Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

# THE DEPARTMENT OF COMMUNICATIONS COMMUNICATING WORD PROCESSOR NETWORK PILOT TRIAL

FINAL REPORT



JUNE '82

DIVISION OF DEVELOPMENT & ENGINEERING

GOVERNMENT TELECOMMUNICATIONS AGENCY

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DIVISION OF DEVELOPMENT & ENGINEERING
GOVERNMENT TELECOMMUNICATIONS AGENCY

JUNE '82

# REPORT
# ON
# PLANNING & DEVELOPMENT OF
# GOVERNMENT OFFICE COMMUNICATIONS

# PILOT TRIAL
# OF
# A COMMUNICATING WORD PROCESSOR NETWORK
# IN
# THE DEPARTMENT OF COMMUNICATIONS

## FINAL REPORT

Division of Development & Engineering
Government Telecommunications Agency
June, 1982

## ACKNOWLEDGEMENT

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In particular, thanks are extended to :

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  E. Lee, T. Whalen, A. Cazabon, L. Côté and M. Morin
- DATS, DAP and Regional Coordinators
- Communication Security Branch
- The operators of all message centres.

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## Executive Summary

This document reports on the DOC Communicating Word Processor (CWP) trial network project as a study on the cost-effectiveness and implications of "Teletex" applications (interconnection of CWP type terminals) for electronic text communications in the government.

The trial, initiated towards the end of 1980, was concluded in April, 1982.

The use of Teletex type service (CWP) for text communications is found to be cost-effective compared to other alternatives based on the attributes of the technology employed:

- Low incremental cost of adding communications capabilities, since the cost of terminal has been justified by its word processing functions

- Low transmission costs due to the use of the Government Intercity telephone network and short duration required for transmission

The finding was not unexpected in view of the rapid development of this service in Canada and elsewhere internationally.

The DOC experience also indicated that users were generally positive especially with regard to the non-tangible benefits of the network service, such as instantaneous reception of original letter-quality texts.

The users, however, felt that network operation could be improved with proper scheduling of transmissions, to minimize any interference to the word processing function of the terminals. Availability of background communications should alleviate this shortcoming.

Secured communications using Data Encryption Standard devices as part of the communication links was also implemented in the trial. The outcome, as evaluated by the DOC Communications Security Branch, was completely satisfactory.

# I Introduction

To evaluate the application of electronic communications technology in a typical government environment, it was proposed in July 1980 to establish a trial network to carry communications between DOC regional offices and headquarter offices within the ADMST sector. The use of existing and planned DOC word processors installations (upgraded with communication capabilities) communicating via the Government Inter-City Telephone network was selected because of the following considerations:

- the study was not intended to be a technical R & D project but an examination of the application of available technology to users
- it was desired to minimize incremental costs and
- there are already a great number of word processors in use in the federal government departments to which the findings would be applicable.
- the evolving "Teletex" service is communicating word processor technology based.

Subsequently towards the end of 1980, a project was established to introduce a Communicating Word Processor network in DOC.

The general objective of this pilot trial was to gain experience in the planning, operation and evaluation of electronic text messaging systems for a potential introduction by user departments and by GTA as a government-wide shared service. The performance of the Government Inter-City telephone network as a transmission medium for office communications was also an important consideration.

Preceeding this proposal was a preliminary study on electronic mail and office communications technology and services which suggested that moving and storing of non-simultaneous inter-personal communications electronic mail comprises two general categories: text communication and personal messaging.

Since at that time, no integrated system satisfying all office communication needs was available, the proposal was to study text communications as one of the primary dimensions of office communications.

The pilot project was composed of three stages:

1. Pre-test (to determine level of usage and mode of usage)
2. Operation and
3. Post-test Evaluation.

The Pre-test was carried out by means of personal surveys and discussions. The Operational phase involved development of both User and Operator Manuals and regular Information Bulletins. At least one region developed a local supplement with specific instructions for users within that region.

The Post-trial evaluation was designed to measure and reflect:

1. Technical viability including secured communications
2. Productivity: quantitative and qualitative (intangible benefits)
3. User acceptance and attitude regarding electronic text communication
4. Other factors such as organizational design and service development potential.

Operation of the DOC Communicating word processor pilot network was phased in over a four month period beginning in early December 1980 to early April 1981 when nine message centres, four at Headquarters and one in each of the five regions, were fully operational. Two additional message centres were added at Headquarters in August 1981.

Throughout the duration of the trial, information on user applications, usage and concerns were collected through systematic logging procedures and telephone surveys. Three progress reports were generated to provide preliminary assessments, status and developmental highlights at different stages of the trial.

The trial was terminated at the end of April 1982. This is the final report on the project.

# II Conclusion, Recommendations & Summary Findings

## II.1 Conclusion

The study concludes that:

- Teletex application is cost-effective for text communications between offices (and will likely form the basis for future electronic office communications)

- The technology provides for reliable electronic communications

- The performance of the government intercity telephone network is adequate to support electronic text communications services

- "Protected Communications" is feasible in a teletex network with the use of encryption device

- User acceptance is positive, but highly influenced by network administration (e.g. scheduling of transmission) and perceived degree of interference of the communication function of the terminal with its primary word processing function.

## II.2 Recommendations

It is recommended that:

1. The DOC retain its CWP pilot network to be integrated with the GTA planned government-wide Teletex network.

   ° DGPA be responsible for:

   - administration of the CWP network including scheduling of transmission between HQ and regional centres,
   - expanding the use of the CWP network to meet the text communication needs of all DOC,
   - reviewing the need for and to add "background" communications mode to the network.

2. Collaboration between GTA and other sectors be increased focusing on the significance and role of teletex technology and application for office communications with particular reference to:

   ° the issues and implications of interworking of teletex and other telematic services (e.g. Telidon) and the interworking of teletex and other electronic messaging services provided as part of Canadian common carrier data network services; and
   ° the development of terminal technology to provide a combination of teletex and other telematic capabilities,
   ° plans for the development of government teletex service and the evolution of the teletex service to support government office communications.

## II.3 Summary Findings

The following are summary findings of the pilot project on various aspects of application of Communicating Word Processors (CWP) in DOC.

- Profile of DOC (ADMST Sector) Text Communications (1980)

  ° 60% of out-going communications is inter-office and 40% is intra-office.
  ° 85% of the pieces of text communications was handled by various forms of postal service, the remaining 15% was transmitted via telex or facsimile. These represent 92% and 8% respectively in terms of number of pages sent.
  ° Excluding Telex, average number of pages per piece of communications was 2.6. Average Telex message was about 800 characters.
  In the CWP trial, the average number of pages per transmission is six (6).

- Productivity Measure

  ° In addition to Word Processing (WP) productivity considerations, the implementation of communication capabilities to existing or planned WP installations for text communications between offices, at minimum incremental cost, is cost-effective as long as a reasonable level of communications traffic is maintained. The boundaries and parameters of this "reasonable level" have also been established in this study and reported in the subsequent sections. The use of the Government Inter-City network is a favourable cost factor.
  ° The per page cost of using CWPs is comparable to the weighted average cost for text communications in DOC (as per the profile above) using former mode of communications (i.e. Postal Service, Fax and Telex).
  ° The intangible benefits identified during the trial should further support the use of electronic communications.

- Technical Considerations

° The available technology in Canada to add communications capabilities to WP is viable for reliable electronic text communications between offices.

° Communications protocol translation is generally required between dissimilar CWPs to provide maximum compatibility. Usage of common protocols (ASCII and IBM 2780/3780) provides only limited text compatibility.

° In general, the Government (GTA) IX network provides satisfactory performance for point-to-point communications in a synchronous mode at the rate of 2400 bps.

° The servicibility of use of an encryption device tested for "protected" communications has also been proven acceptable.

° "Background" mode of CWP communications in a network type application has not been evaluated.

° The CWP network and technology can be the basis of a Government Teletex service compatible to CCITT defined and Canadian Common Carrier planned Teletex services.

- User Acceptance and Organizational Considerations

° End users are generally positive with CWP type service from intangible benefits point of view (end users are not aware of the cost dimensions).

° WP operators are generally positive with regard to adding communication functions to their normal typing routines.

° There was some reluctance of accepting CWP by some regional management due to lack of "background" mode of communications in equipment (AES) used in the trial. Possible interference to primary function (WP) of message centre is of major concern.

° Users' perception of acceptability of CWP application is influenced by "Technology Push", i.e. expectation of what new technology should or can offer. Acceptance of CWP may jeopardize opportunity for acquiring other new technologies.

° CWP is generally perceived as a possible device for Personal Messaging type requirements, although it is not designed for that purpose.

- Network Usage Level

  ° During the trial period, with minimum promotional effort, network usage level was lower than anticipated.
  ° Low usage level tends to reflect user unawareness of costs dimensions, reluctance of use by some users and outright objection to receive messages in some cases. Reporting of usage to the project evaluation office by messages centres was also not made consistently by some centres
  ° Level of network usage varies from region to region.
  ° In general, a minimum level of network usage is required to cost justify the adding of communication capabilities to the WP. The level of network usage in the HQ as indicated in the trial (from those centres reported its usage) can be satisfied with a maximum of two CWPs. This suggested figure is based on cost justification only.

- Methodology

  ° The methodology used in the conduct and evaluation of the trial project would be applicable to other user organizations and for other studies relating to electronic text communications.
  ° The methodology used in the cost-effectiveness analysis would be applicable for other studies on general office communications.
  ° Determination of the communications profiles and related statistics is the key to any investigation of the application of office communications.
  ° Operators and Users' Manuals and related procedures developed for this trial would provide some guidance for other user organizations contemplating the development of a CWP network.

# III Findings and Discussions

## III.1 Introduction

During the course of the trial, three progress reports were generated on the status, development activities and various facets of the project. This report is not intended to provide a continuous account of the development of the project (network) but rather to present its findings.

The following sections describe briefly the methodology used in the pilot project and provide discussions on matters relating to technolgy, productivity (cost-effectiveness) and user acceptance.

The various sets of statistics on Pre-test user communications profile, network usage statistics, cost comparison charts, etc., are included in the report as appendices.

## III.2 Methodology

The methodology used for the network trial involved two project stages.

### A. Prior to Implementation

- Evaluation Design (including pre-trial tests)
- Needs and behavioural analysis
- User participation
- Procedures development

### B. After Implementation

- Operation of network
- Needs and behavioural analysis
- Performance analysis
- Final Evaluation

An evaluation design was devised to evaluate the efficiency and effectiveness of the application of electronic communications.

## Prior to Implementation

### i) Pre-test

A Pre-test was implemented to determine the level of usage and mode of communications used within the participating organizations of DOC. To ensure that the required data were available and to provide an introduction to the CWP trials, a visit was paid to each of the potential message centres (CWP sites) and personal interviews were conducted with each of the user participants. The participants were asked to estimate a number of parameters of their communications. These interviews provided an opportunity to measure the participant's perceptions of their inter-office communications.

### ii) Applications for Field Trial

For the purpose of the field trial, six DOC communications application areas were selected. They were:

- memoranda
- reports produced internally
- draft documents
- documents pertaining to Ministerial Inquiries
- Prosecution orders, and
- translation

## After Implementation

### i) Operational Procedures

Data on the use of the CWPs were collected at the word processing centres by the operators with a Typing Requisition and a Word Processor Operator Log Form suitable for that site. Traffic data

were then captured by the word processor operators on Transmission Logs. These logs maintained at the word processors sites provide relevant data for the evaluation at the termination of the trial.

Each document received at a message centre had a distinctive cover sheet attached to it before being forwarded to the receipient. In addition to identifying the item as having been transmitted via electronic mail, this sheet also provided a space for comments which the user was invited to submit to the project office. Operators were provided with Trouble Report forms which they coudl use to report failures of equipment to the project office.

During the trial period, data on the general communications of the participants were also collected by means of a telephone survey. This constant interaction with the participants by telephone allowed the participants to get answers to their questions or to express their concerns to the evaluation team.

ii) Performance Analysis

The performance of the implemented CWP network was evaluated considering:

- the technical viability of both the IX network and the communicating terminals
- cost benefits involving both quantitative measures and the identification of qualitative intangible benefits and costs
- user acceptance (human attitude) concerns and other impacts

Guidelines and comments on evaluation design for this trial is appended to this report as Appendix IV.

