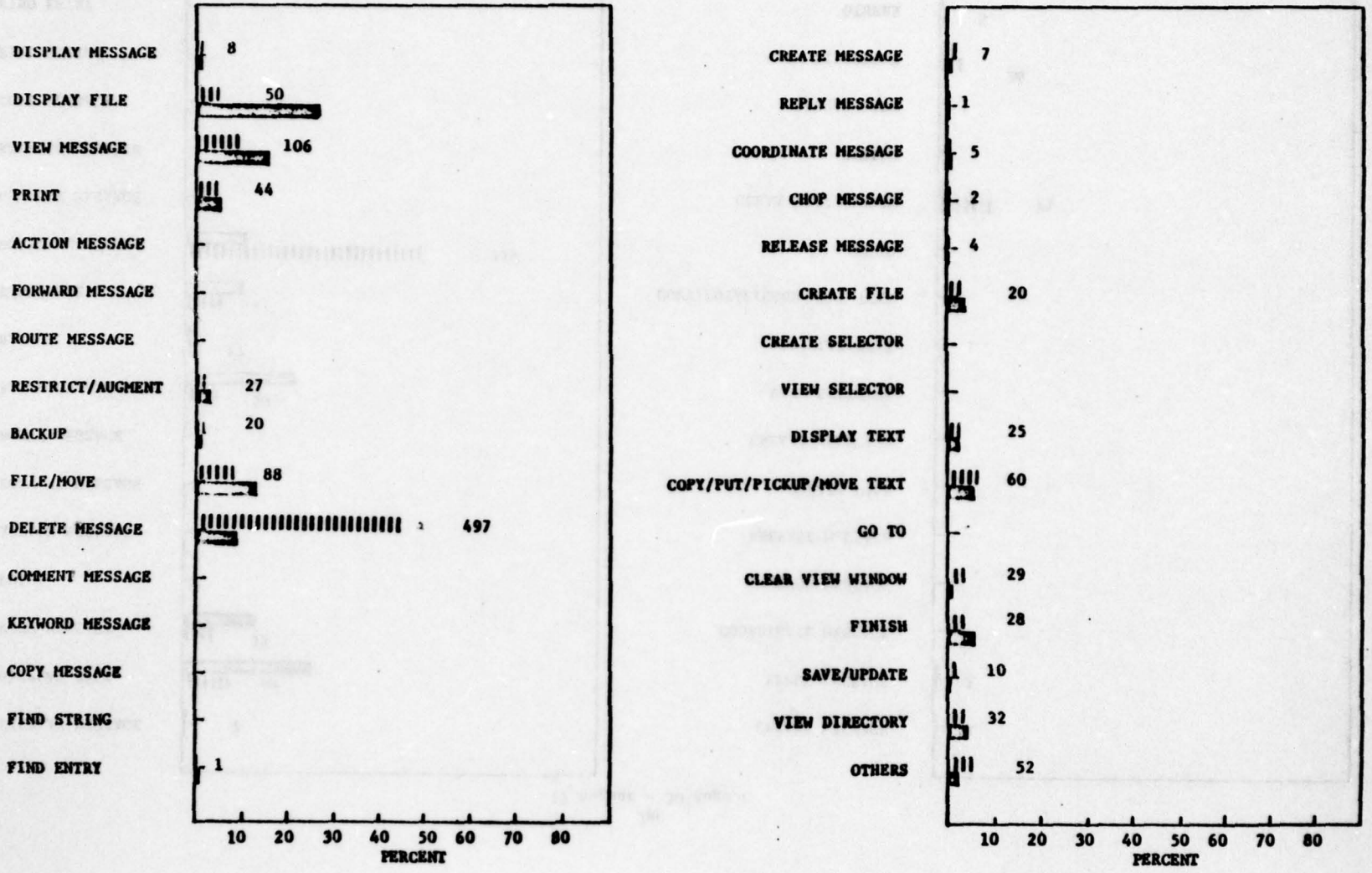
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17 August - 30 August



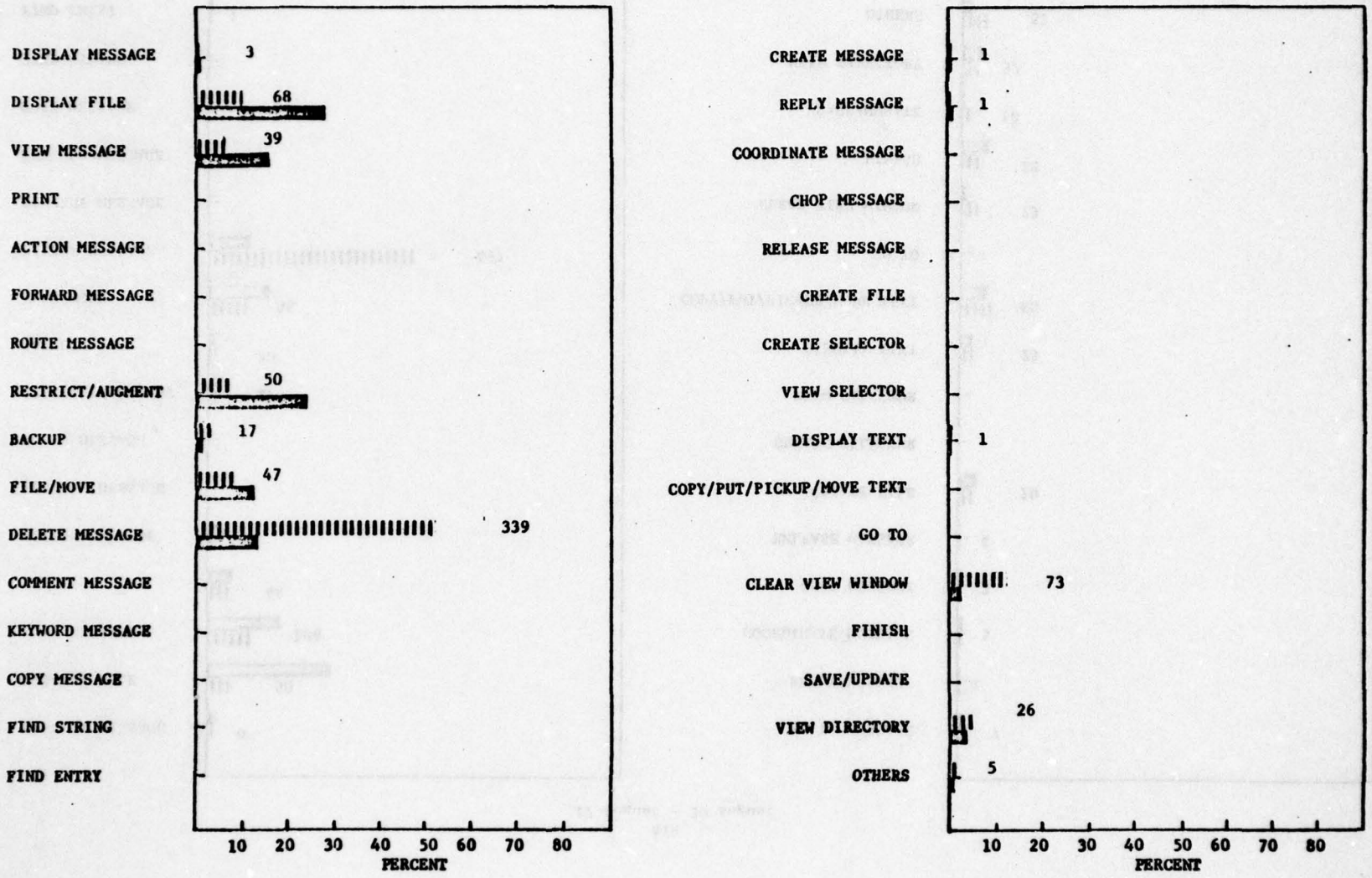
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17 August - 30 August

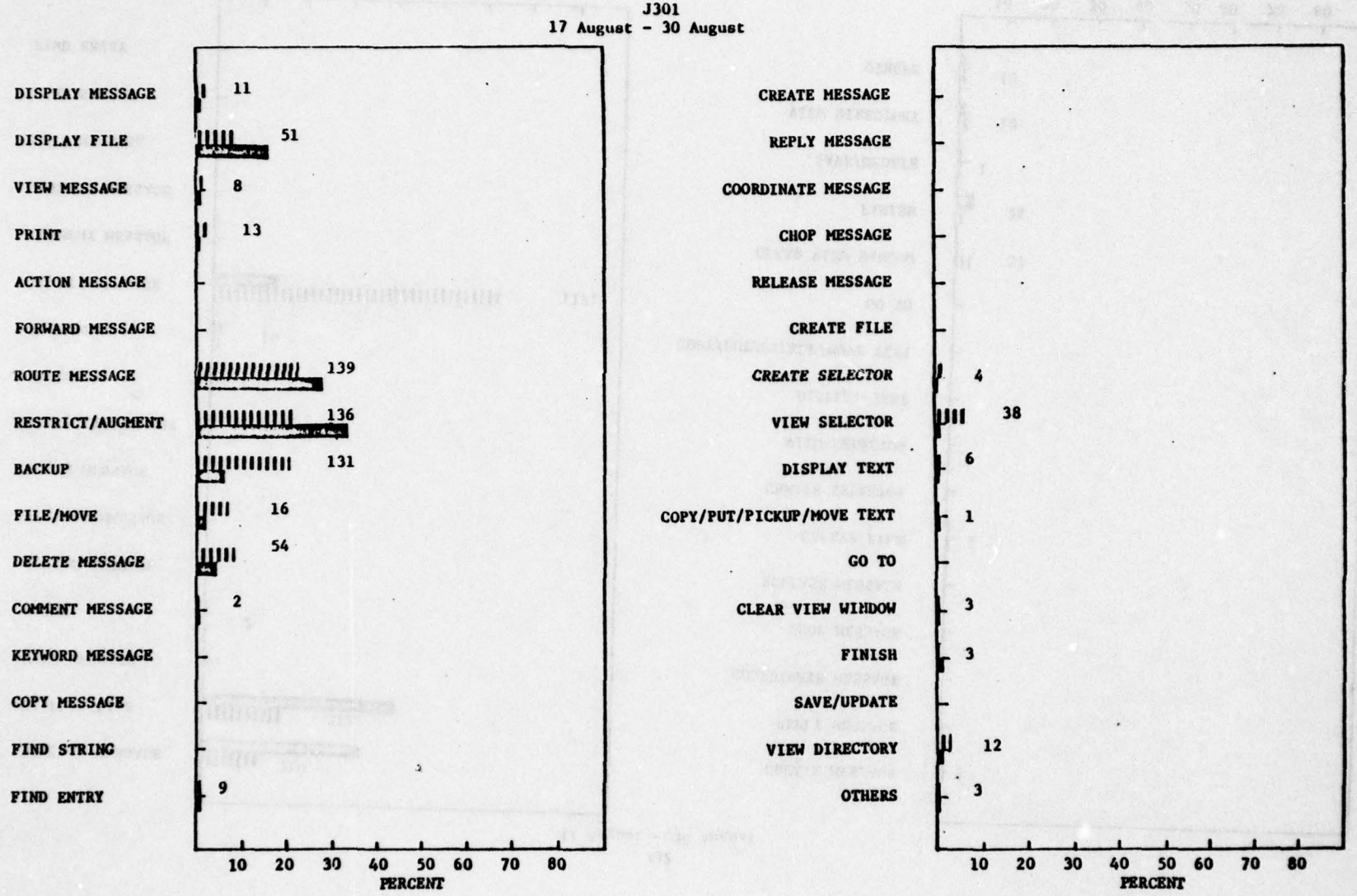


AIR
17 August - 30 August

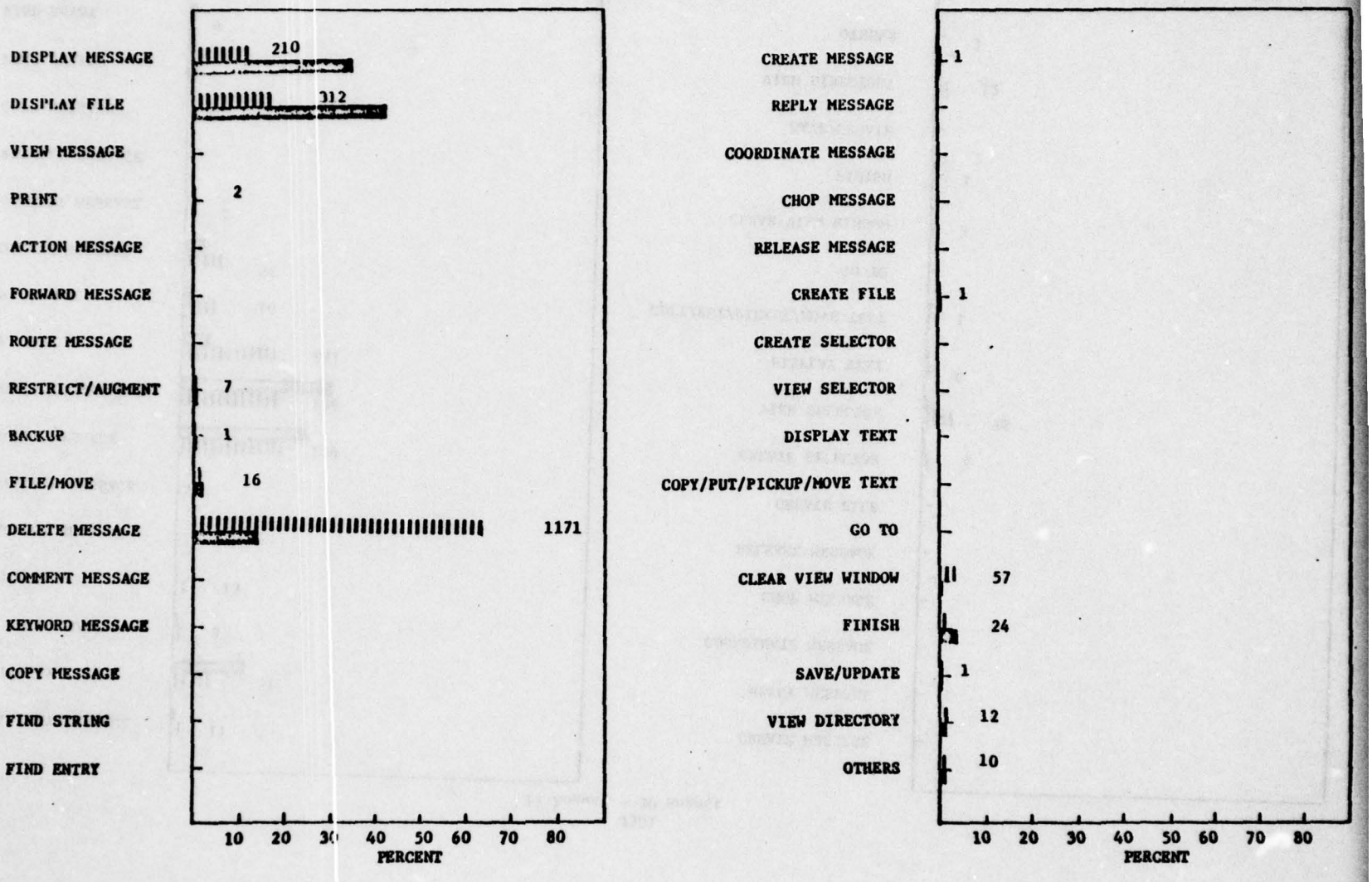


JRC
17 August - 30 August

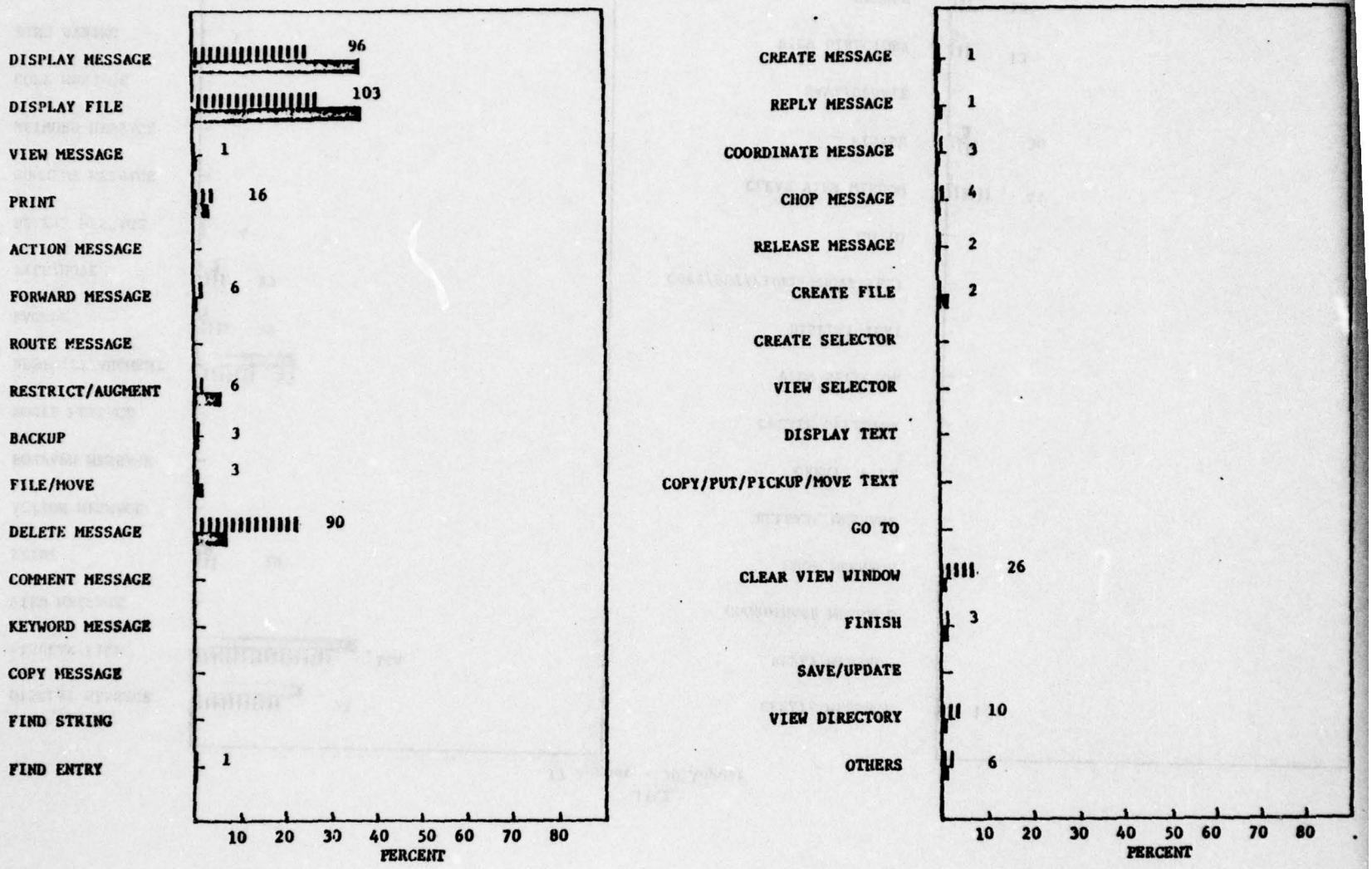



J301
17 August - 30 August
DISPLAY MESSAGE
DISPLAY FILE
VIEW MESSAGE
PRINT
ACTION MESSAGE
FORWARD MESSAGE
ROUTE MESSAGE
RESTRICT/AUGMENT
BACKUP
FILE/MOVE
DELETE MESSAGE
COMMENT MESSAGE
KEYWORD MESSAGE
COPY MESSAGE
FIND STRING
FIND ENTRY
11
51
8
13
139
136
131
16
54
2
9
10 20 30 40 50 60 70 80
PERCENT
CREATE MESSAGE
REPLY MESSAGE
COORDINATE MESSAGE
CHOP MESSAGE
RELEASE MESSAGE
CREATE FILE
CREATE SELECTOR
VIEW SELECTOR
DISPLAY TEXT
COPY/PUT/PICKUP/MOVE TEXT
GO TO
CLEAR VIEW WINDOW
FINISH
SAVE/UPDATE
VIEW DIRECTORY
OTHERS
4
38
6
1
3
3
12
3
10 20 30 40 50 60 70 80
PERCENT

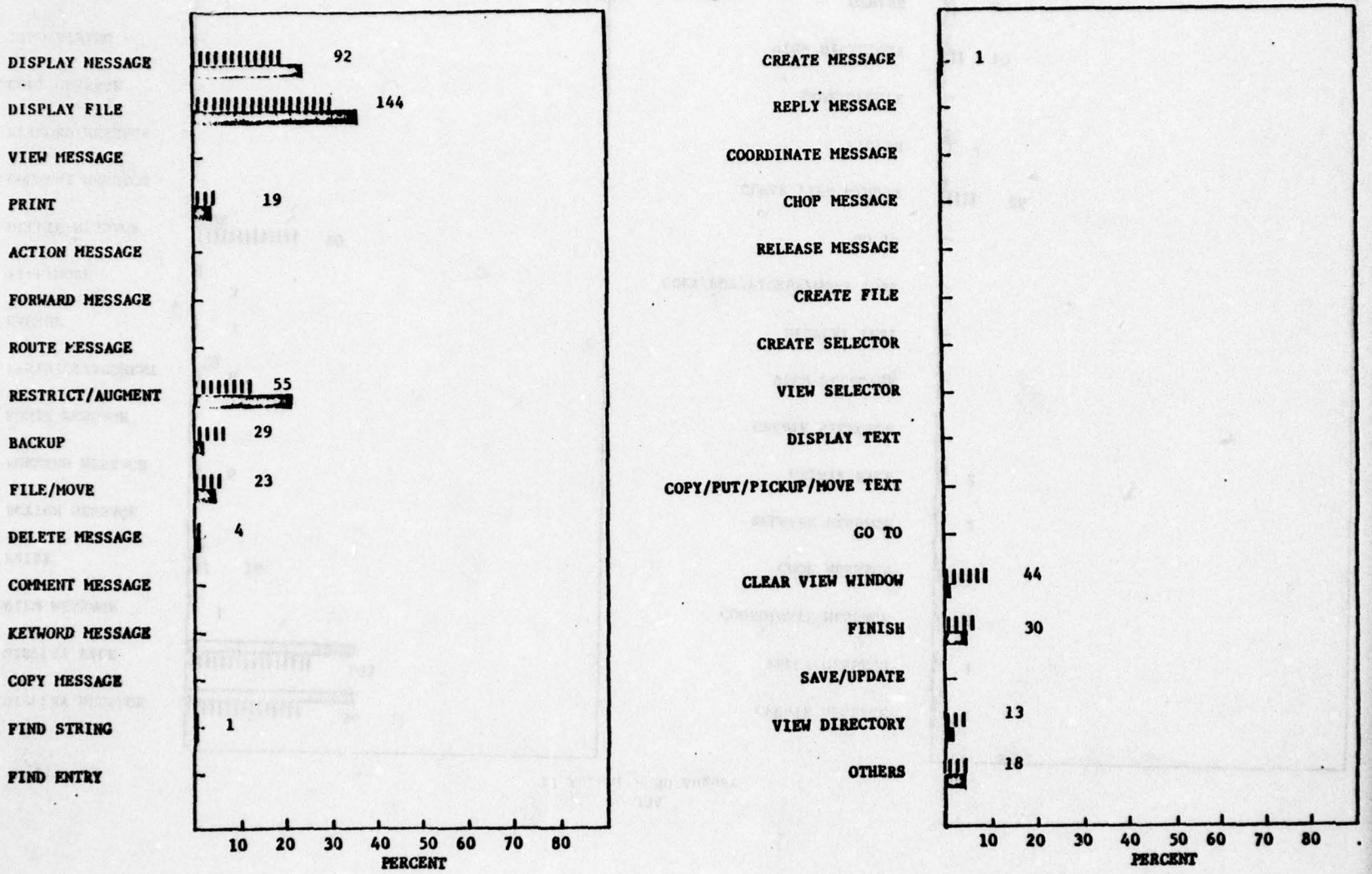
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17 August - 30 August



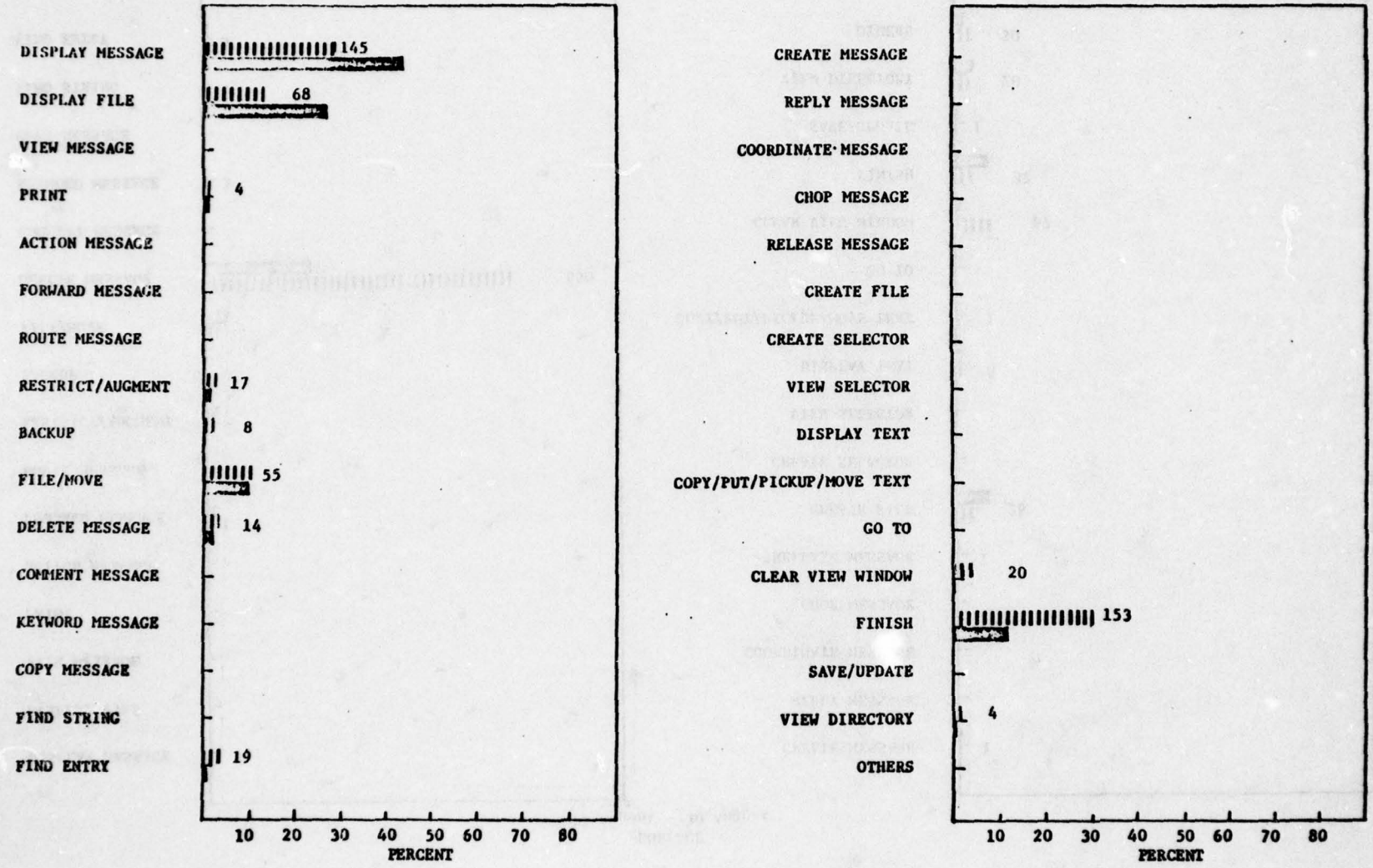
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17 August - 30 August



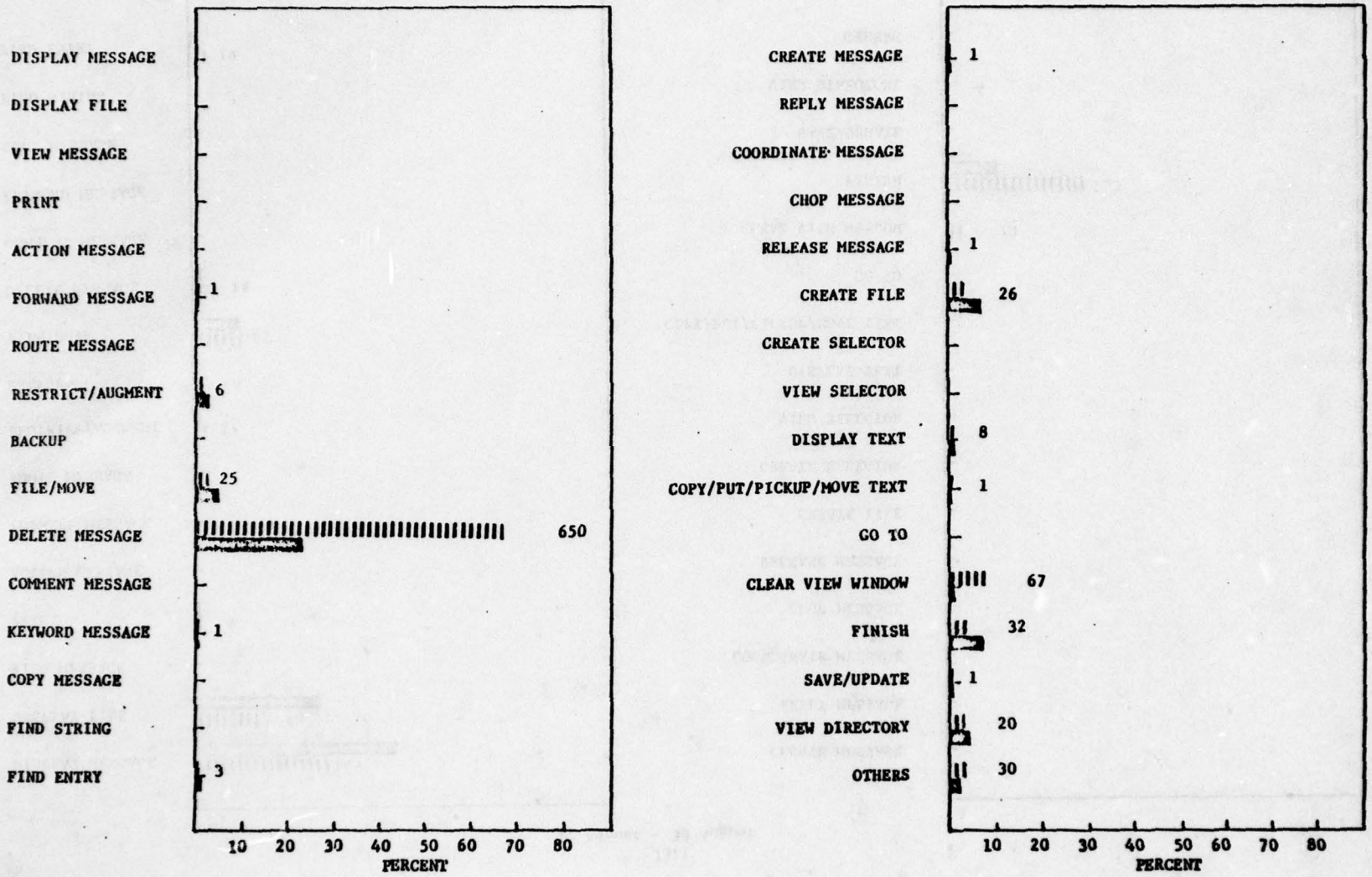
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17 August - 30 August