## III.3 User Office Communications Profile

### Pre-test

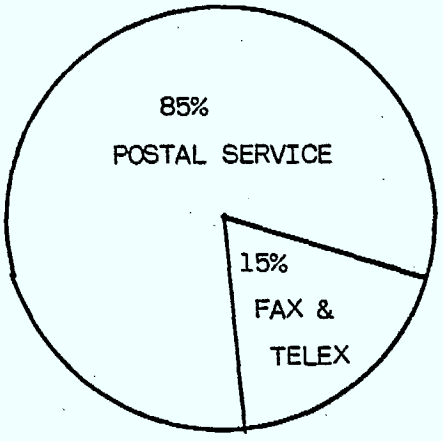
An objective of the Pre-trial test was to establish the profile of the inter-office communications of the participating users. This was done in personal interviews during which they were asked to estimate a number of parameters of their communications. The outcome of the Pre-trial test is documented and attached to this report as Appendix III.

i) Overall, there is a large amount of communications between headquarters and the regional offices using the existing telephone, mail and telex facilities. The distribution of inter-office communications via the various existing modes of communications is shown in Figure 1.

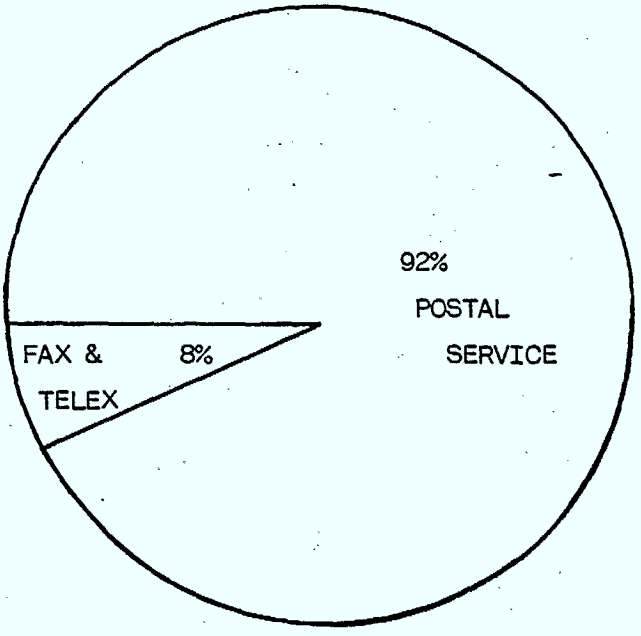
A further breakdown of the information indicated that each of the participating management staff sends, on the average, 11 pieces of mail per day, as well as 15.5 telex messages per month and 4.6 Fax communications per month. The average number of pages per piece of mail, including Fax, is estimated as 2.6.

ii) The profile also indicates that mail often arrived too close to the deadline for the recipient to complete a proper response. To compensate for the delays, the regular mail was often preceeded with either a telex or a telephone call.
The deficiency in the telephone system stems from the fact that more than 30% of telephone calls were not completed successfully due to the unavailability of the party called. This is reflected in the number of telephone messages received compared to the number of calls received. Most of these messages required a return call, rather than containing the necessary information.

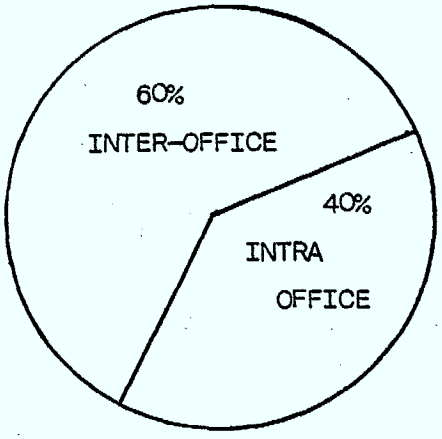
PROFILE OF DOC TEXT COMMUNICATIONS FIGURE 1




NO. OF PIECES OF COMMUNICATION




NO. OF PAGES OF COMMUNICATION




PERCENTAGE OF OUT-GOING COMMUNICATION

During the trial

i) Figure 2 charts the communication pattern (distribution) of the number of pages transmitted versus the number of transmissions. The average number of pages per transmission is calculated as 6 which indicates that the traffic volume is such that the CWP message centres transmitted each piece of "mail" when requested by the sender without accumulating it to increase the number of pages per transmission.

A high proportion (60% - 80%) of text communications of documents of 5 pages or less is also highlighted (Figure 3).

III.4 User Applications and Network Usage

During the trial, of the six applications chosen, prosecution orders, ministerial inquiries and MIS reports produced internally have not been used to any extent. Translation has been used when required, between DATS and the Secretary of State translation bureau in Quebec City, but has not been used to any extent by the Regions.

The CWP network has been used primarily for internal communications (i.e. memos, bulletins, etc.) and documents.

Network Usage

Monthly breakdown of network usage in terms of number of pages sent is shown in Figure 4.

The usage statistics were compiled based on the information reported to DDE by the message centres. Since some Headquarter centres did not report usage, the usage chart therefore can only indicate the trend and the minimum level of network usage.

Several factors are found to have influenced the level of usage of the CWP network:

FIGURE 2

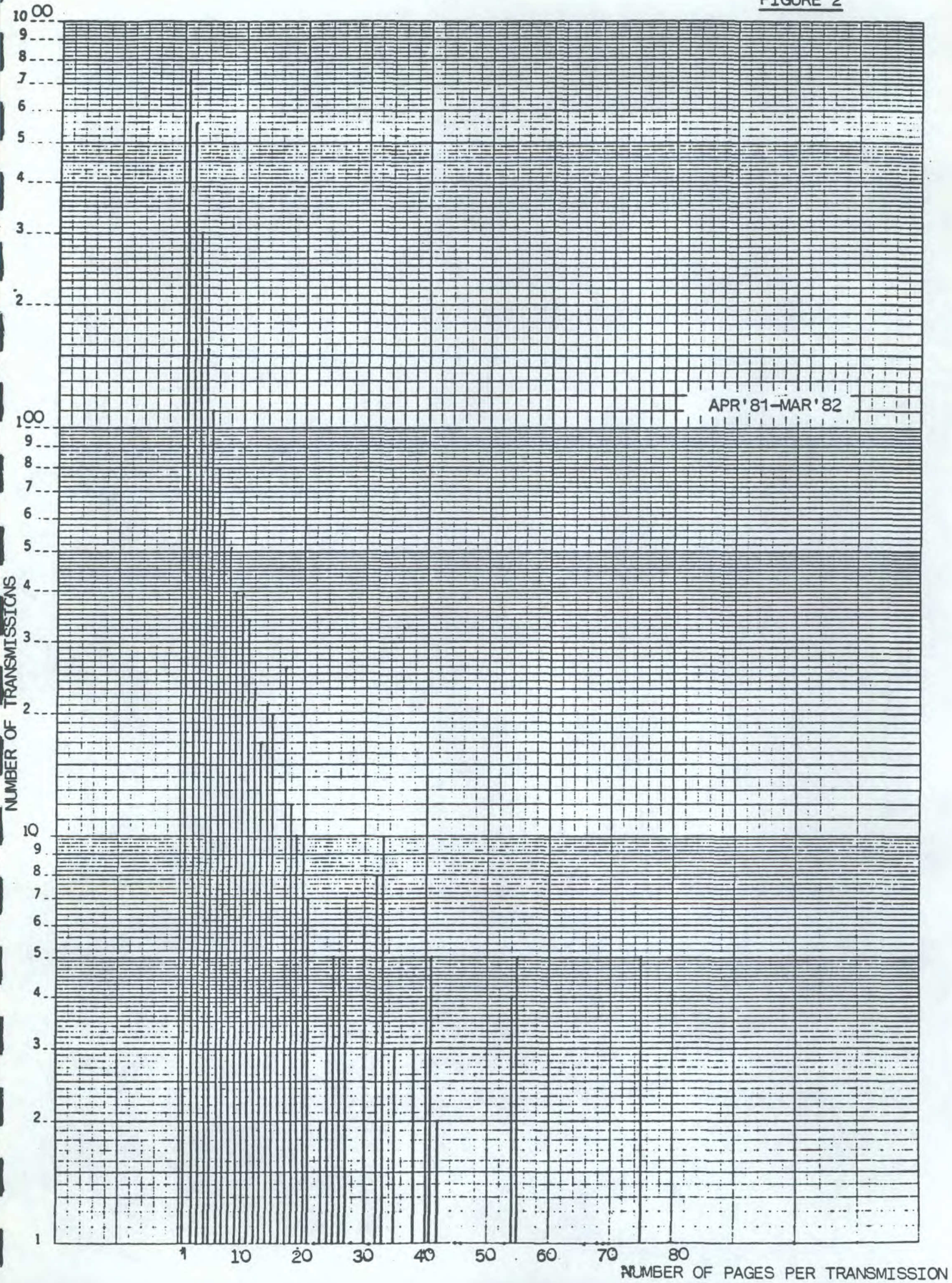
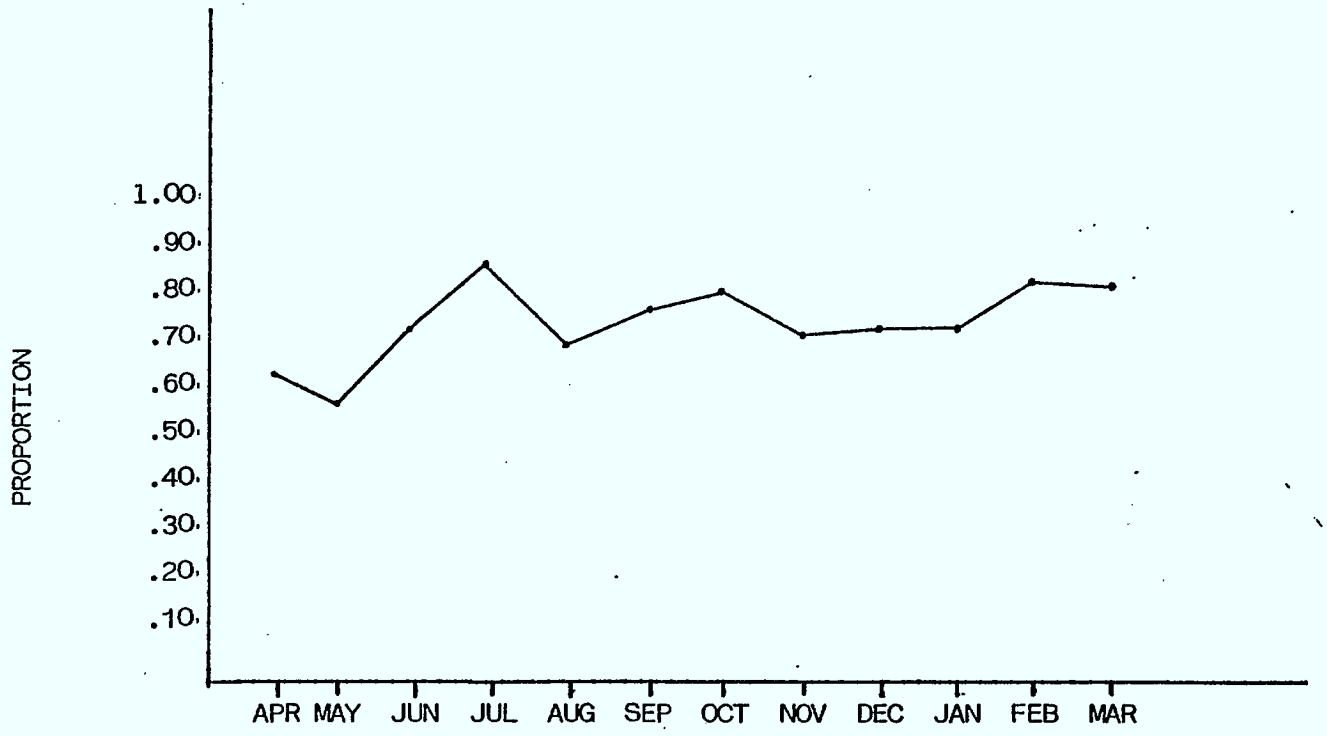
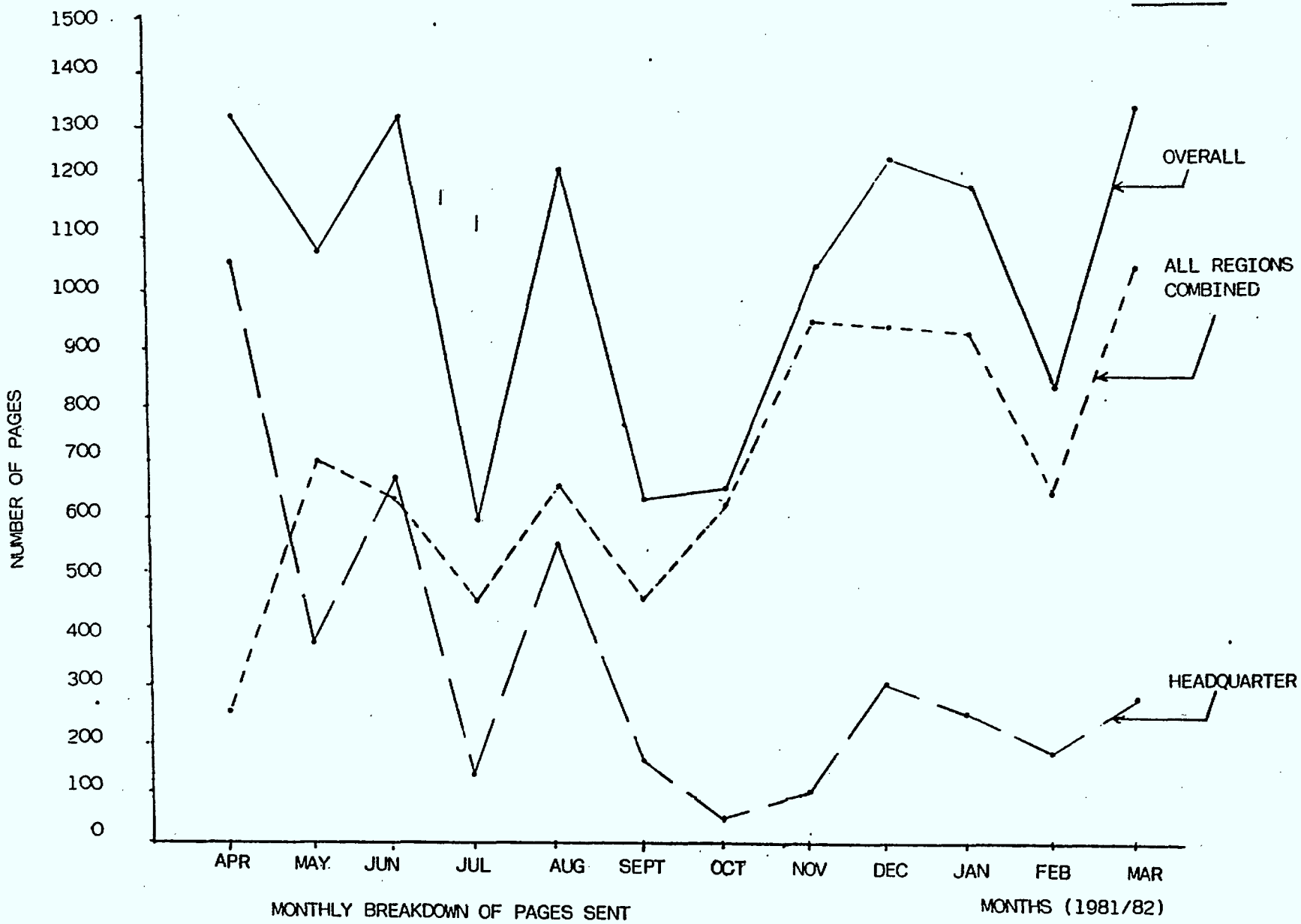

APR'81-MAR'82
NUMBER OF TRANSMISSIONS
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
1
10
20
30
40
50
60
70
80
NUMBER OF PAGES PER TRANSMISSION

FIGURE 3




MONTHLY BREAKDOWN OF DOCUMENTS - 5 PAGES OR LESS

FIGURE 4


1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
NUMBER OF PAGES
OVERALL
ALL REGIONS COMBINED
HEADQUARTER
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
MONTHLY BREAKDOWN OF PAGES SENT
MONTHS (1981/82)

- CWP has not been exposed to all potential users. Users are not generally aware of the cost dimensions of the network. The usage of the CWP network was primarily to accelerate the delivery of correspondence and not to attempt to replace some other communications media by electronic text communications
- WP operators have been coping with a high volume of activity. WP centre managers are reluctant to introduce new applications in an already demanding situation
- Other factors affecting the use of the network are:

    - different time zones between regions
    - centres are left unattended at various times during the day
    - lines are busy
    - no centralized scheduling for communications between centres

## III. Productivity Considerations

### Introduction

Productivity is the inverse of efficiency; it is the amount of output per unit input (investment, work)

i.e. Productivity = $\frac{\text{Output}}{\text{Input}}$ = # Units/$

Investment can be either expressed in terms of time or other measureable costs. A measure of improved productivity is a measure of time saved and other cost/benefits.

The amount of productivity gain (or loss) of the application of a communicating word processor system in an organization has two components:

- change of productivity of the office from the application of electronic word processing and
- change of productivity due to the addition of the electronic communications capabilities in the office

The object of this study is to identify the cost/benefits of the second component. The following provides the cost/benefit considerations of the application of CWP network within the DOC.

### Cost/Benefit Measures

### Methodology

Quantitative benefits are those which can be measured providing a sound basis for cost justification.

Qualitative benefits are those which are intangible and almost impossible to measure. These are the subjective measure of the perceived values (utility) to the users.

In this project, the evaluation of the quantitative benefits consists of the determination and comparison of the displacement costs resulting from a replacement of the existing text communications method (in DOC) by another namely (the use of CWP).

The cost effectiveness is derived by bundling the various communications media (mail, telex, etc.) used by an organization (DOC) and then determining a weighted average cost for each communications transaction and comparing it to the cost of the use of the CWP.

The qualitative benefits are hypothesized and rationalized based on observations and comments by the users during the trial. No statistical empirical data are presented to support these observations.

Quantitative Cost/Benefits Analysis

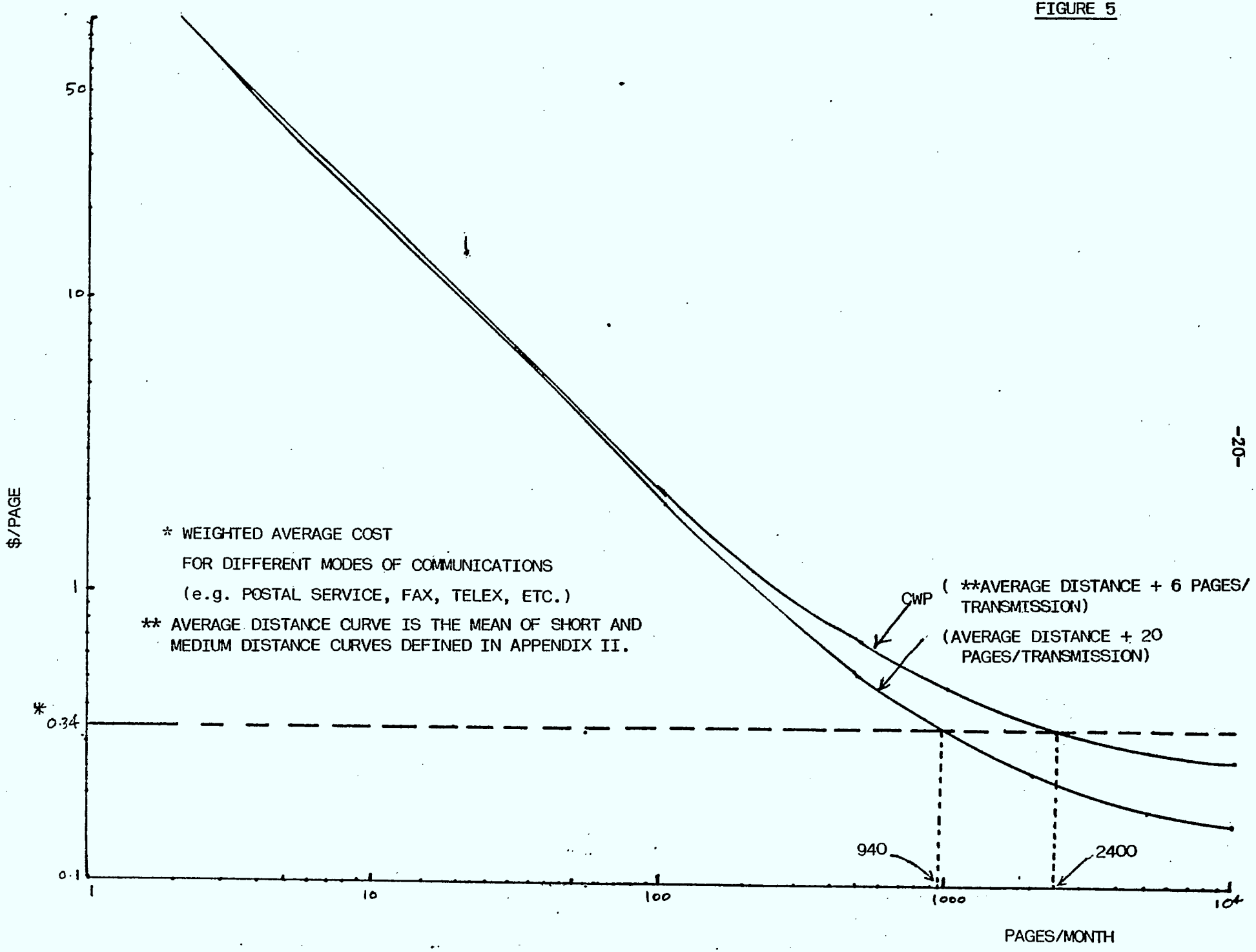
i) The cost/benefit analysis is performed by:
- comparing the cost of communications via a CWP network to the costs of transmission via other electronic means (Ref. Appendix II)
- comparing the cost of the CWP network to the weighted average cost for a composite mode of communications (communication profile), as indicated in Figure 5

Figure 5 shows a cost-effective break-even point for the CWP network to be 940 and 2400 pages (volume) per month using either 6 pages or 20 pages per transmission strategy respectively. These equate to approximately 40 pages and 110 pages of transmission volume per day, and depending on the transmission strategy, they represent approximately 28 to 50 minutes of transmission time per day.

The CWP costs on a per page basis is sensitive to two factors:

- the number of pages transmitted per transaction (to minimize the overhead costs of the time required to set up each transaction)

FIGURE 5


50
10
1
0.1
$/PAGE
* 0.34
1
10
100
1000
10⁴
PAGES/MONTH
940
2400
CWP
( **AVERAGE DISTANCE + 6 PAGES/ TRANSMISSION)
(AVERAGE DISTANCE + 20 PAGES/TRANSMISSION)
* WEIGHTED AVERAGE COST
FOR DIFFERENT MODES OF COMMUNICATIONS
(e.g. POSTAL SERVICE, FAX, TELEX, ETC.)
** AVERAGE DISTANCE CURVE IS THE MEAN OF SHORT AND MEDIUM DISTANCE CURVES DEFINED IN APPENDIX II.

- the number of pages transmitted per transaction (to minimize the overhead costs of voice communications to set up each transaction)
- the number of pages transmitted per month (to minimize the overhead cost of the rental of the communications software package and the modem)

The pro-rated cost of the WP equipment (excluding communication) is insignificant because the usage of the WP for transmission is limited to 28-50 minutes per day. At other times it is used for text editing functions.

On the other hand, the entire cost of adding communication capabilities to the WP (hardware/software/modems and line) has been used for calculating the cost per page, since it has been added specfically to enable communications.

The average cost of existing mode of communication was estimated to be $0.34 per page with an average of (2.6 pages per piece of mail). The average cost of postal service and fax communications per page is estimated as $ .13 and $ .80 respectively. The average cost of a telex message (800 characters) is $4.20.

ii) It is recognized that the primary function of the WP for use in the CWP network application is word processing. Although from the cost point of view, the higher the volume of traffic the lower the per page communication cost, the communications function beyond a certain level of volume, will interfere unacceptably with the WP function.