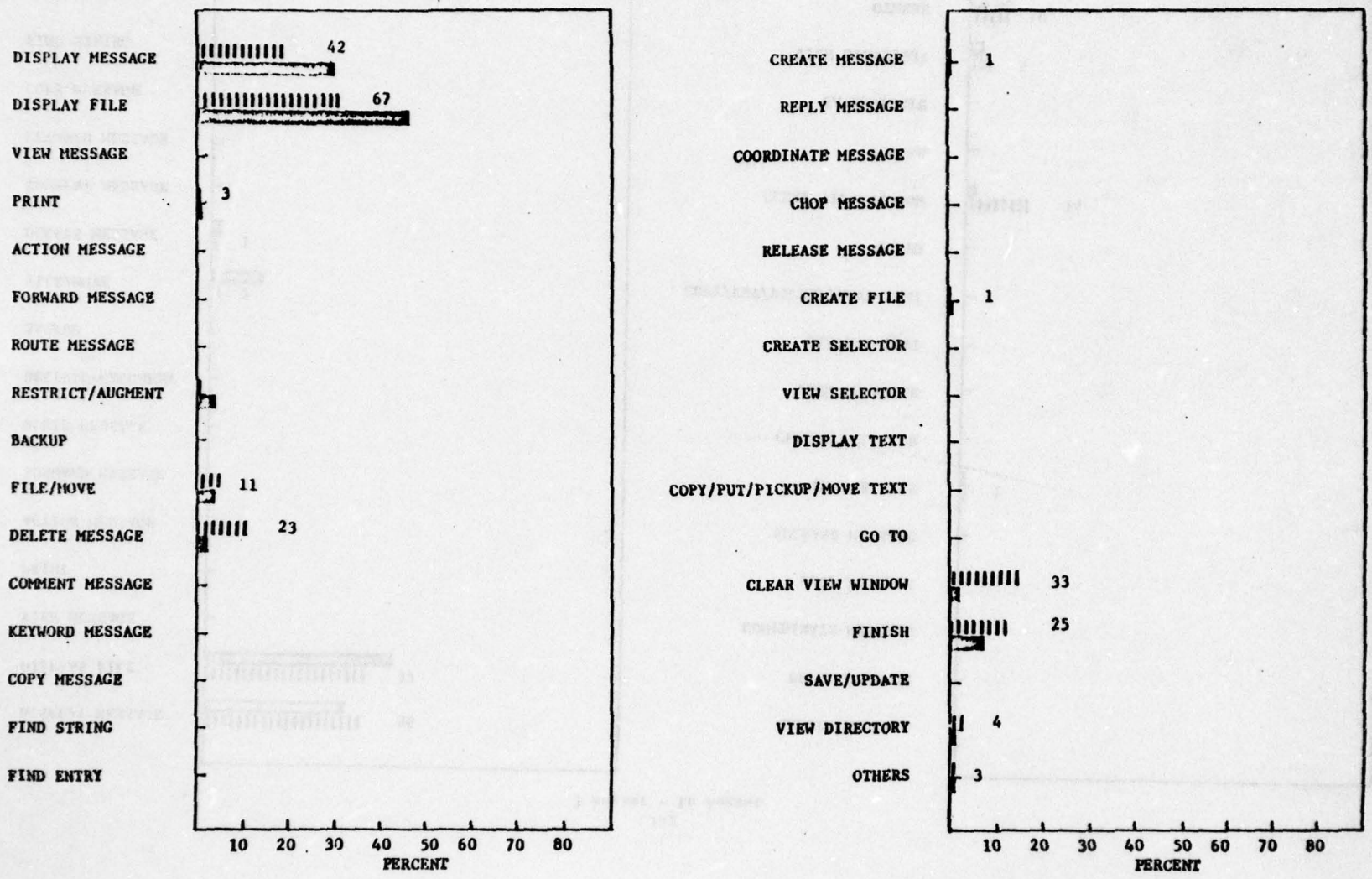
J311
17 August - 30 August



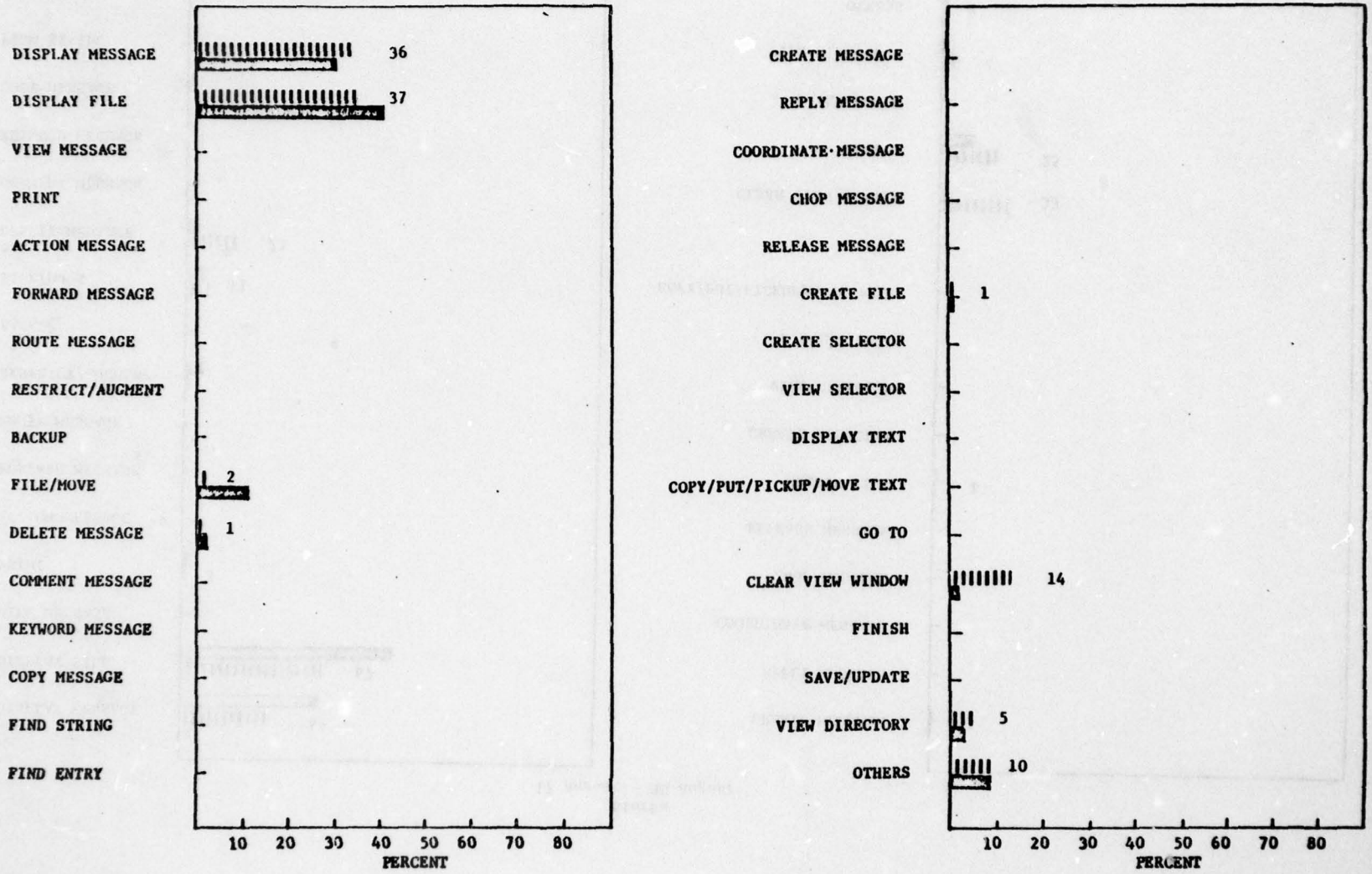
SURFACE
17 August - 30 August



Clerks
17 August - 30 August



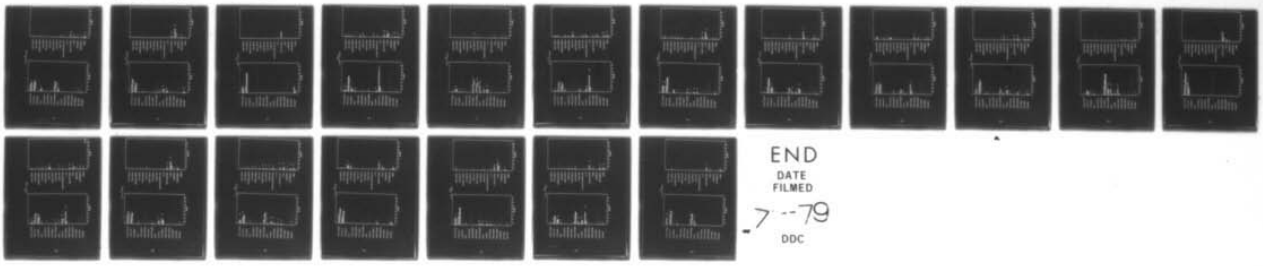
J32
3 August - 16 August



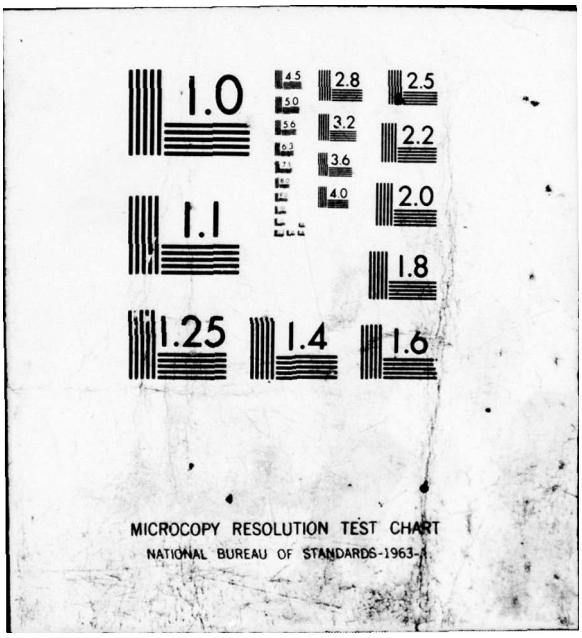
AD-A068 701 NAVAL RESEARCH LAB WASHINGTON DC F/G 17/2
MILITARY MESSAGE EXPERIMENT QUICK LOOK REPORT.(U)
APR 79 S H WILSON, J W KALLANDER, N M THOMAS