Even it is cost effective to equip a WP with communications capability for traffic volume beyond the threshold value, a step size of 70 pages requiring 40 minutes to transmit should be considered as a criterion to equip a second WP with communications. This step size is proposed, of attempting to utilize approximately 10% of the capacity of the WP for communicating purposes.

Qualitative (Intangible) Benefits

While no empirical data has been collected to measure the intangible benefits, it is possible to identify the principle ones.

i) The speed of document transmission compared to other types of communications. Whereas mail or courier requires at least 24 hours and sometimes longer, documents which are transmitted by CWP will arrive almost immediately. The actual amount of time that will pass before the document is delivered to the recipient depends on the way the document is distributed once it has been received. The user to user delivery time, however, should always be less than the regular mail, since they rely on the same internal distribution system from the message centre to the recipient.

ii) Reliability of document transmission. Not only will the document be delivered more quickly, but the time that it takes for the document to be delivered should be constant and known to the users. This is in contrast to other mail systems which may have widely variable delivery times, occasionally losing mail altogether. Not only is this delivery time known, but it can be verified because each operator makes an entry into their log when the document is transmitted. In other types of communications, if the document has been lost, there is no way to find out where it went astray.

iii) Non-Simultaneous Communication. The recipient need not be present to accept delivery of the communication, unlike the telephone which requires that the sender and recipient both be present simultaneously.

iv) Quality of the document. Quality of the document is as good as the original. This would not be true if facsimile or Telex had been used to transmit the document. Furthermore, it is a physical document, unlike a telephone call which is very ephemeral.

v) Editability. The document is easily editable by the recipient because it is already on the word processor. Thus, draft documents can be easily produced by multiple authors in remote locations. In less drastic cases, the recipient may make minor corrections to a final document before distributing it more widely.

vi) Transmission of telex messages often requires re-typing by the operator.

The users' responses have confirmed that the documents have been sent by CWP in order to take advantage of these benefits, as the users of the trial are not aware of the quantitative financial cost dimensions. Because a large volume of small documents have been sent during the peak hours, the senders were taking advantage of the ability of the CWP network to deliver the document immediately.

It should be noted that each of the benefits listed above may be obtained by the use of an alternate communication system. The unique aspect of the CWP network is that it provides all of the benefits simultaneously. It is only in the case that a document requires some combination of these benefits that the CWP cannot be replaced by an existing communications system.

## III.6 Technical and Operational Considerations

### i) Transmission Network

The CWP using the GTA IX telephone network as transmission medium provided excellent quality text transmissions as commented by the users. There are however, networking factors which require consideration.

Due to the significant time zone differences between Atlantic and Pacific regions, a certain communication window is imposed during which the transmission link can be established, since for this trial, the operators are required at both ends. Therefore, priority should be established for a pre-assigned schedule for transmission and reception of documents.

Transmission quality for the long haul connections between the East and West coasts of Canada at times is unsatisfactory. This is to be expected due to the tandeming of trunking facilities of the IX network. The problem can be eliminated by installing direct lines linking, for instance, RAG to other regions west of Ottawa, and RPG to other regions east of Ottawa. Another feasible alternative would be a central distribution of messages controlled by Ottawa. This would alleviate both the time zone and the tandeming problems.

Another networking issue raised by the users, is the in-house distribution of documents after reception by the message centre. Separate procedures will be necessary for prompt distribution. This requirement supports the argument that electronic work stations should be made available to the smaller size of organizational unit rather than being provided at a central distribution point.

ii) Terminals

One of the major technical drawbacks expressed by quite a number of participants in this trial is the limitations of not having background communication capabilities available for the word processors involved in the trial. Operators cannot perform local word processing functions while communicating with others. This difficulty manifests itself especially when transmitting long documents. It should however be recognized that CWP equipment is currently available with such capabilities.

The inherent text transmission capability of the word processors imply that document containing graphics cannot be communicated. This poses definite problems with authenticating documents since signatures cannot be sent. There is no immediate foreseeable remedial action that can be taken in these situations except using supplementary transmission of graphics information over facsimile machines.

Certain users express the need to transmit documents which were not orginally prepared using the word processors. This would include typewriter prepared materials and information stored in files which were previously recorded on paper. Optical character readers (OCR) may be a partial solution. However, specific type fonts and type sizes are necessary to permit proper interpretation by the OCR. It should therefore, be viewed upon as an interim solution before all office documentation is electronically prepared, stored, retrieved and transmitted.

A major concern in the development of a government-wide text messaging network would be the incompatability of dissimilar equipment. This was not encountered in the trial because the network consists only of one family of word processors that have the capability to communicate both synchronously and asynchronously. It is recognized that to achieve an absolute compatibility of word processing functions, control codes and embedded commands offered by

competing vendors is almost an impossible task. The use of a protocol translation device and the development of standardized virtual terminal protocols are subjects under study in other activities within DDE.

## III.7 User Acceptance and Concerns

User acceptance of the application of CWPs was monitored both from the network usage point of view, and by means of suggestions received from the users by regular telephone surveys during the trial. Some observations are subjective observations of the evaluators of this project.

The following observations were made during the trial:

- End users, in general have a positive attitude towards the use of electronic technology for text communications. The value of electronic text communication is expressed primarily from the intangible benefits point of view (i.e. excellent quality of document received, speed, editability, etc.) since users are not aware of the various costs.

- Except for minor initial reluctance and apprehensions, WP operators in general are positive to perform communications functions as a variety to their normal typing and editing routine.

- Some management negative attitude shown can be attributed to
  i) technology push (i.e. perception that now technology discussed in the literature can offer much more flexibility than CWP).
  ii) concern that acceptance of application of CWP may jeopardize future acquisition of newer technology and systems.
  iii) concern that communications function interfere with primary WP function of the message centre (i.e. no background communications capability of the equipment installed in the trial)

- A shift of typing work load from secretarial staff to WP operators for correspondence has been observed.

- User attitude reflected in network usage is also affected by operational shortcomings of the CWP trial network due to:
  - no centralized scheduling scheme established to deal with time zone differences
  - unattended centres during part of day
  - busy lines
  - transmission problems (therefore reducing throughput) encountered at times between Moncton and Vancouver, due to tandeming of facilities via Ottawa.

- Although CWP network usage was anticipated to be primarily for documents and reports, users perceive a high efficiency value of network for short messages (i.e. memos) resulting in high percentages of transmission for less than 5 pages per transmission.

- There are no empirical data collected to suggest any significant replacement of existing (1980) communications mode (i.e. telephone call, etc.) to the use of electronic text communications due to the introduction of the CWP network.

## III.8 Secured Communications - Data Encryption Standard

### Introduction

The following section was prepared by C. Hunter and G. Dawson of the Communictions Security Branch on their evaluation of a trial of Data Encryption Standard (DES) devices integrated with Communcating Word Processors.

### Background

Advancing technology, particularly in the so-called "marriage of computers and communications" has given rise to serious security concerns that, because of increasing volumes of information processed by such systems, information is rendered vulnerable to intercept and compromise to a far greater extent than in the pre-computer/communication era. These concerns have led to the development of a data encryption standard, (DES), which can be used to protect information during the communications process, thereby removing hte vulnerability. In view of the foregoing, DOC initiated a trial of DES devices integrated with Communicating Word Processors (CWP).

The trial was undertaken as a joint GTA/DDE and DSCS/ADC venture, with technical support and keying material provided by the Communications Security Establishment, (CSE).

### Objectives

The four objectives of the trial were a) to obtain a satisfactory technical and operation interface, b) to gain experience in the operation of DES in a CWP application, c) to measure the user benefit in the ability to transmit information by protected electronic means, and d) to capture sufficient performance information to support informed decision-making relative to future DES applications.

Unfortunately, objective c) could not be realized due to unresolved security policy issues which restricted the category of material to be transmitted to the "unclassified" level. The remainder of the objectives were accomplished at the unclassified level.

Configuration

Two DES devices, Collins-Rockwell CR-200s were provided by CSE, who also developed and provided the technical interface between the CR-200 and the AES Plus, CWP. Toronto Regional Office was selected as the distant protected terminal and the encryption device was installed on the 18 November 1981. Initially, for a one month period, the GTA/DDE terminal served as the protected Ottawa terminal and when it was established that de-bugging of the system was not a necessity, the encryption device was interfaced, on the 18 December 1981, with the more active DAP, CWP. Both terminals operated in a protected mode until the 28 April 1982.

As DAP Ottawa and Toronto Regional Office were but two terminals of a dial-up CWP network, it was necessary to provide a means of bypassing the encrypted device when communicating with a terminal not fitted with encryption. Again CSE designed and produced a switching capability which enabled operators to bypass the DES when working to a non-fitted terminal. With the exception of this "Protected/Clear" switch the CR-200 encryption device, when set to key, was essentially transparent to the network. The device imposed only a one bit delay in transmission time.

Monthly keylists, produced by CSE, were issued and controlled in accordance with specific key management instructions contained in the provided Operators Manual. The manual presented users with a general overview of the trial, a set of operating and trouble-shooting procedures and criteria for necessary capture of performance data.

Results

The overall results of the six month trial were most encouraging with all established objectives fully satisfied.

The technical interface of the CR-200 and the AES Plus, CWP produced only minor incompatibilities and a fully operational system was achieved with virtually no down-time. The impact on operational personnel of inserting an encryption component into an operational system is moderated by the near transparency of the device. Changing the key once a month for the Master and daily for the Secondary, switching the Protected/Clear switch, when necessary, and the maintenance of an additional column in the daily long were the only increases in operator workload. After a few days practice it was noted that key setting could be accomplished in less than 1 1/2 minutes.

The experince gained from the trial will be invaluable in assessing future applications of encryption such as in digital facsimile, computer data terminals, electronic mail and other office-of-the-future media applications.

The serviceability and performance of the DES devices over the full six month period was exceptional. Not one occurrence of a failure attributable to the DES device was recorded. Such degree of serviceability exemplifies the value of microtechnology.

The trial confirmed anticipated difficulties in the physical security domain and highlighted the need in an environment where "sensitive" material will be handled, stored or transmitted to undertake in-depth and, perhaps, individual examination of physical security provisions such as: security storage of keying material; handling and disposition of keying variables; physical access to "sensitive" areas, and positive adminstrative control and supervision.