UNCLASSIFIED NRL-MR-3992 NL

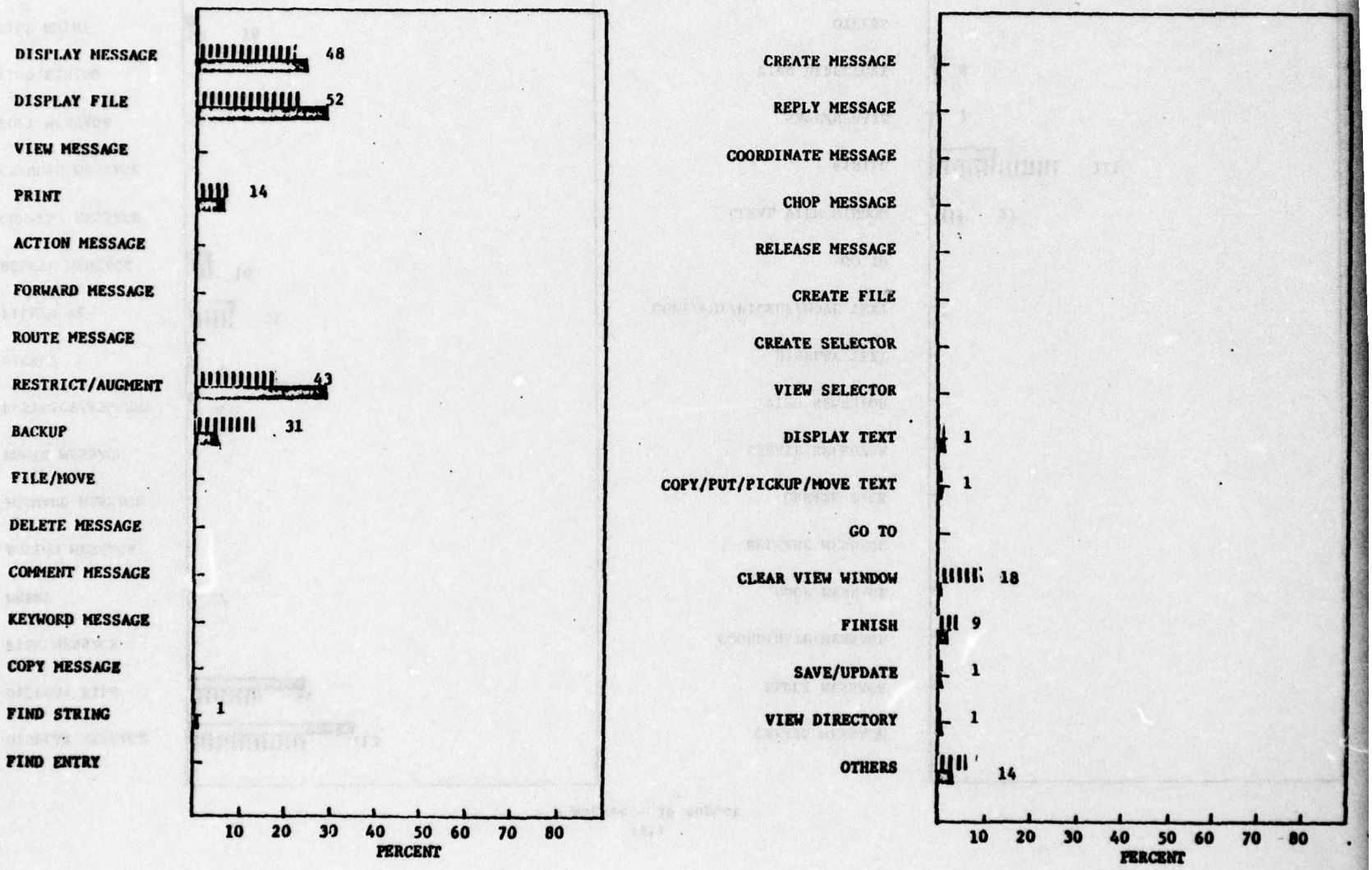
2 OF 2
AD A068701



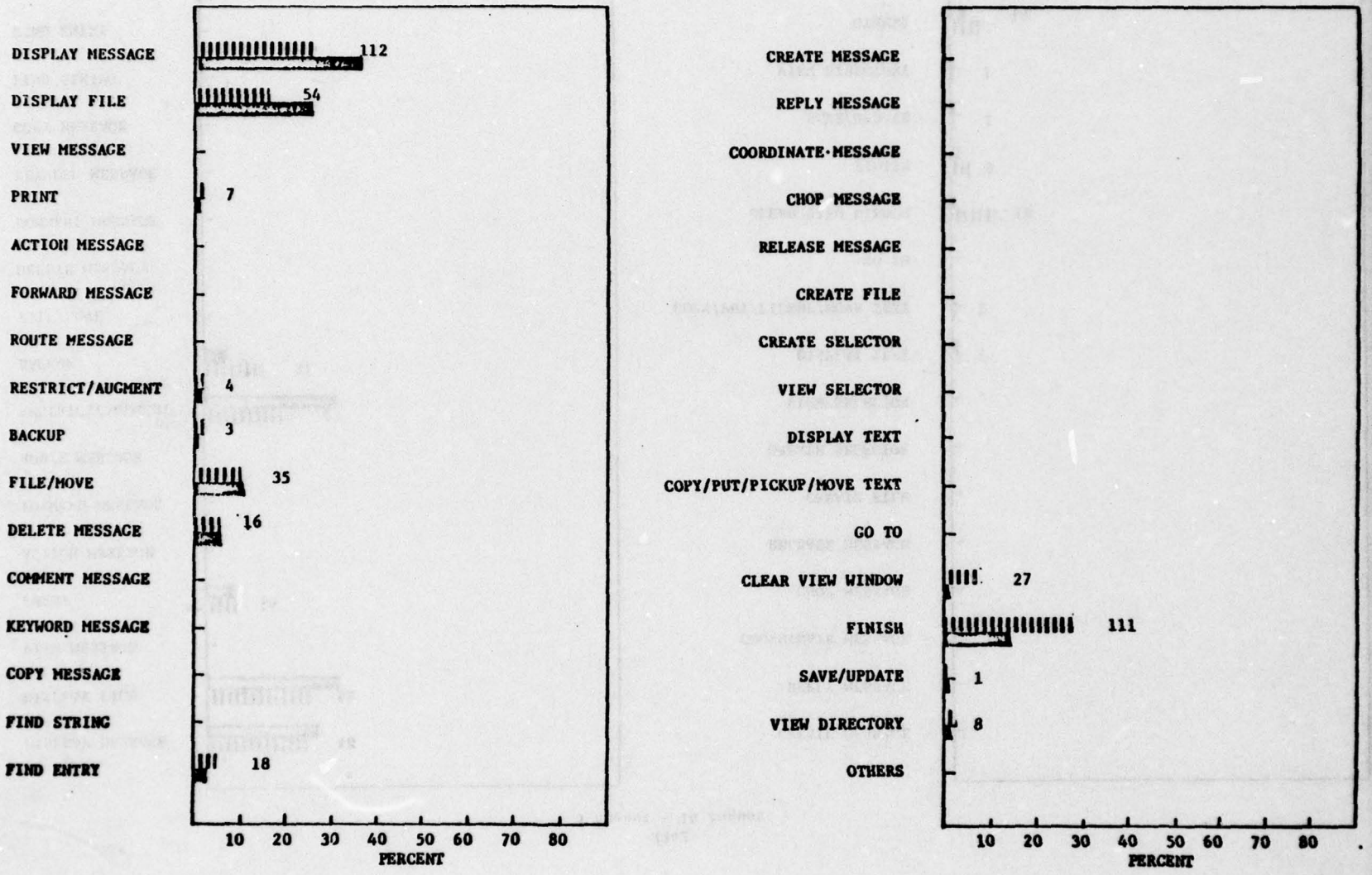
END
DATE FILMED
7-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

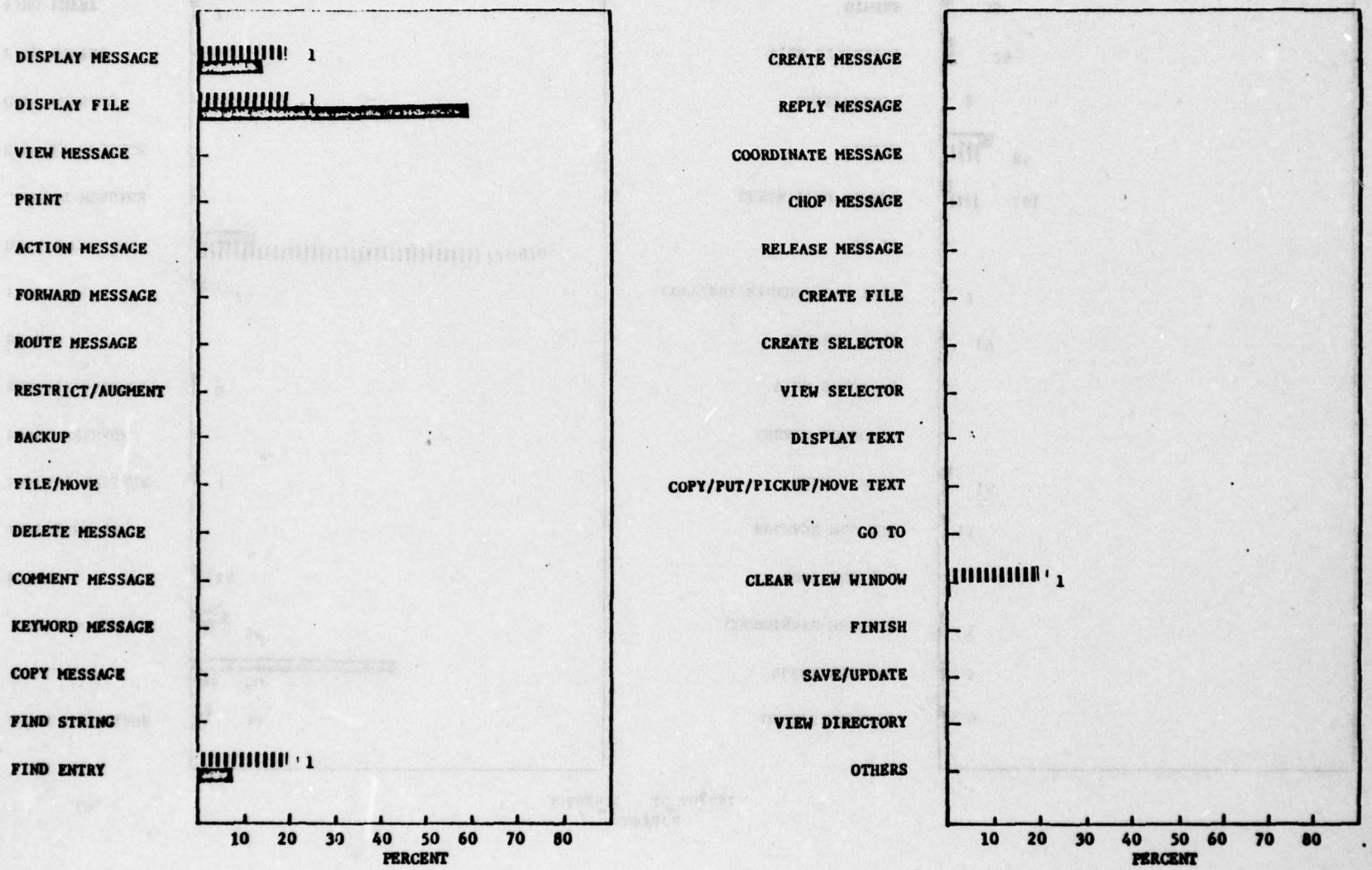
J342
3 August - 16 August



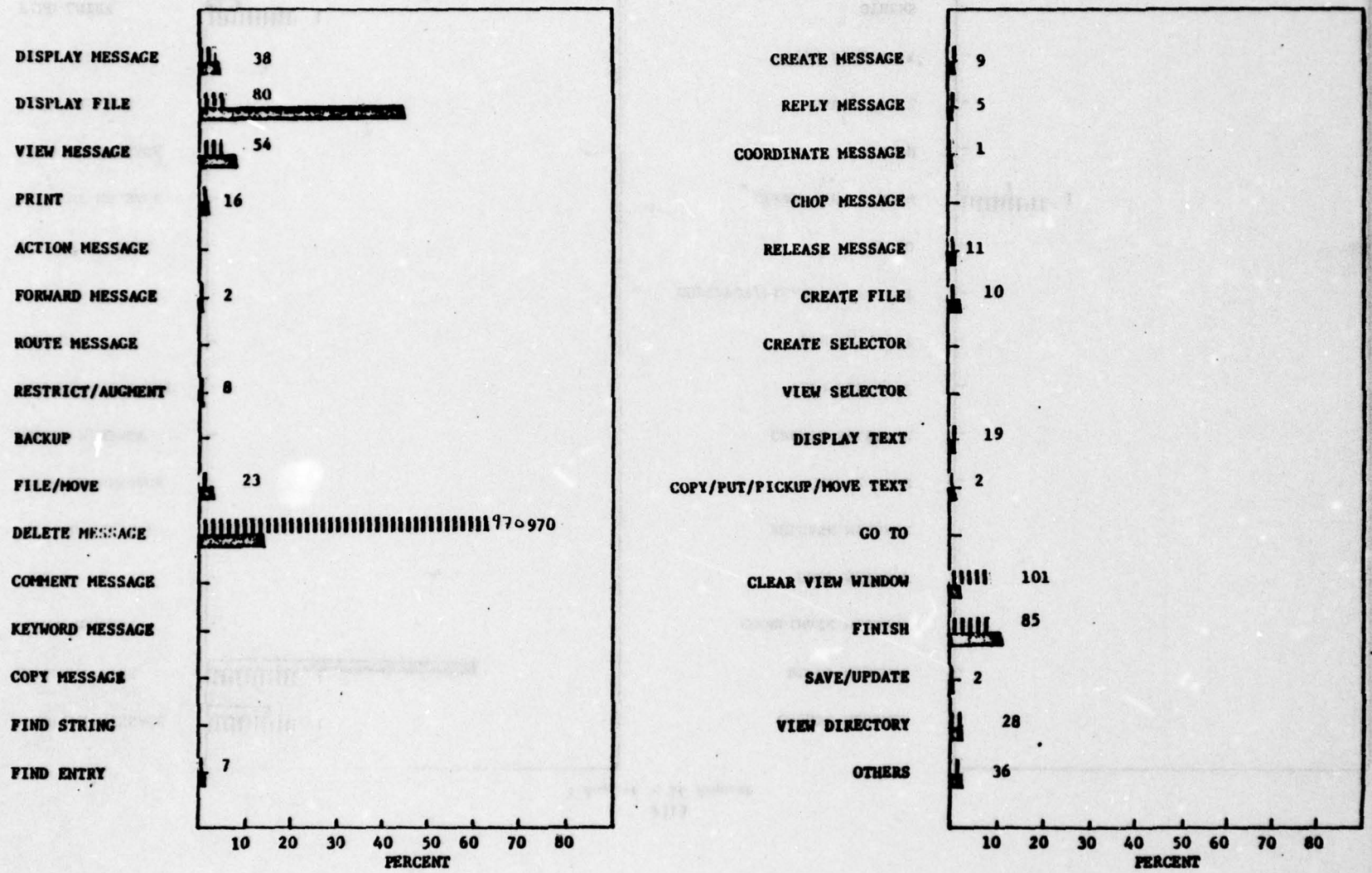
J311
3 August - 16 August



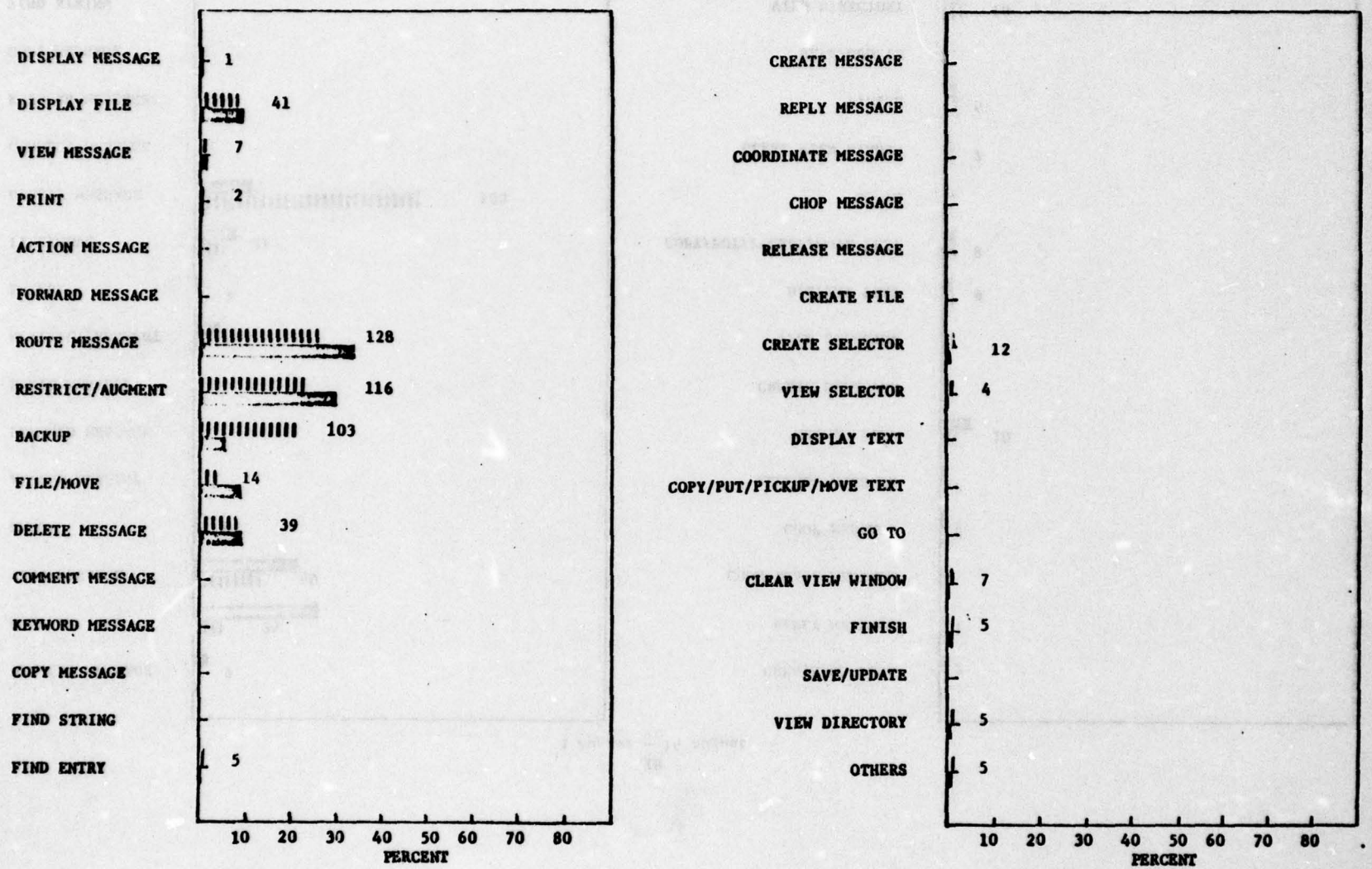
J313
3 August - 16 August



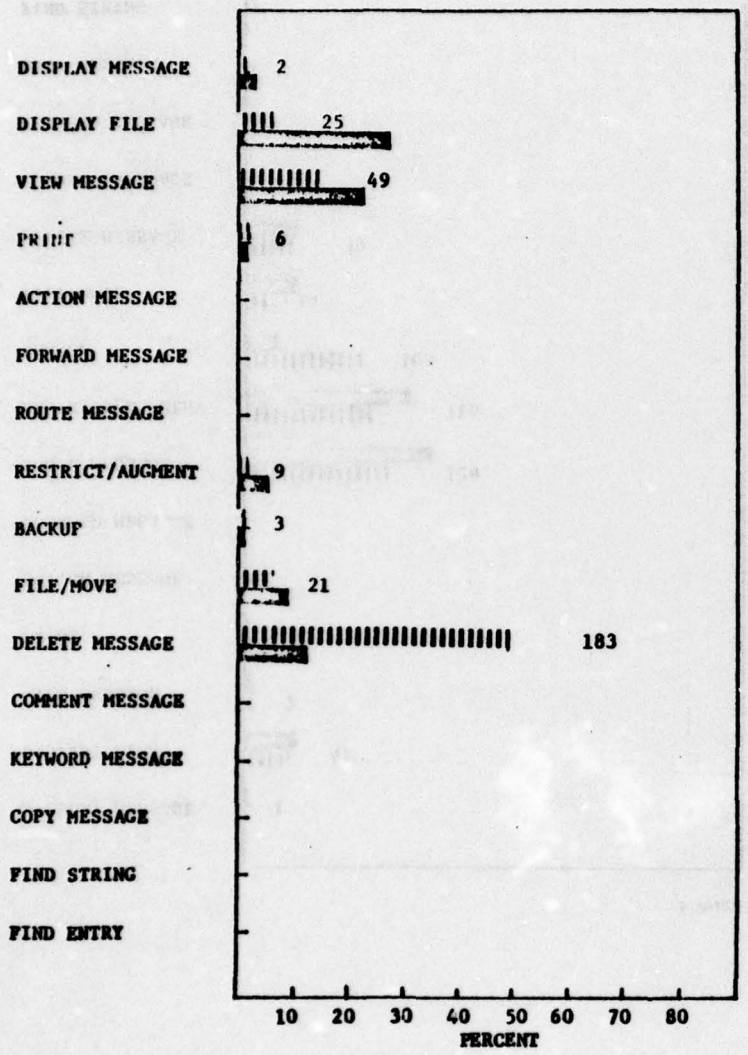
SURFACE
3 August - 16 August

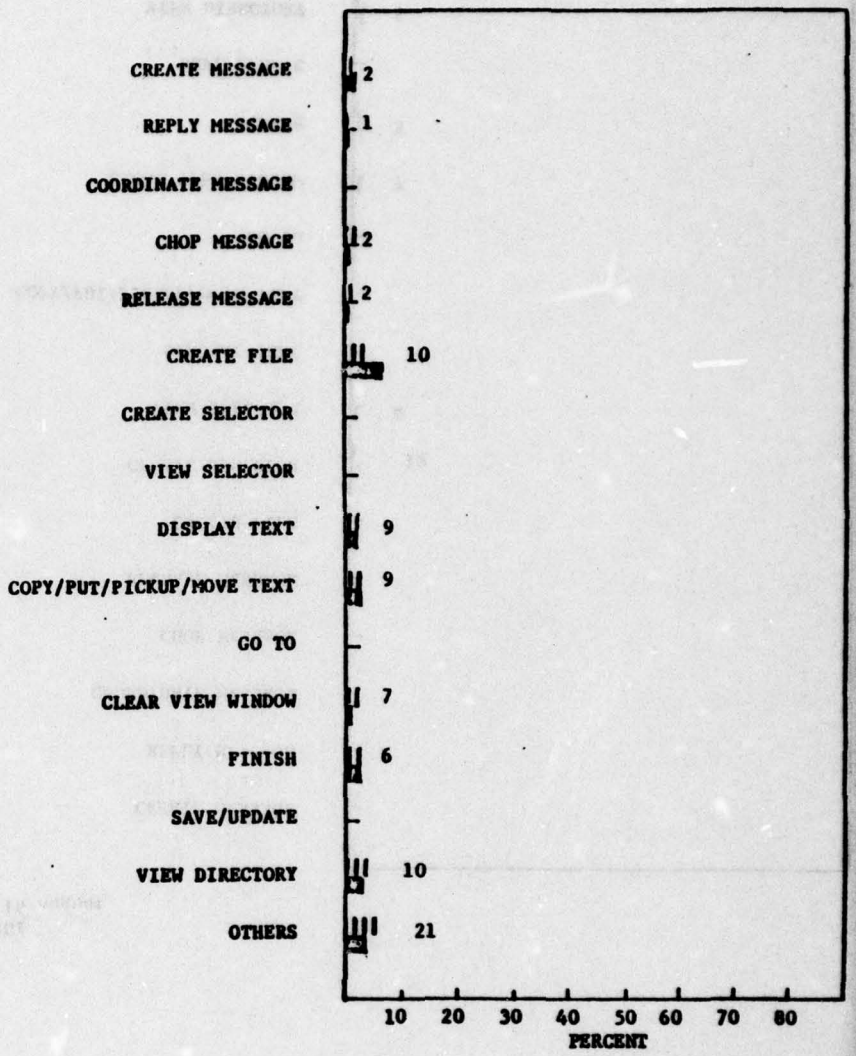


J301
3 August - 16 August

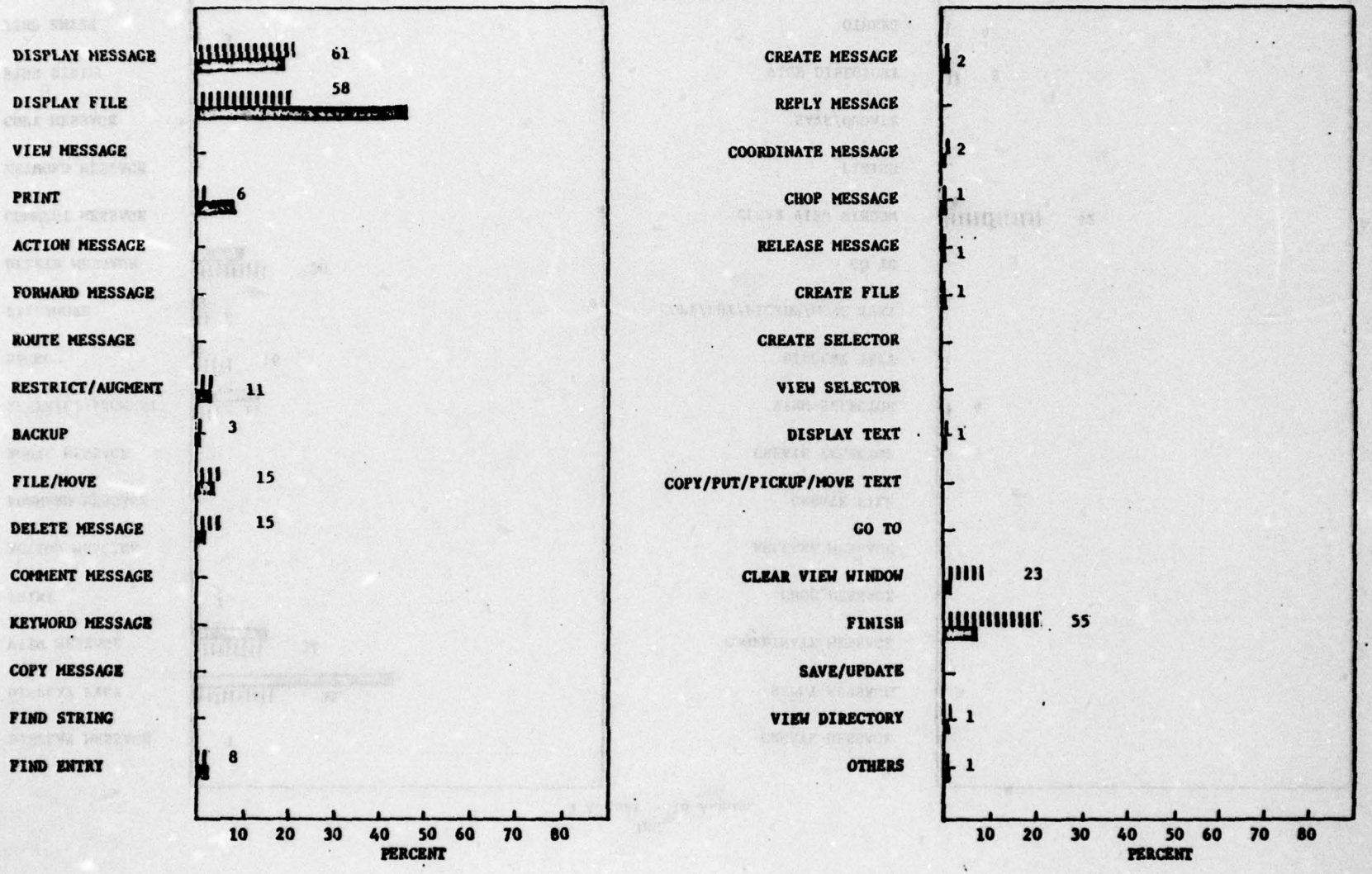


AIR
3 August - 16 August

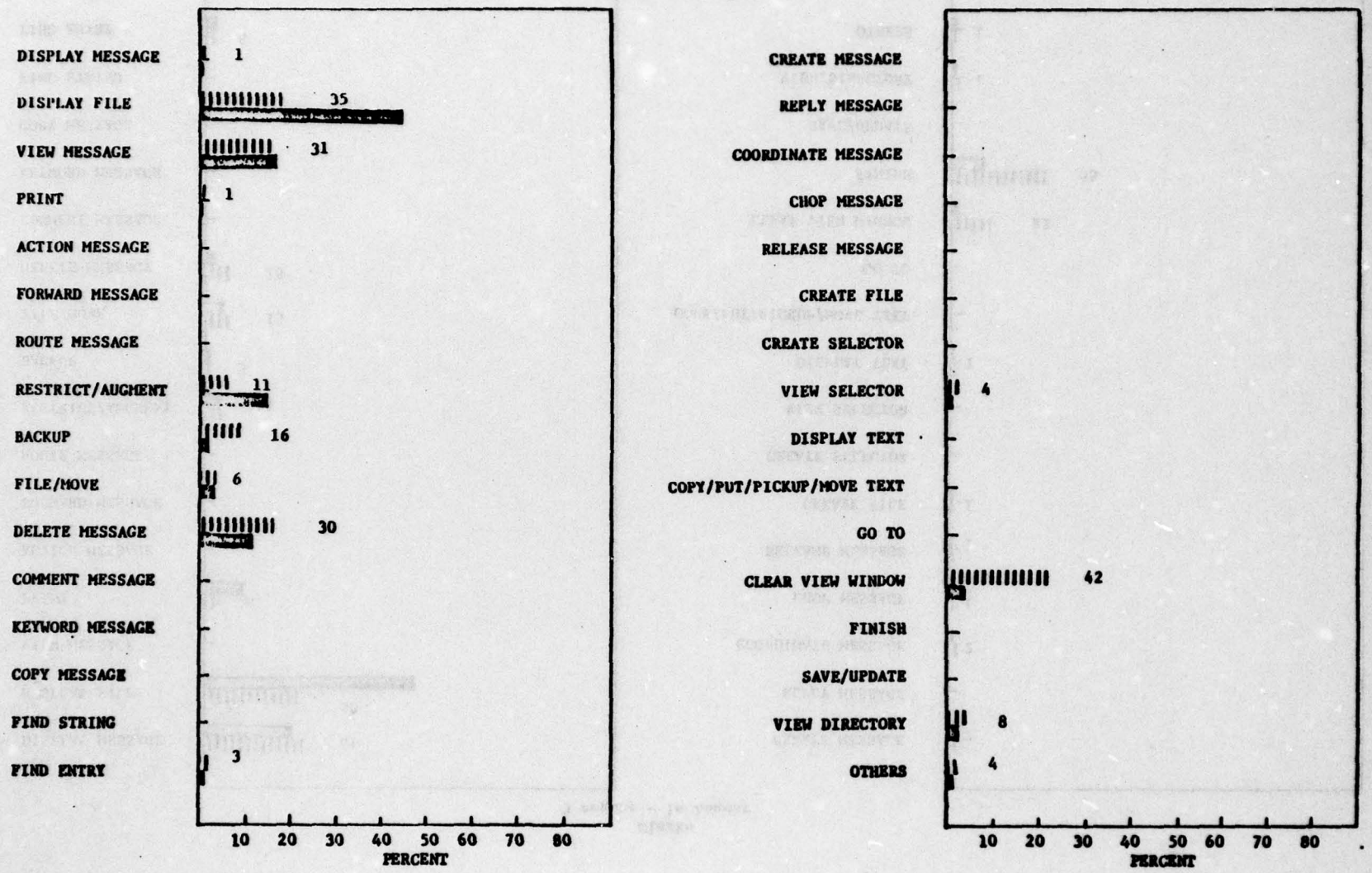




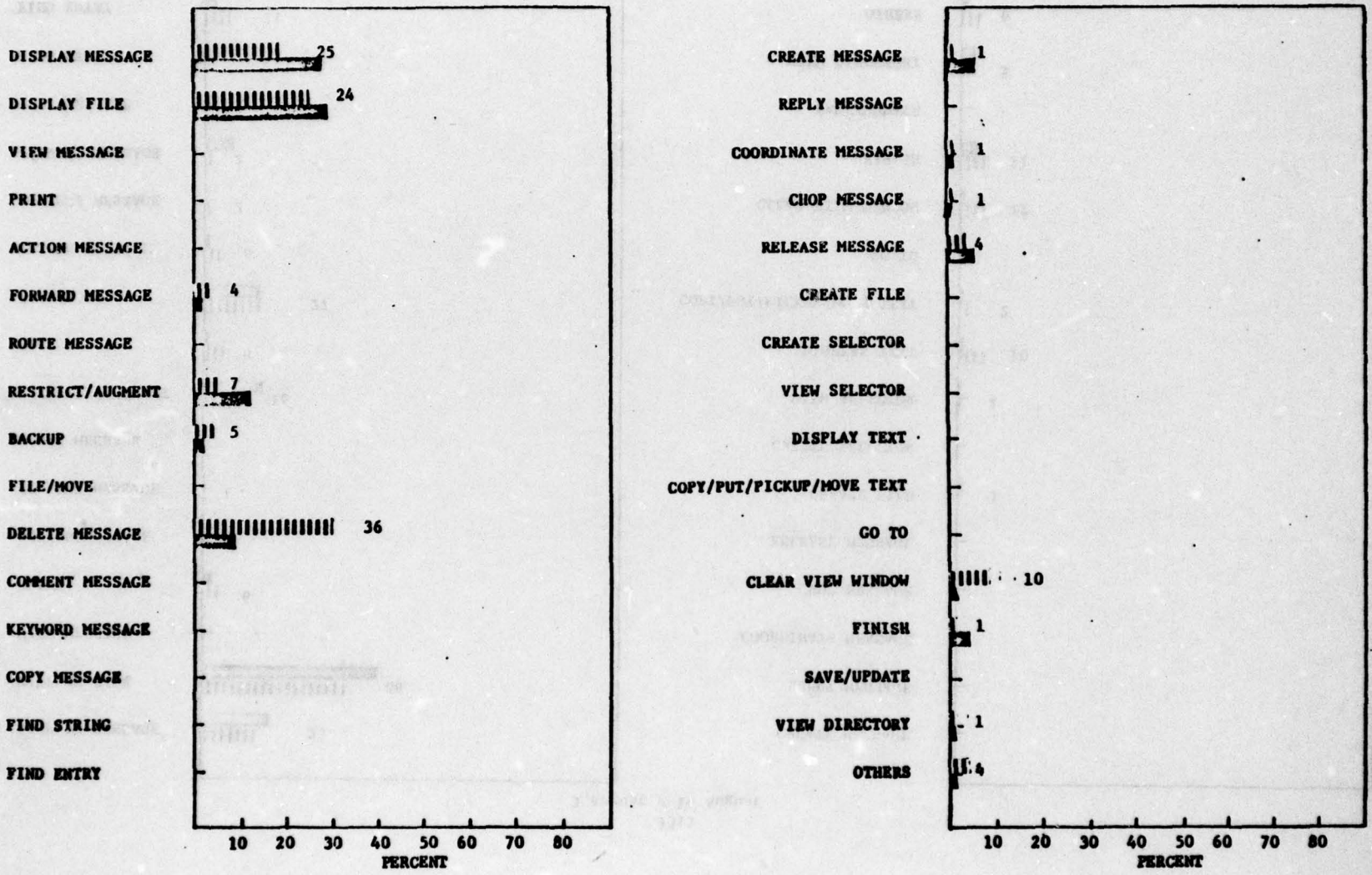