Briefings and Viewings

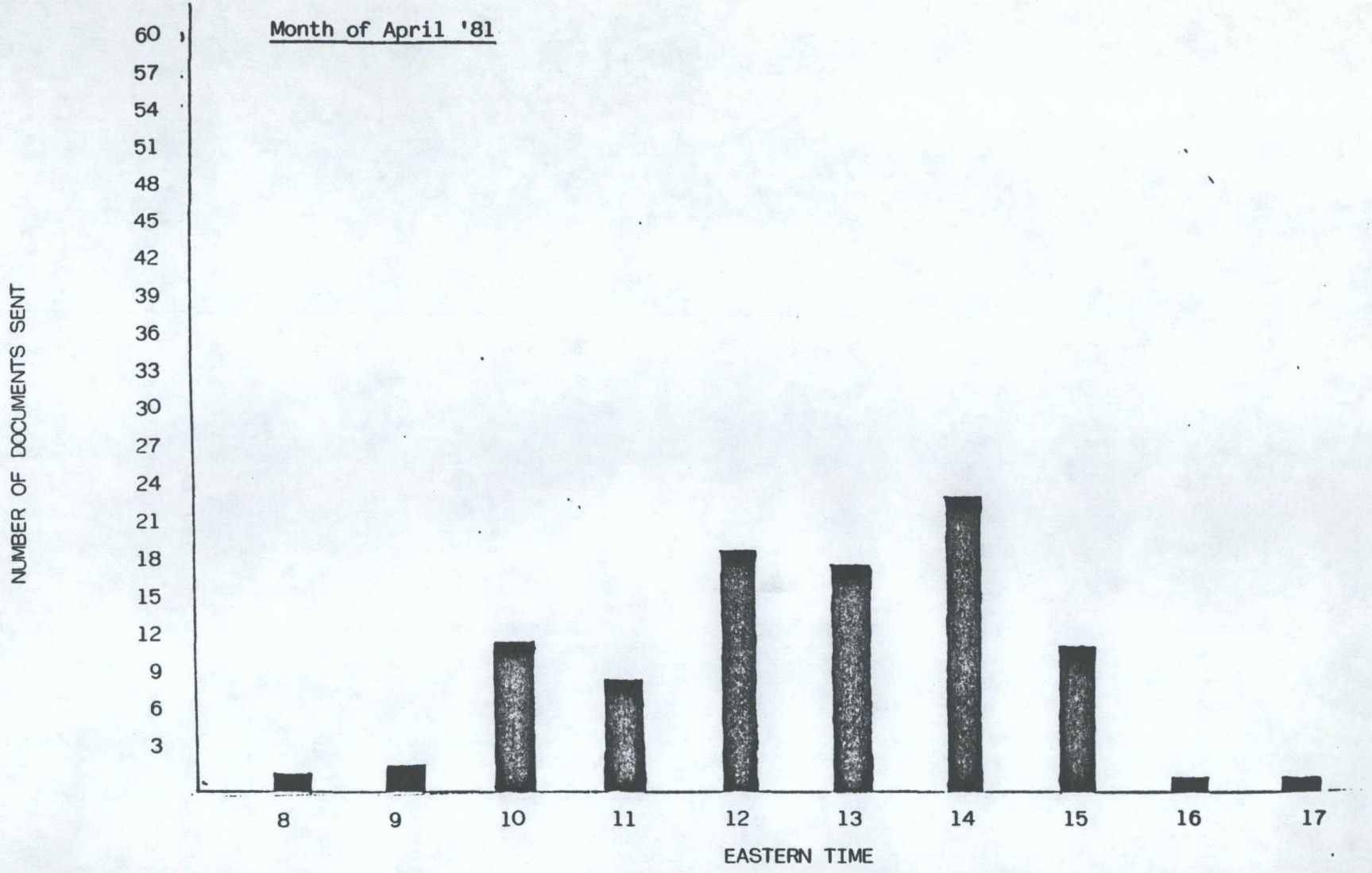
Throughout the period 29 March 1982 to 27 April 1982, detailed briefings and viewings were provided on the "protected" capability of the Ottawa CWP terminal. The briefings were attended by more than eighty personnel representing over 22 Federal Government departments or agencies. The capability of providing "protected" communications, at minimal expense, and in a "now" timeframe was particularly emphasized.

Conclusions - Secured Communication/DES Trial

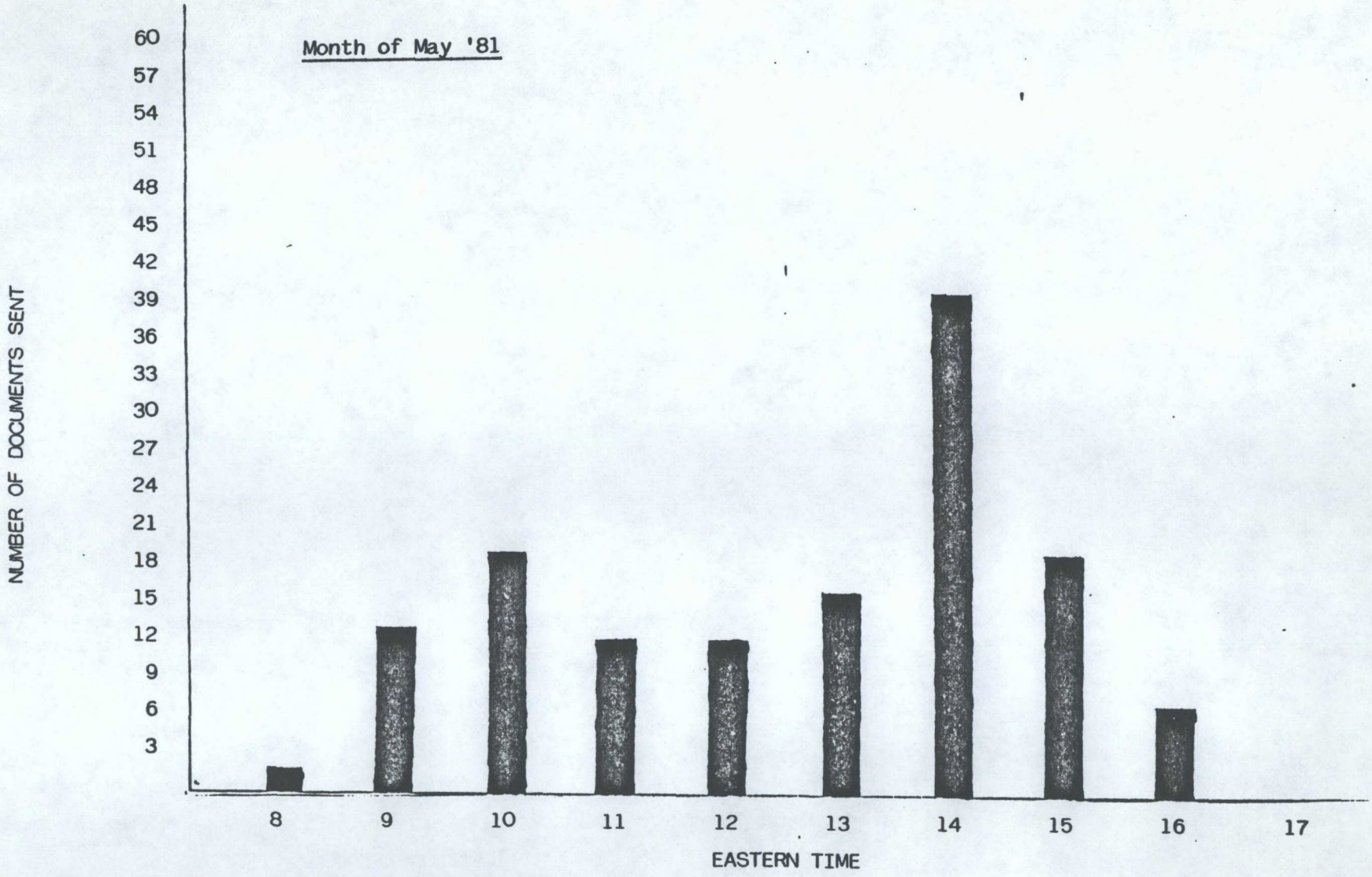
It is concluded that the trial satisfied established objectives. It was completely successful in demonstrating the feasibility of a CWP/DES interface with transparent performance. It highlighted areas which must be addressed and solved in regard to physical security and it provided a worthwhile vehicle for demonstrations to security responsible staff of DOC client departments.

# APPENDIX I

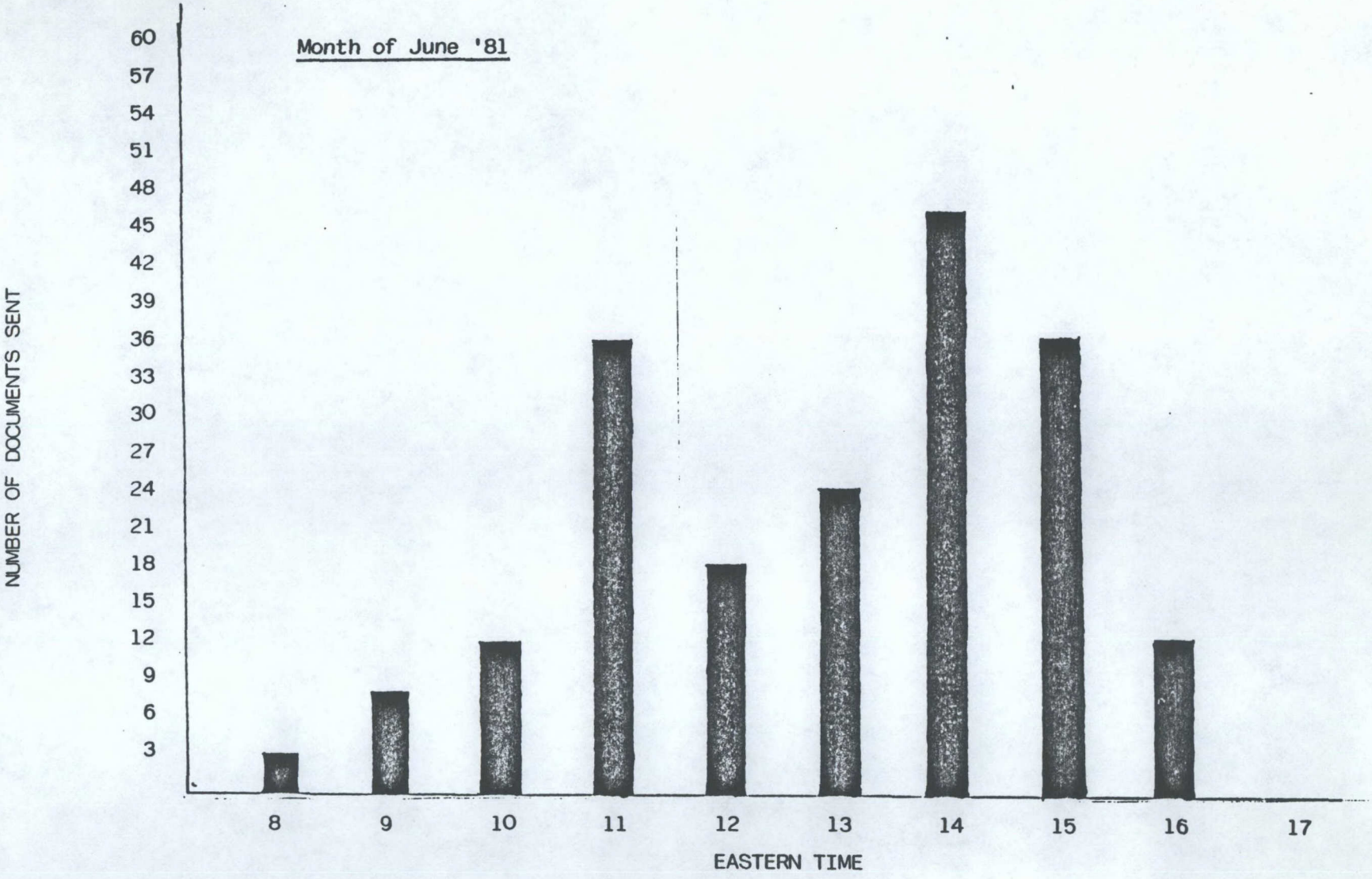
## NETWORK USAGE STATISTICS




TRANSMISSION OF DCCUMENTS BY
TIME OF DAY




TRANSMISSION OF DCCUMENTS BY
TIME OF DAY




TRANSMISSION OF DCCUMENTS BY
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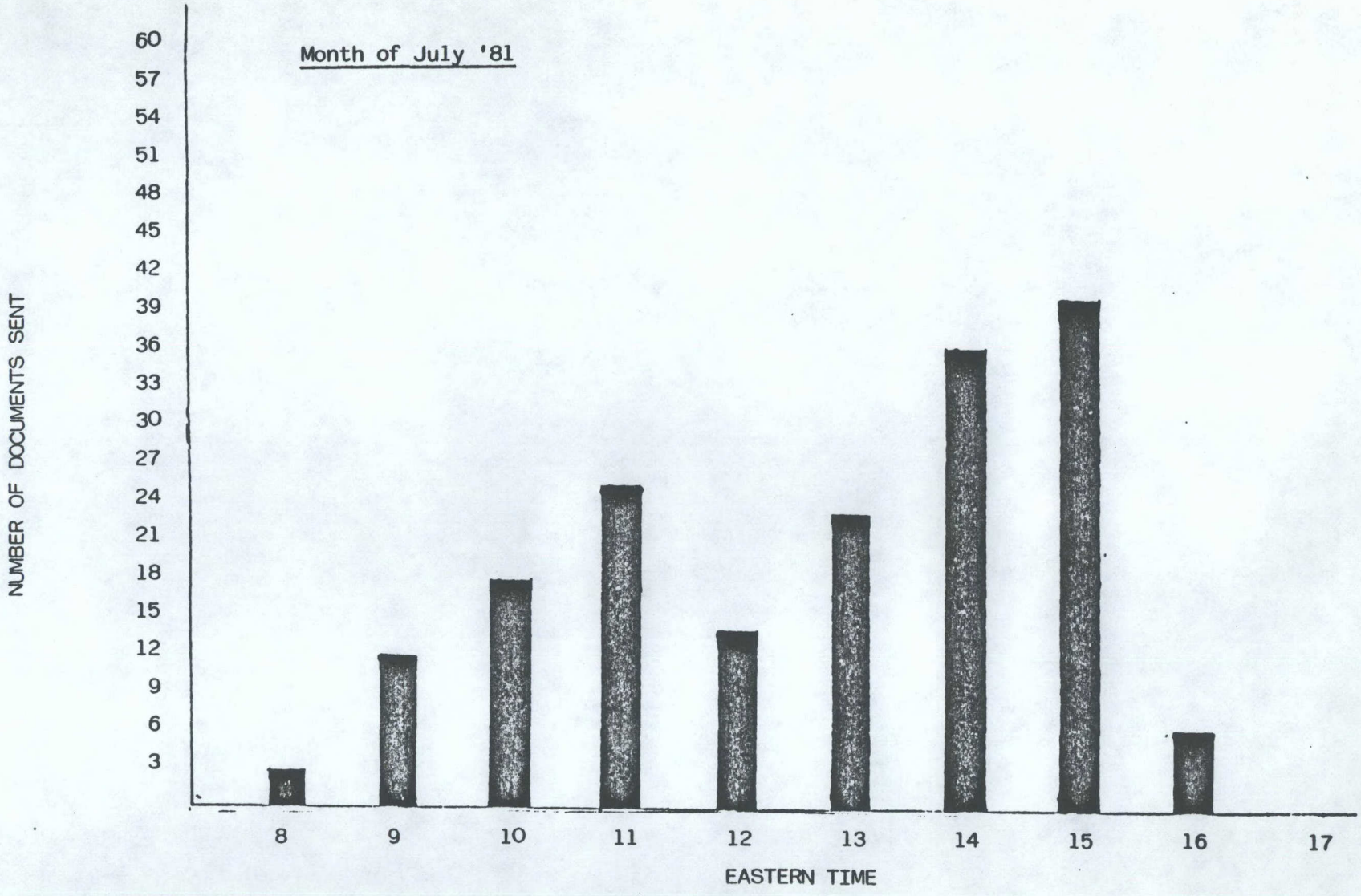


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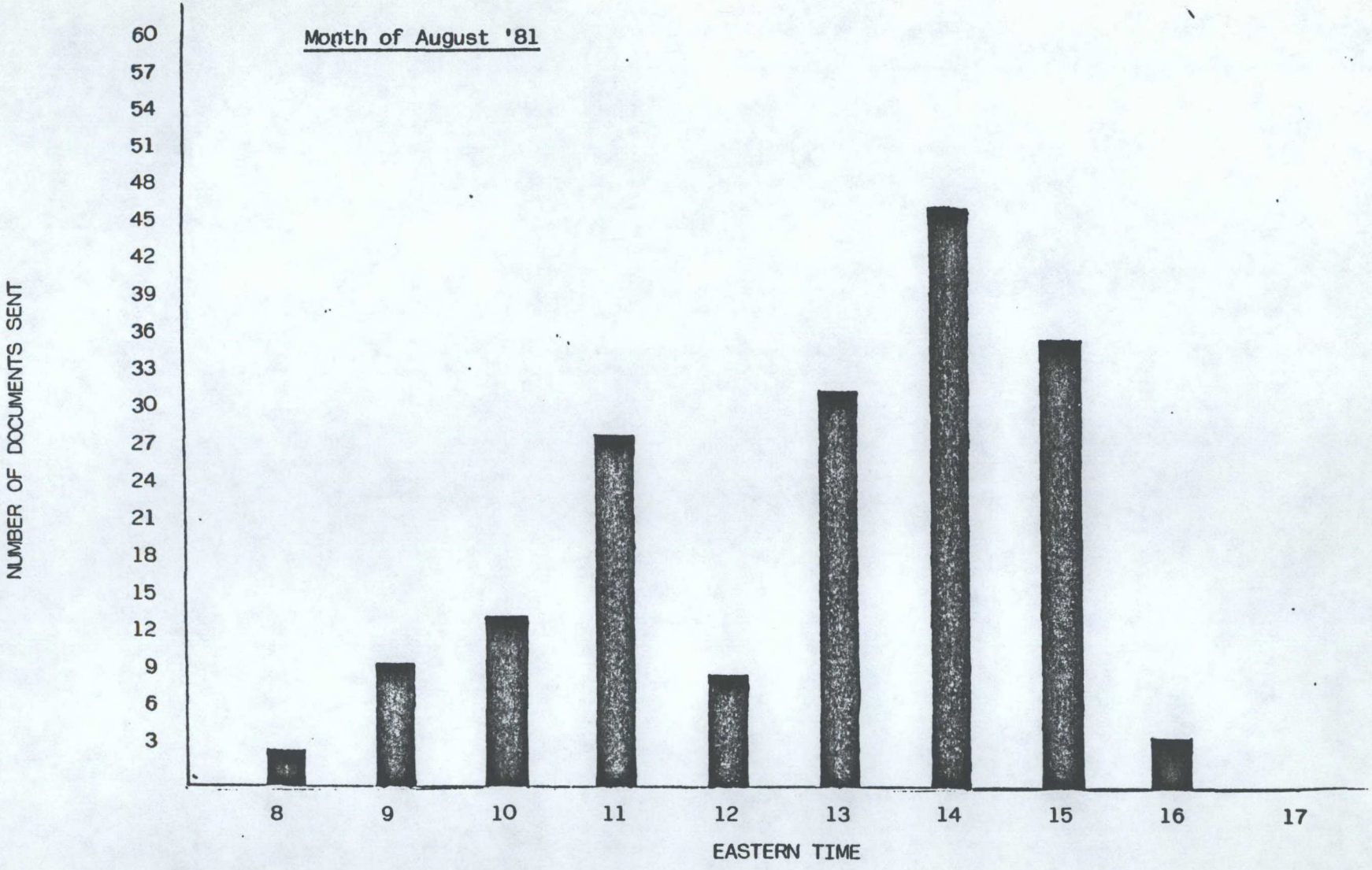
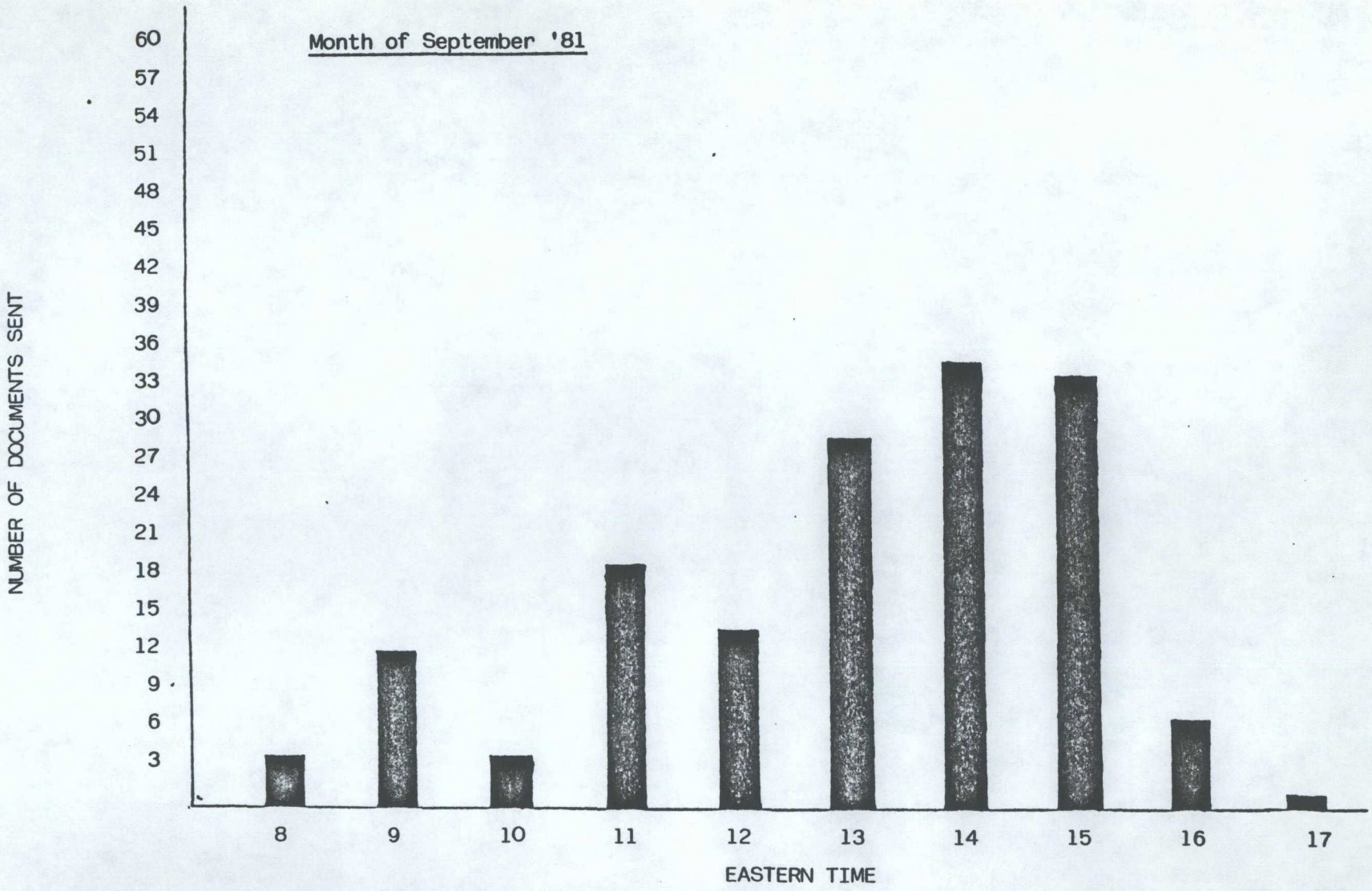



TRANSMISSION OF DCCUMENTS BY
TIME OF DAY

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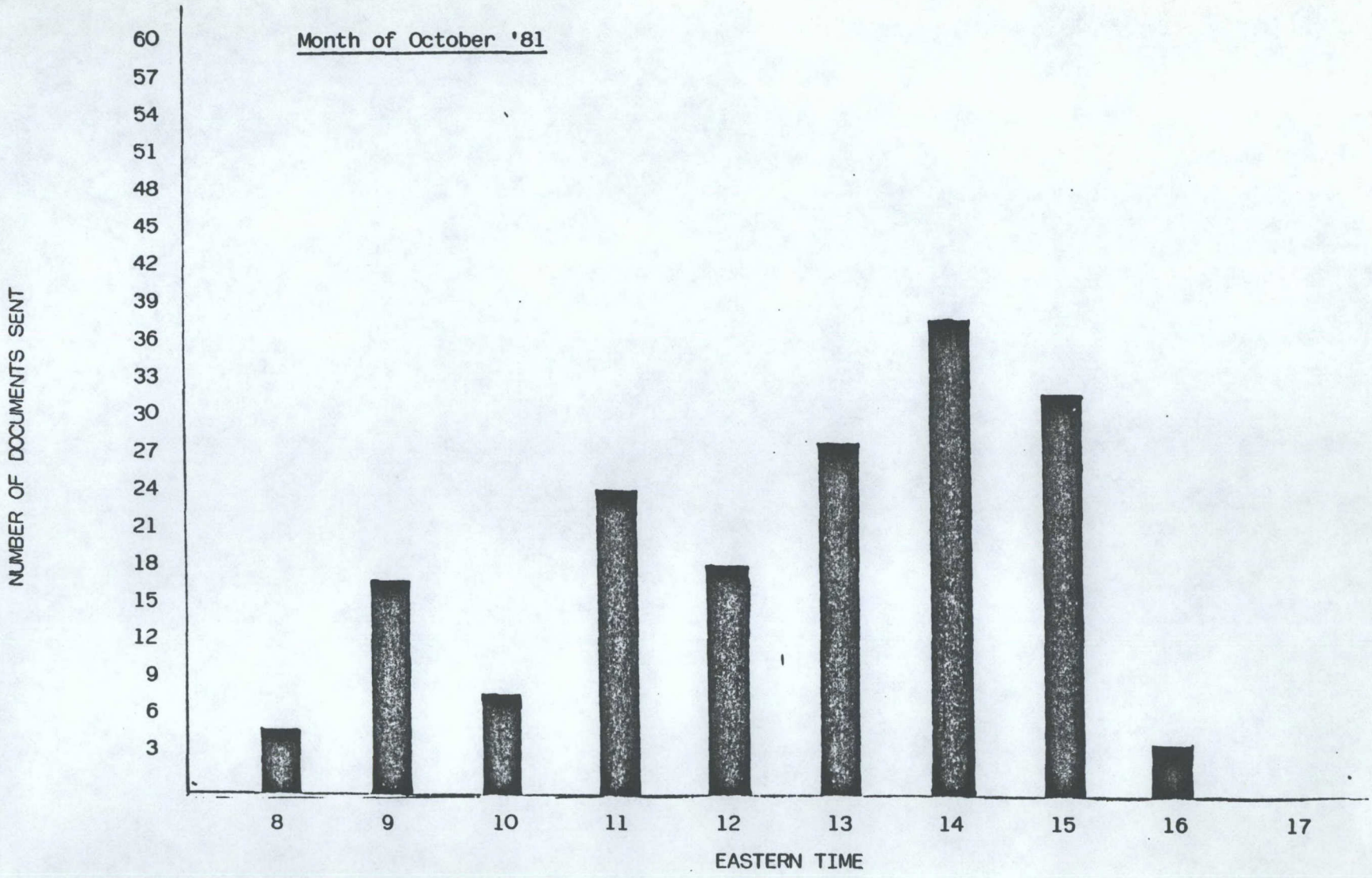
TIME OF DAY