Clerks
3 August - 16 August



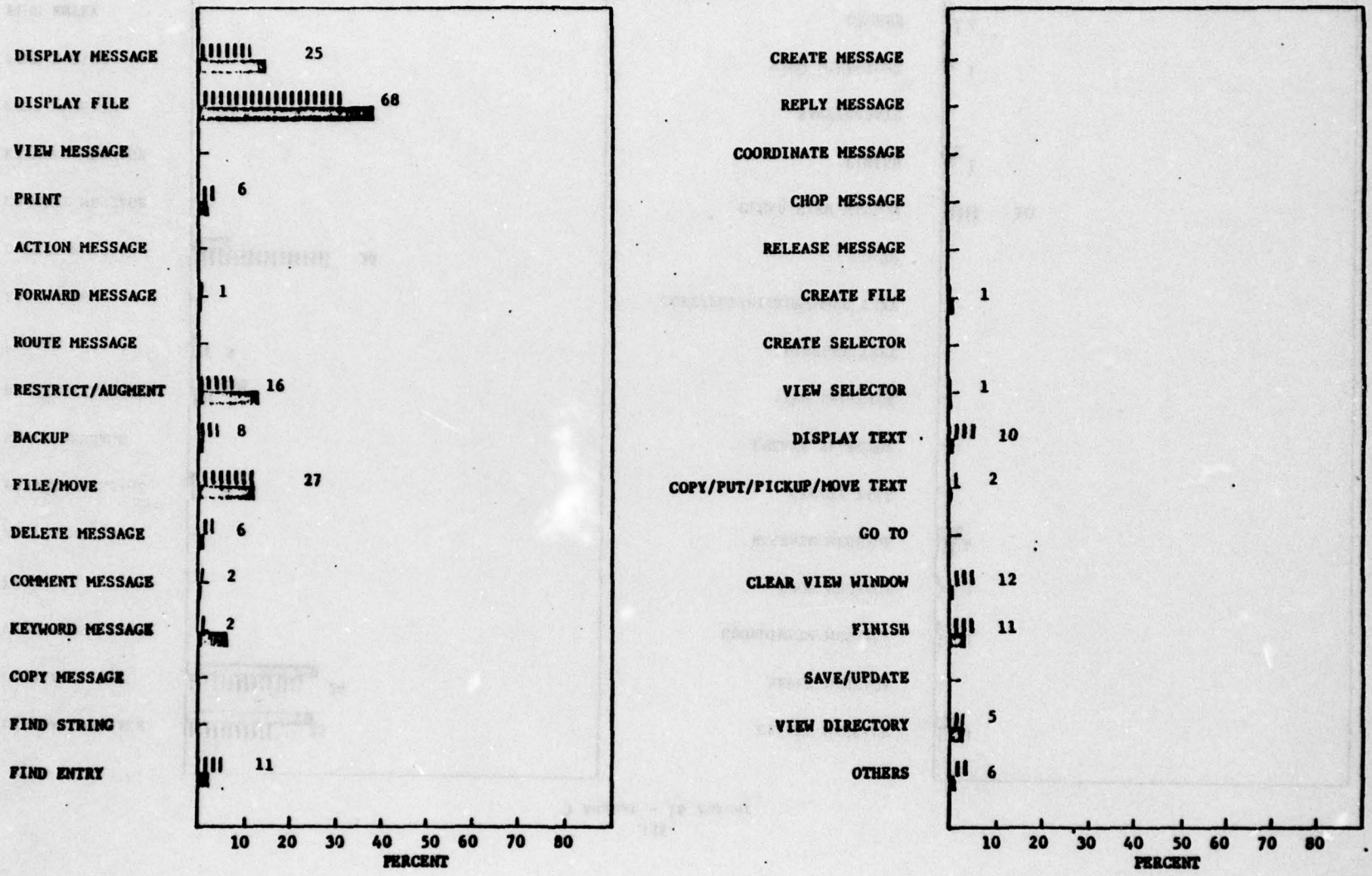
JRC
3 August - 16 August



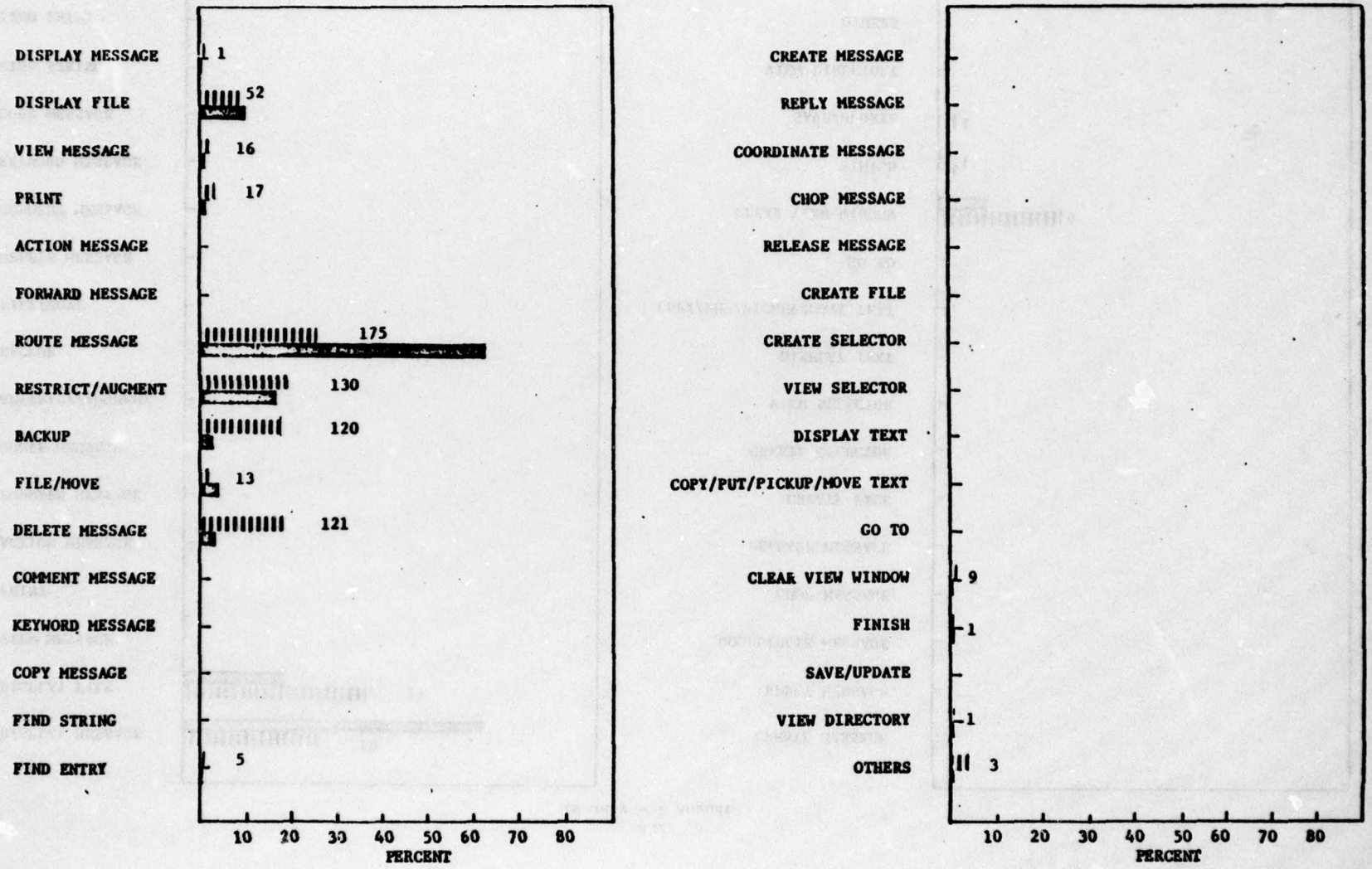
J34
3 August - 16 August



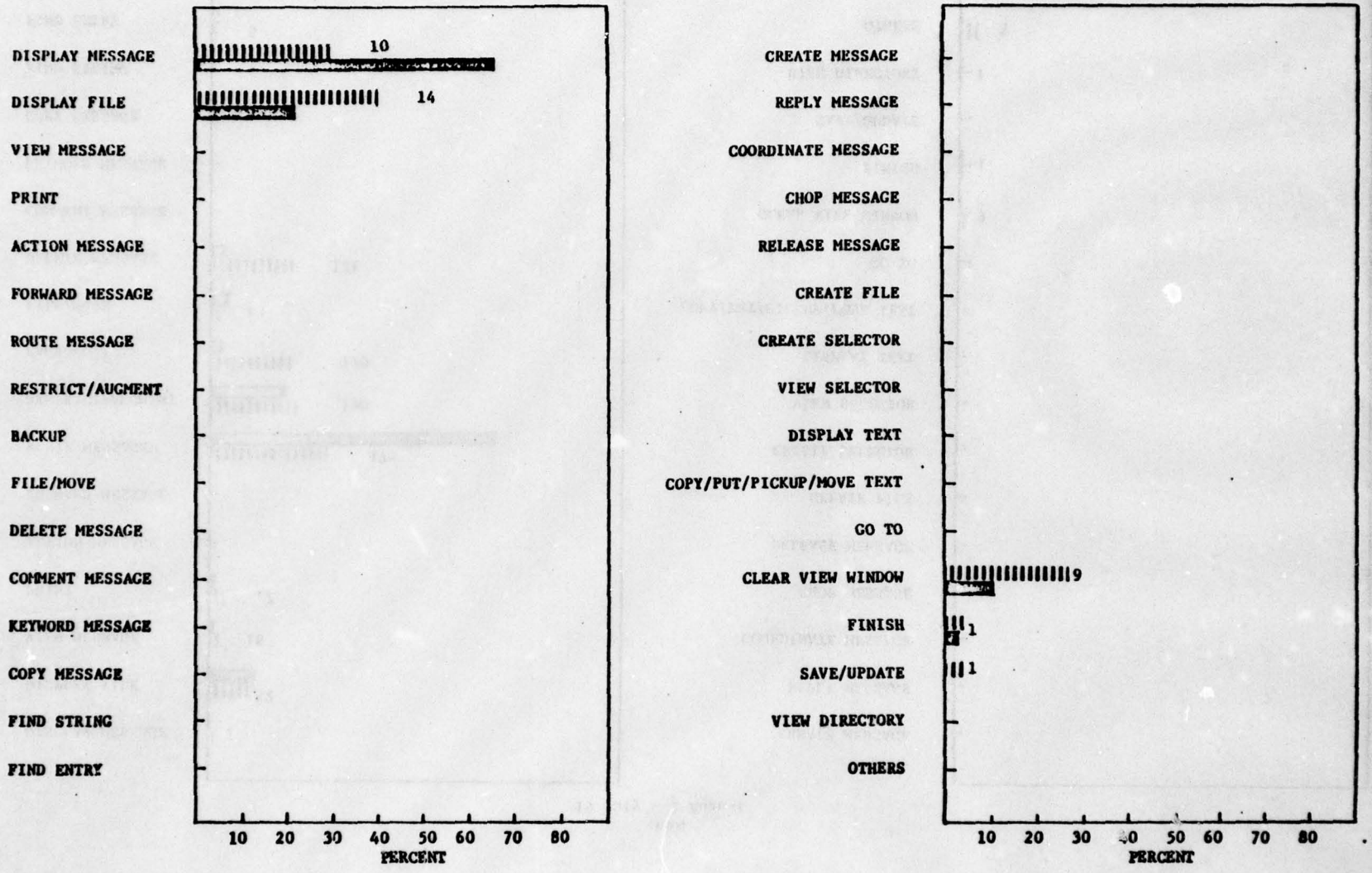
J315
3 August - 16 August



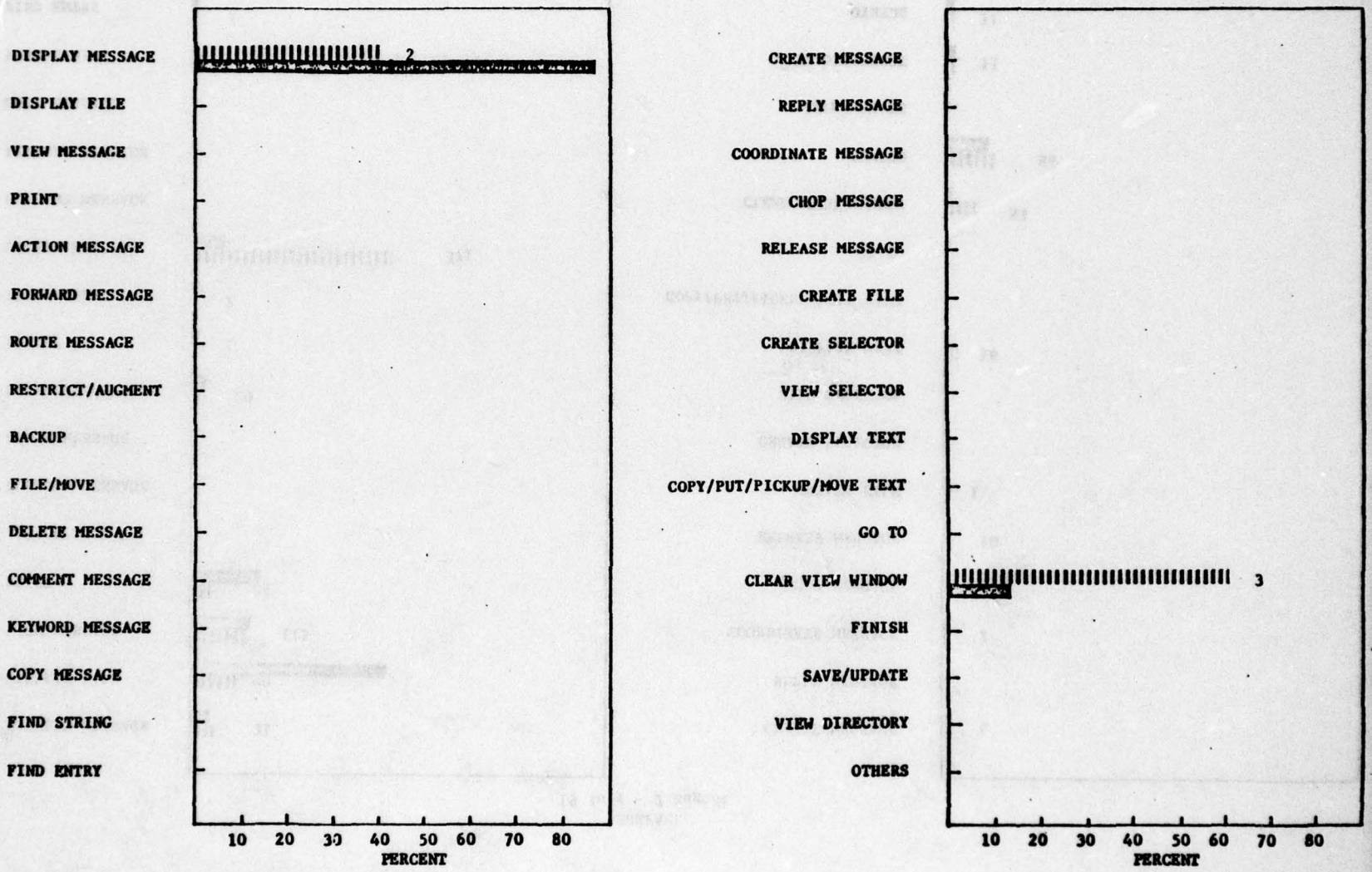
J301
19 July - 2 August



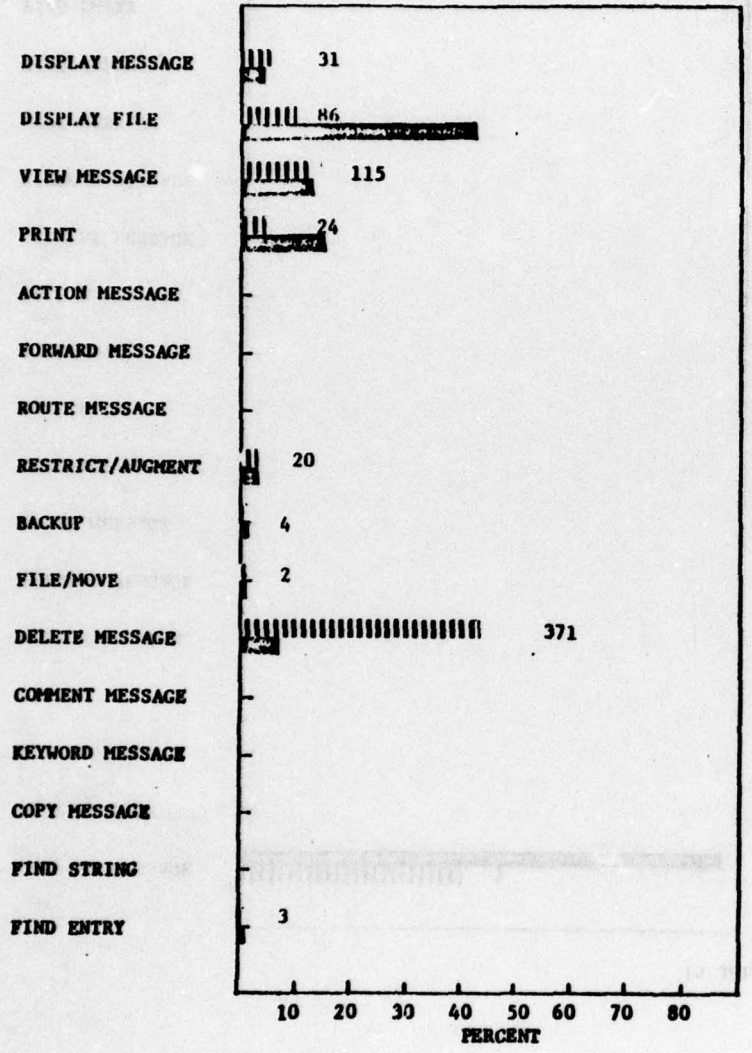
J32
19 July - 2 August

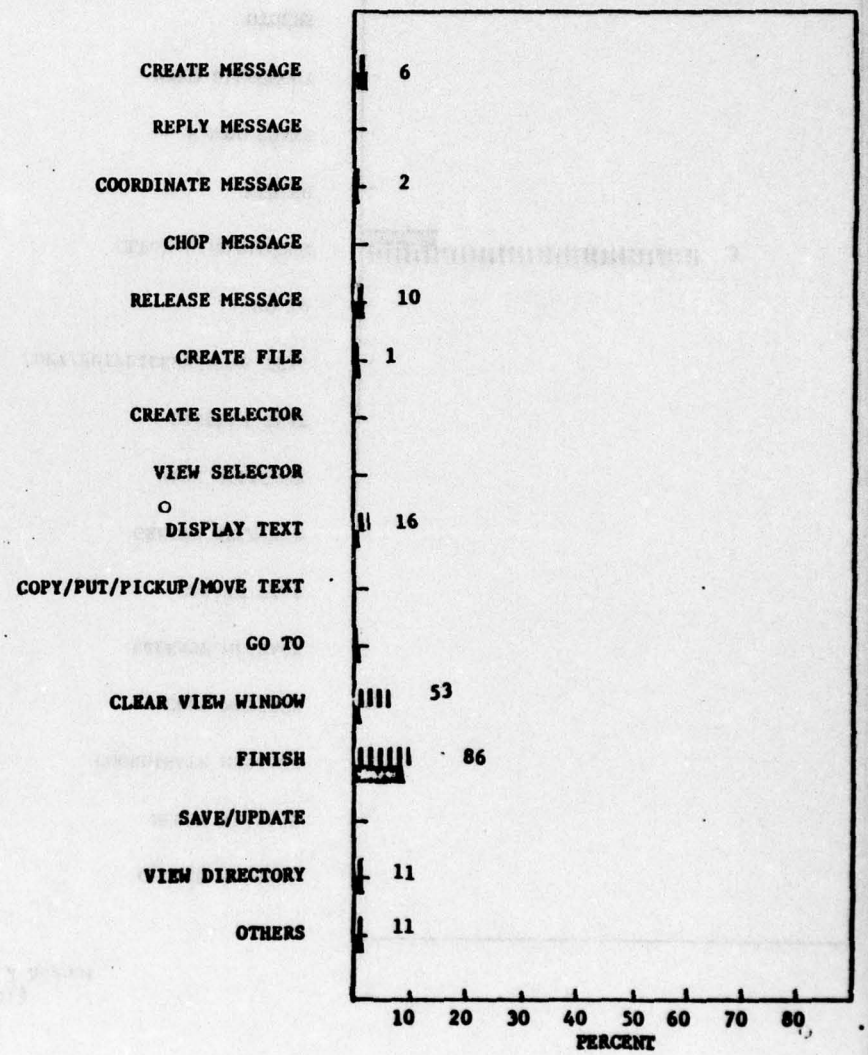


J313
19 July - 2 August

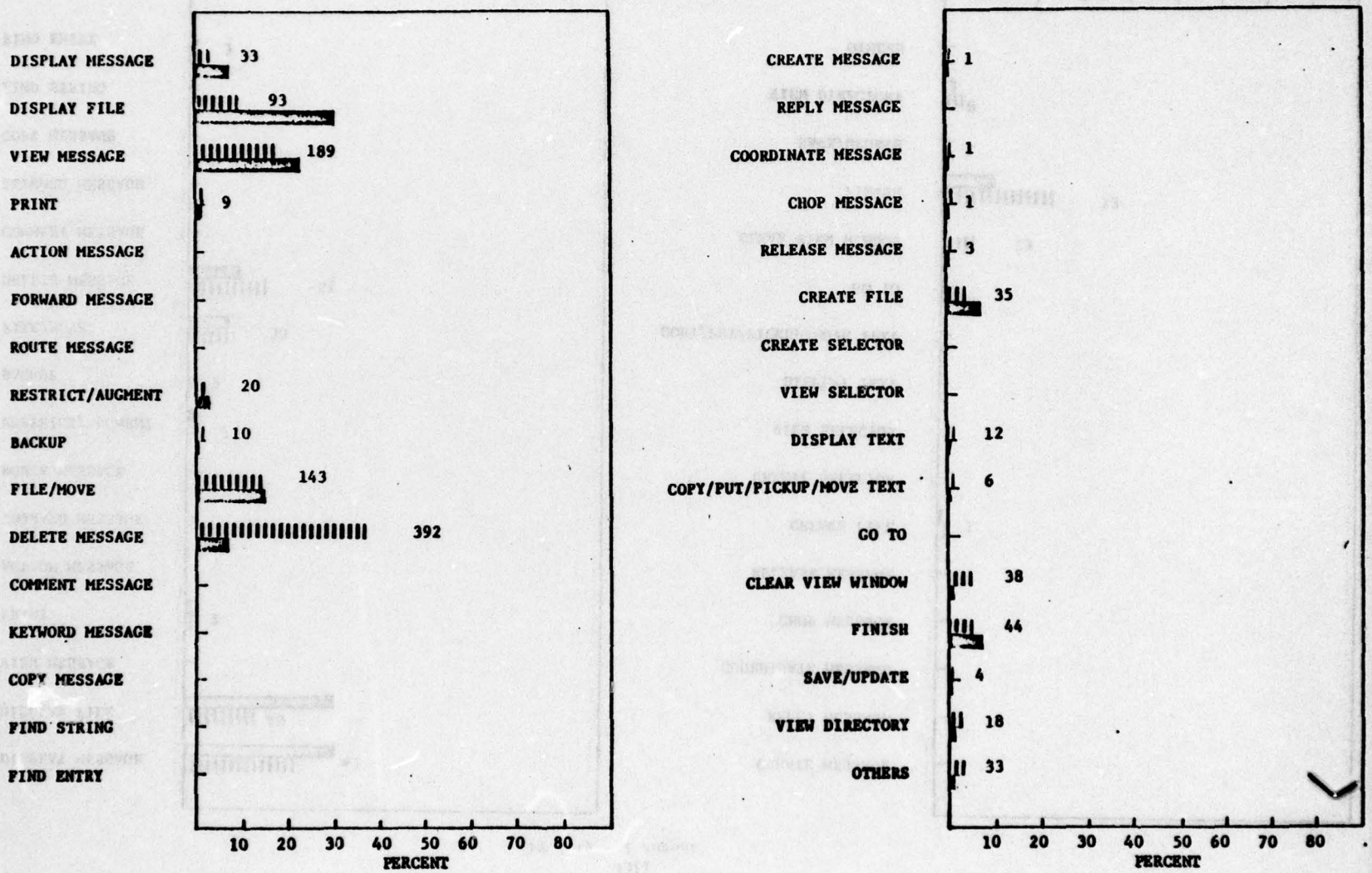


SURFACE