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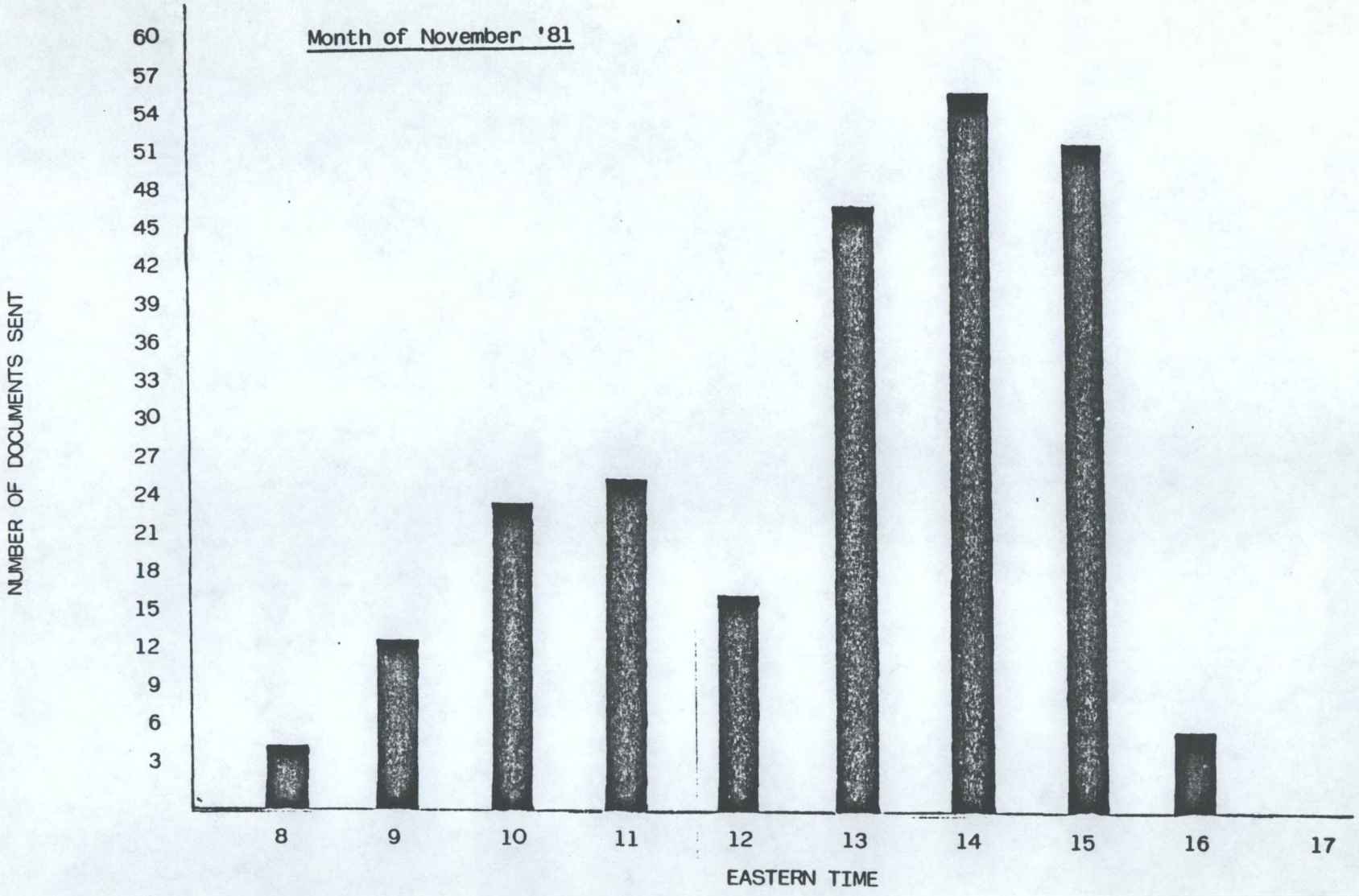
TIME OF DAY

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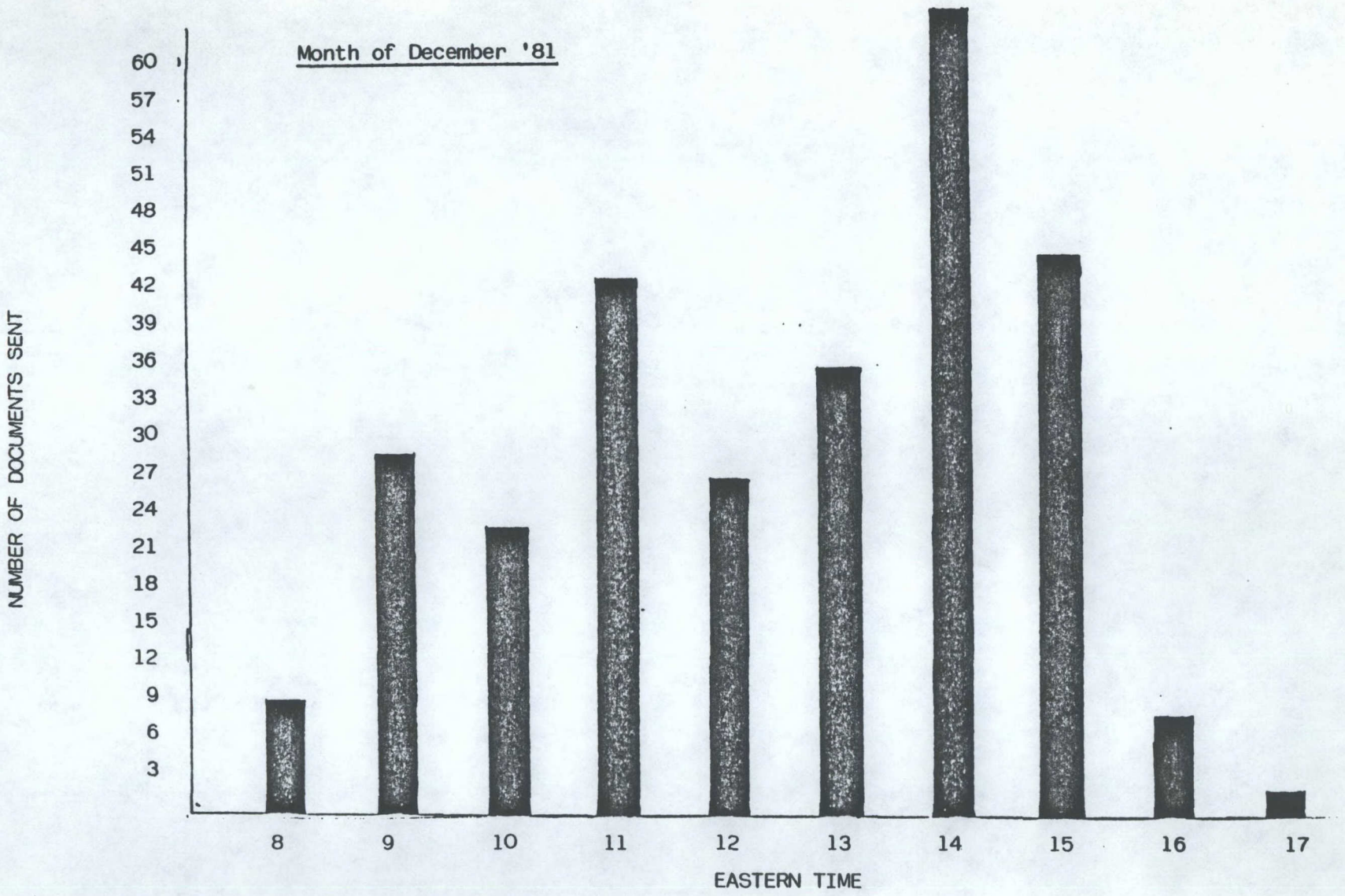