19 July - 2 August

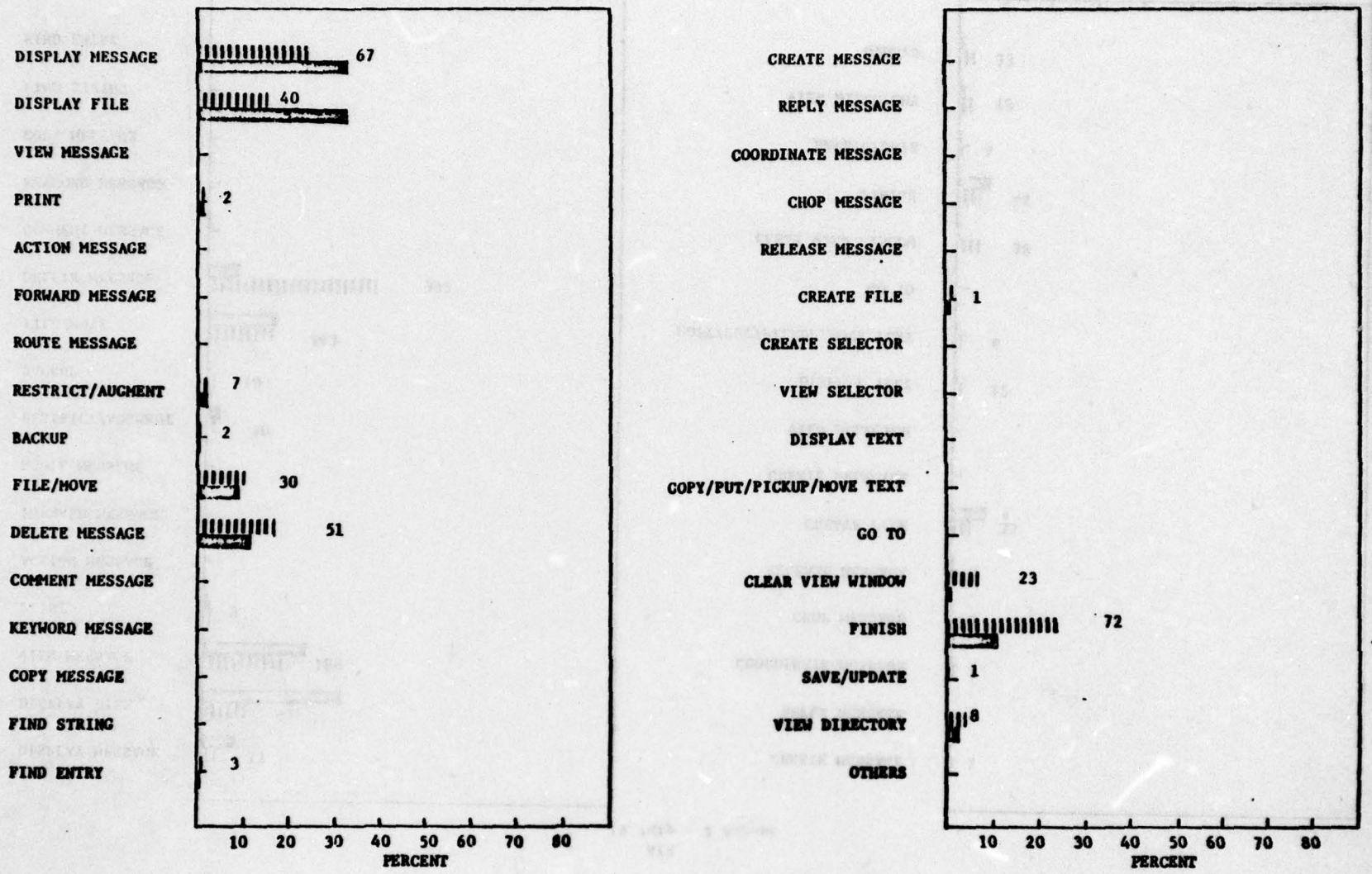




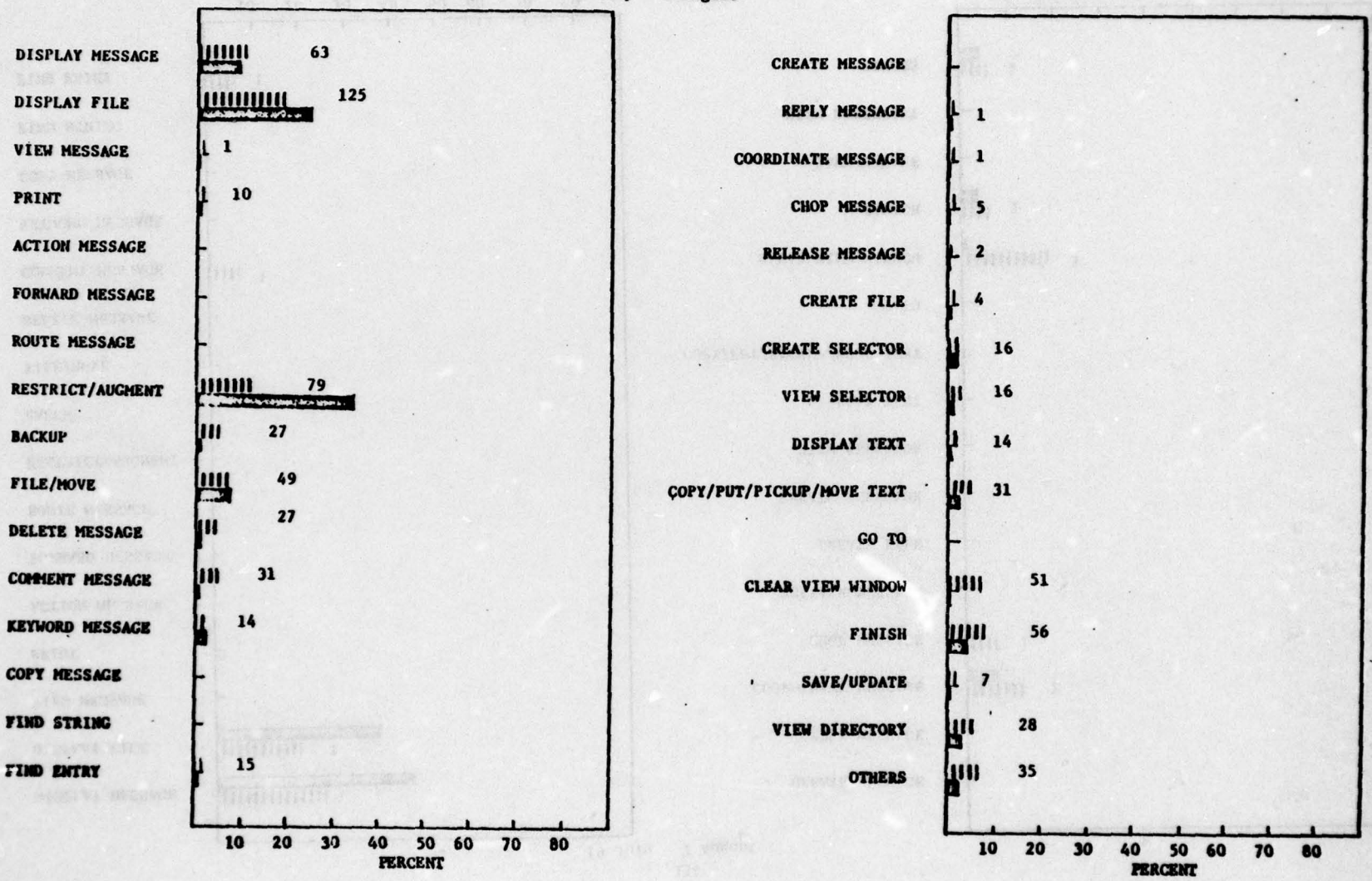
AIR
19 July - 2 August



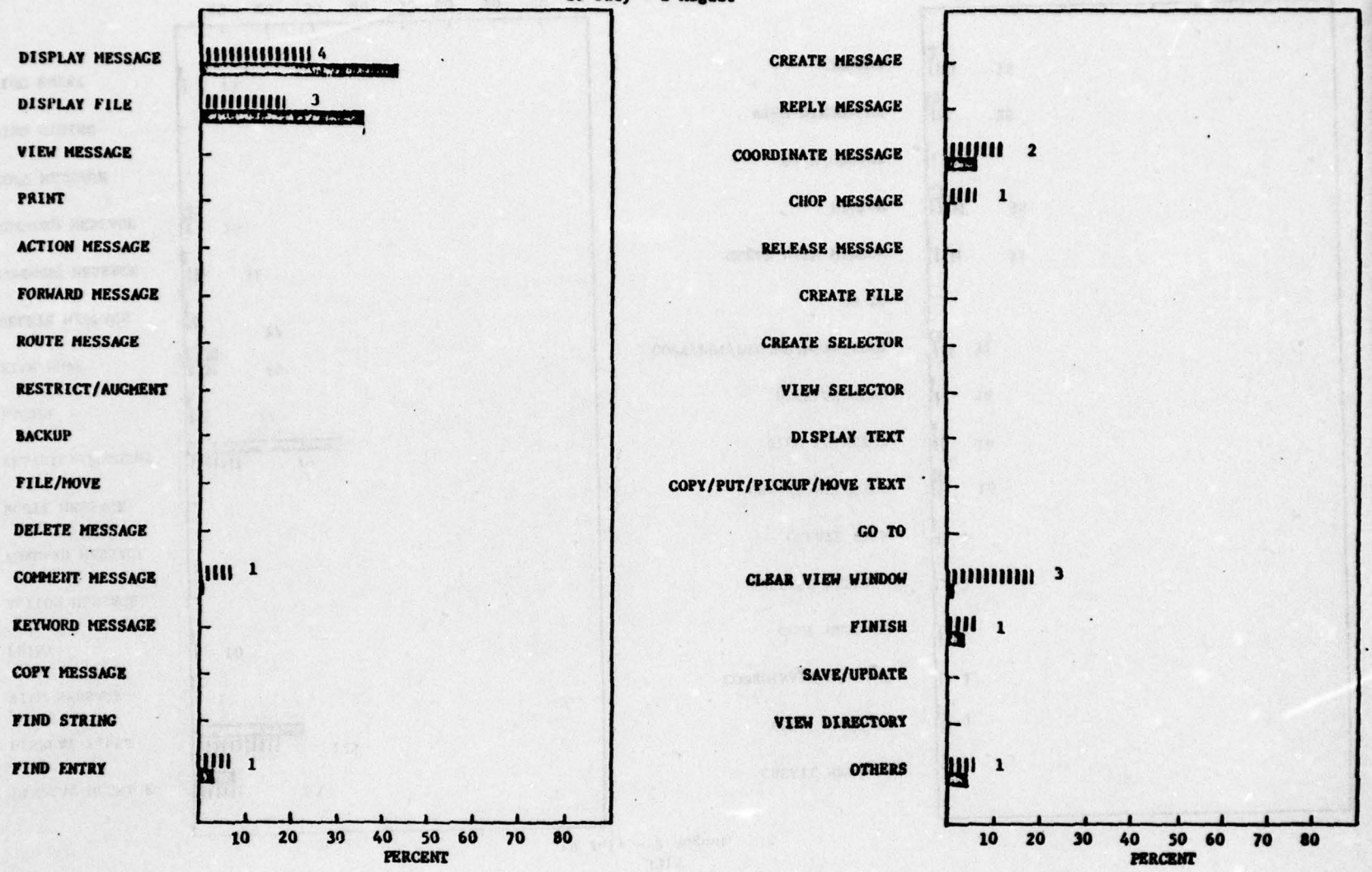
J311
19 July - 2 August

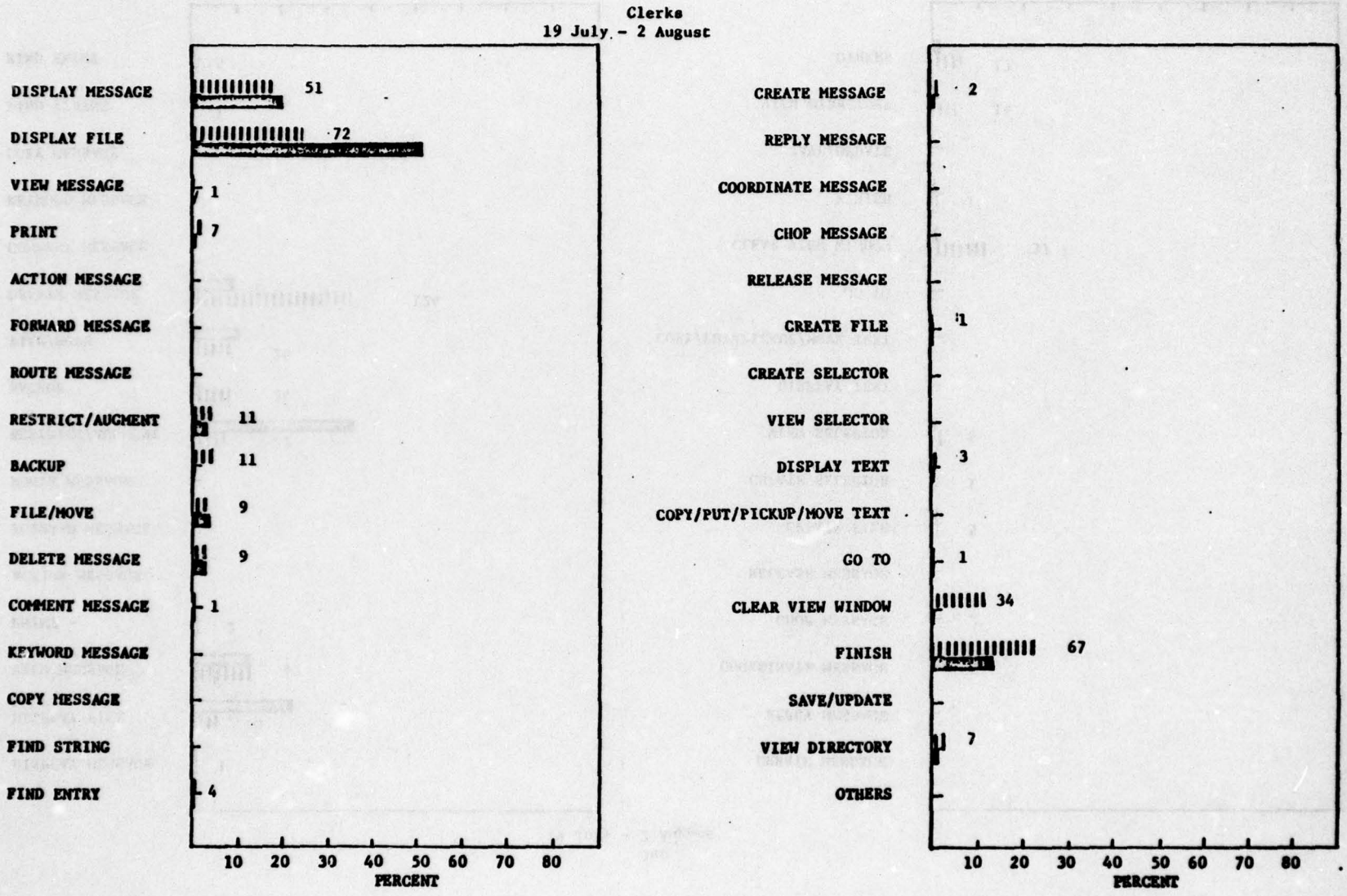


J315
19 July - 2 August

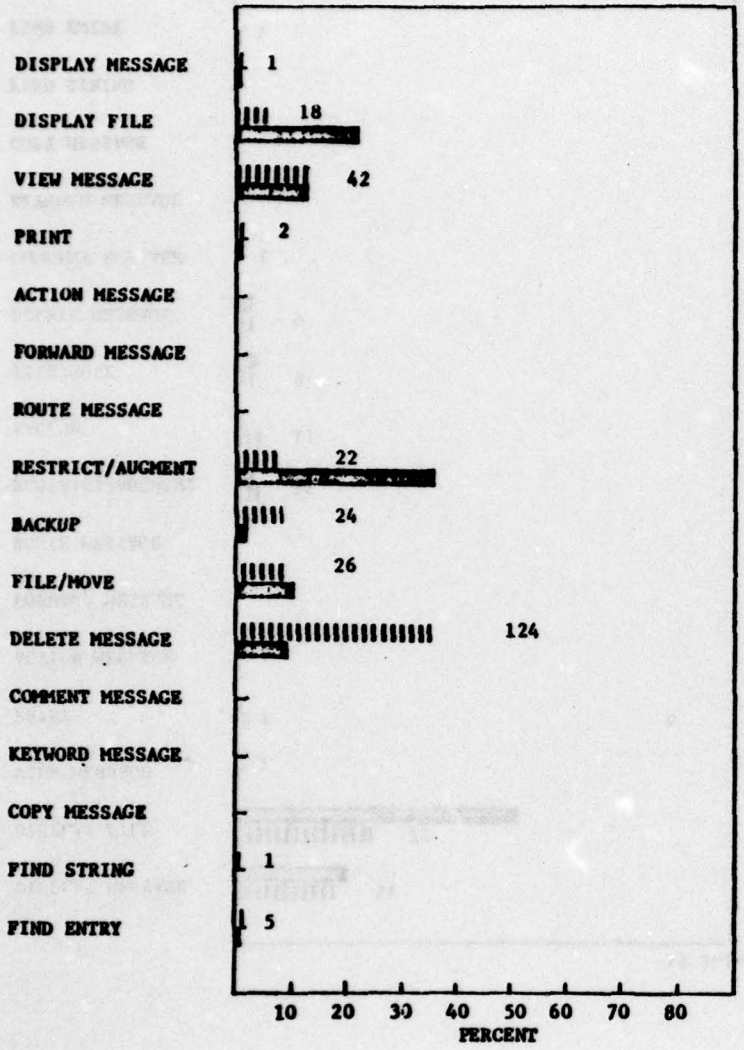


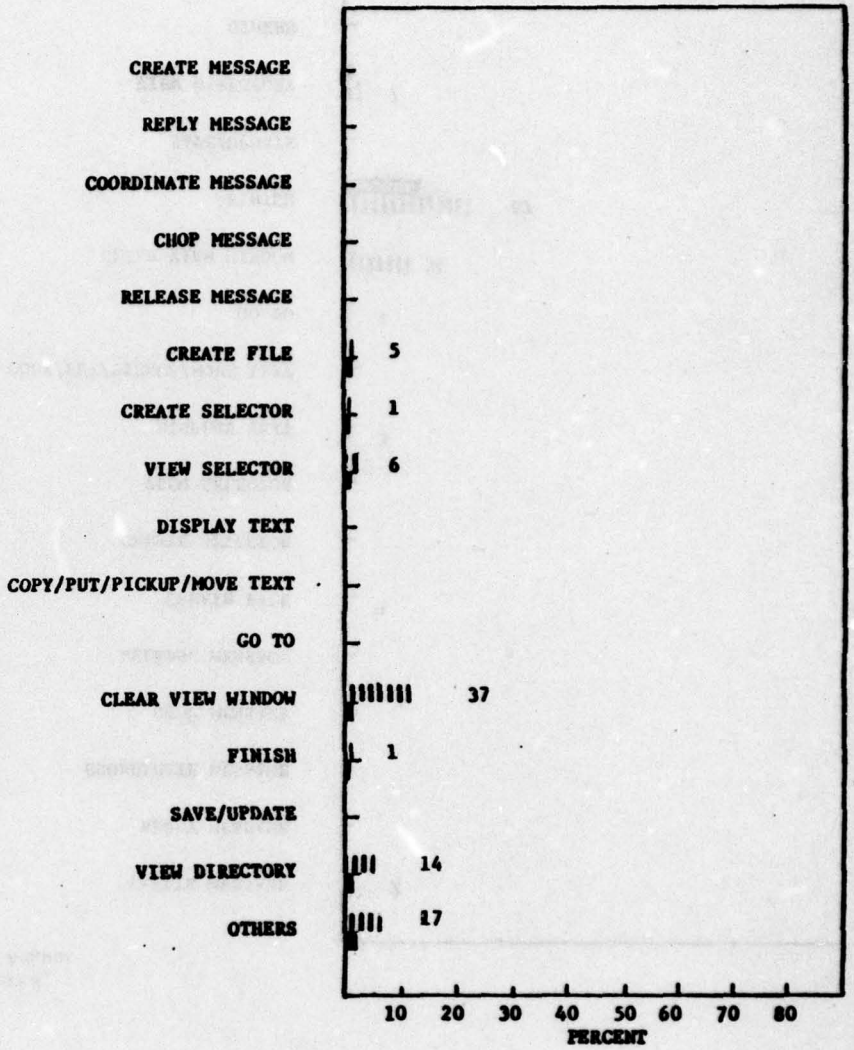
J34
19 July - 2 August




Clerks
19 July - 2 August
DISPLAY MESSAGE
51
DISPLAY FILE
72
VIEW MESSAGE
1
PRINT
7
ACTION MESSAGE
FORWARD MESSAGE
ROUTE MESSAGE
RESTRICT/AUGMENT
11
BACKUP
11
FILE/MOVE
9
DELETE MESSAGE
9
COMMENT MESSAGE
1
KEYWORD MESSAGE
COPY MESSAGE
FIND STRING
FIND ENTRY
4
10 20 30 40 50 60 70 80
PERCENT
CREATE MESSAGE
2
REPLY MESSAGE
COORDINATE MESSAGE
CHOP MESSAGE
RELEASE MESSAGE
CREATE FILE
1
CREATE SELECTOR
VIEW SELECTOR
DISPLAY TEXT
3
COPY/PUT/PICKUP/MOVE TEXT
GO TO
1
CLEAR VIEW WINDOW
34
FINISH
67
SAVE/UPDATE
VIEW DIRECTORY
7
OTHERS
10 20 30 40 50 60 70 80
PERCENT

JRC
19 July - 2 August





J342
19 July - 2 August