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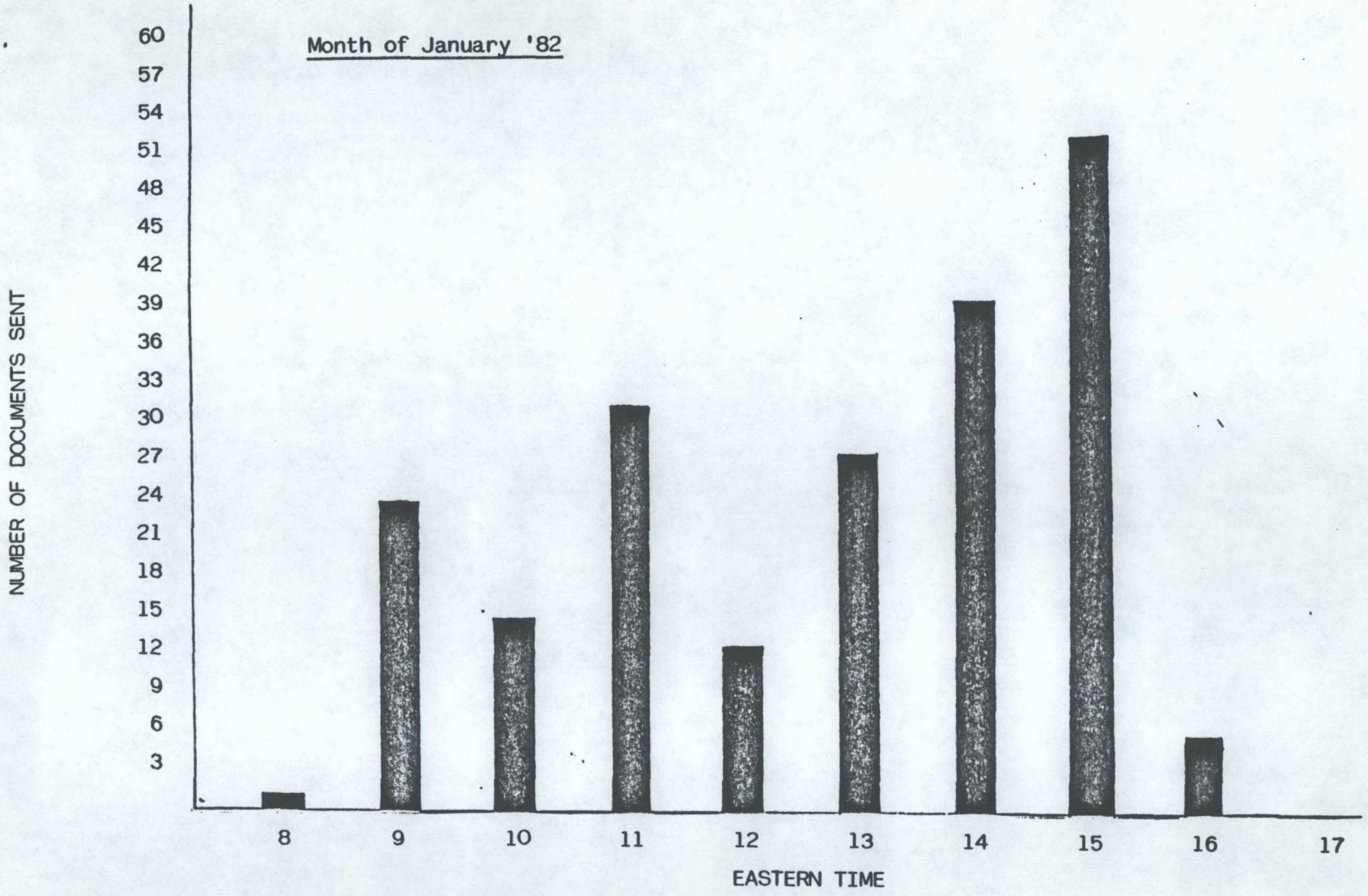
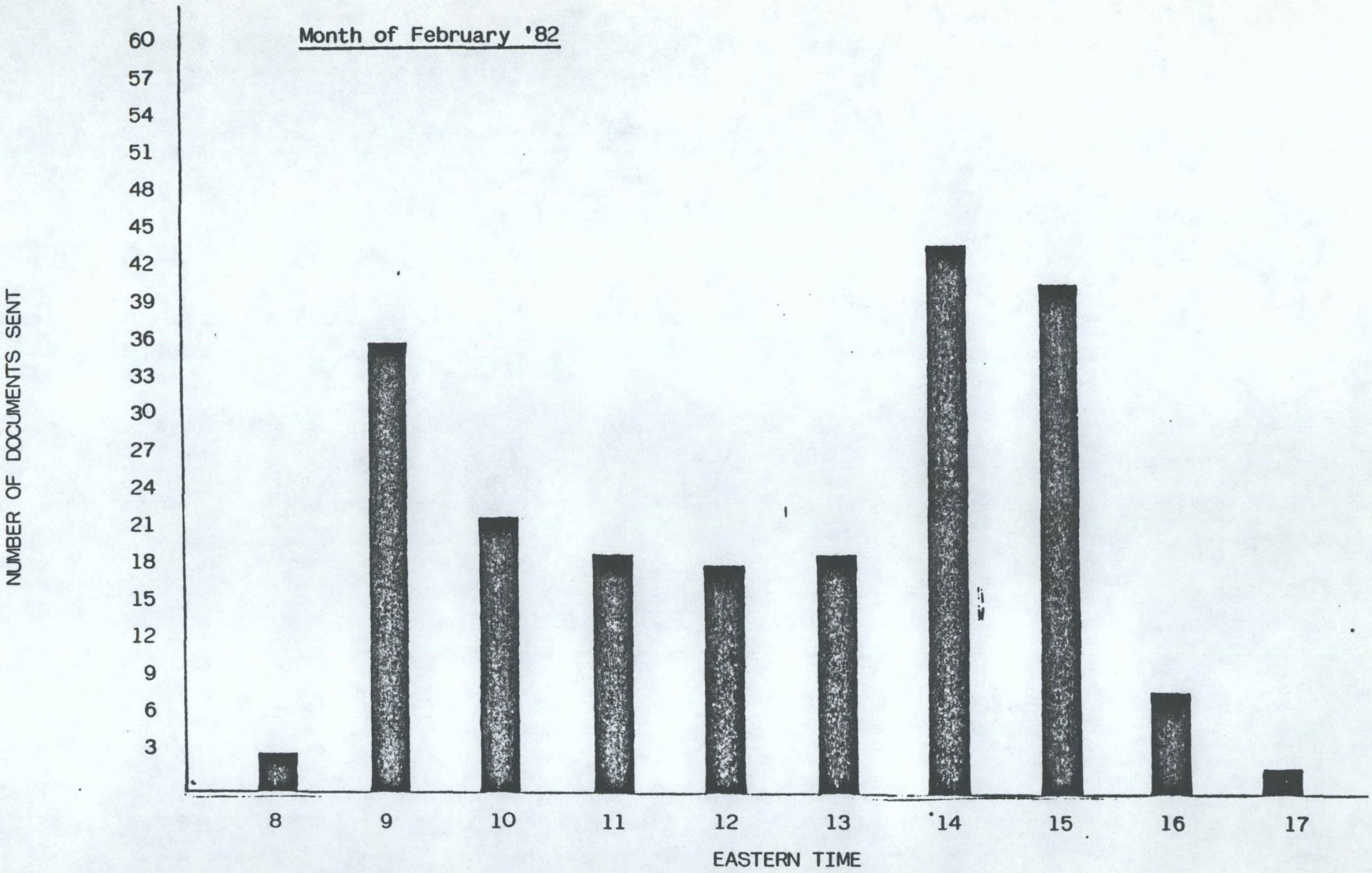
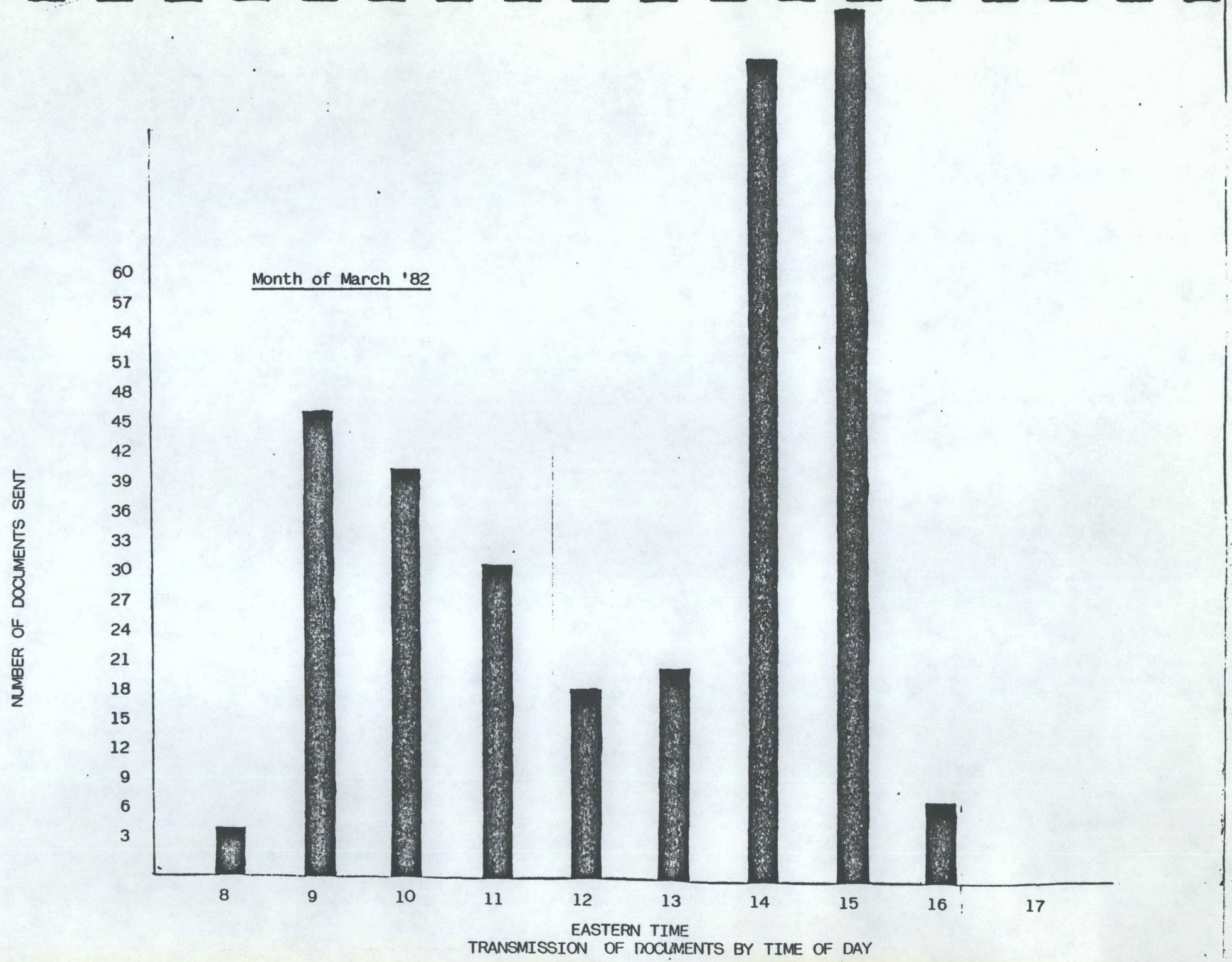
TIME OF DAY



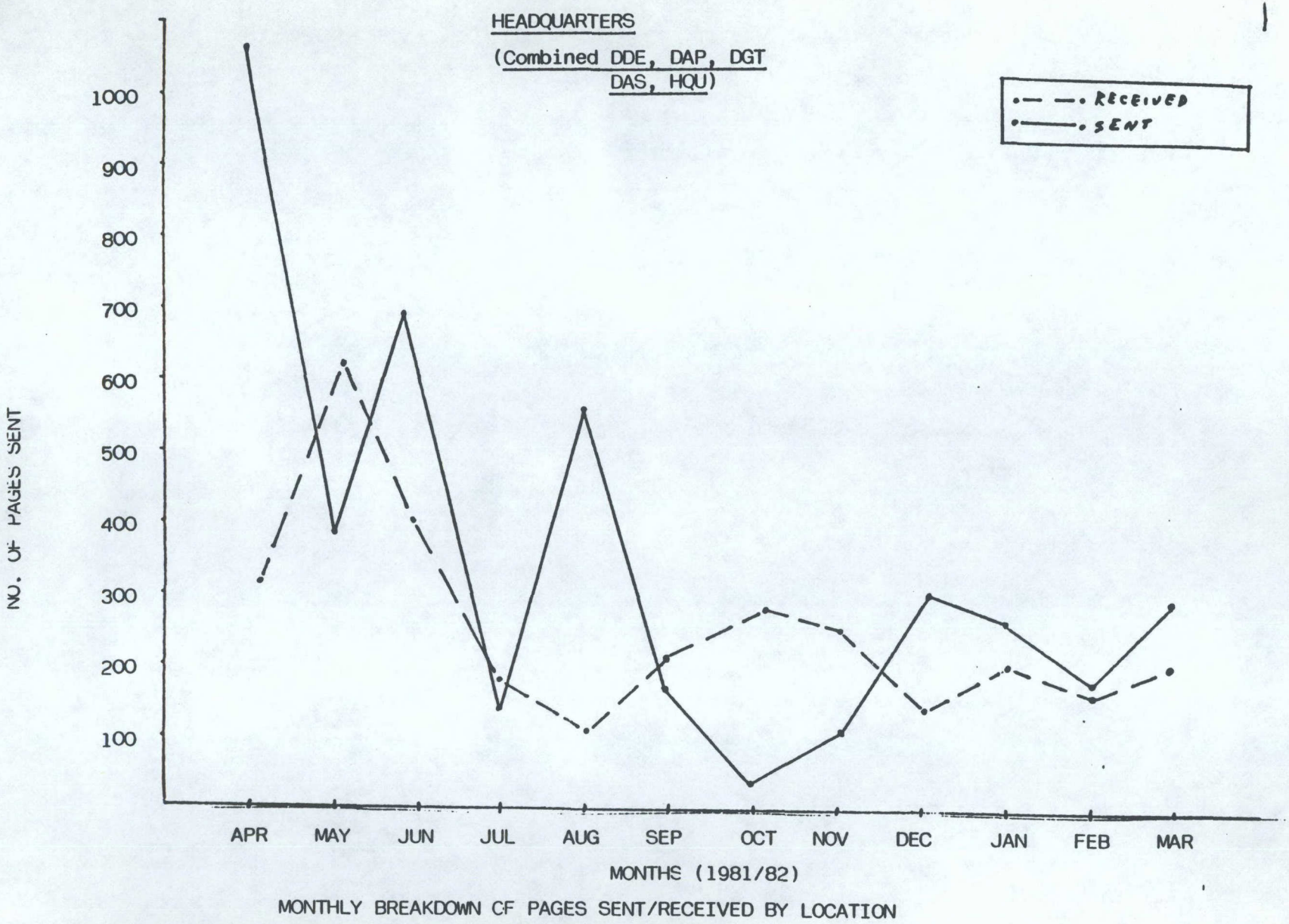

TRANSMISSION OF DCCUMENTS BY
TIME OF DAY



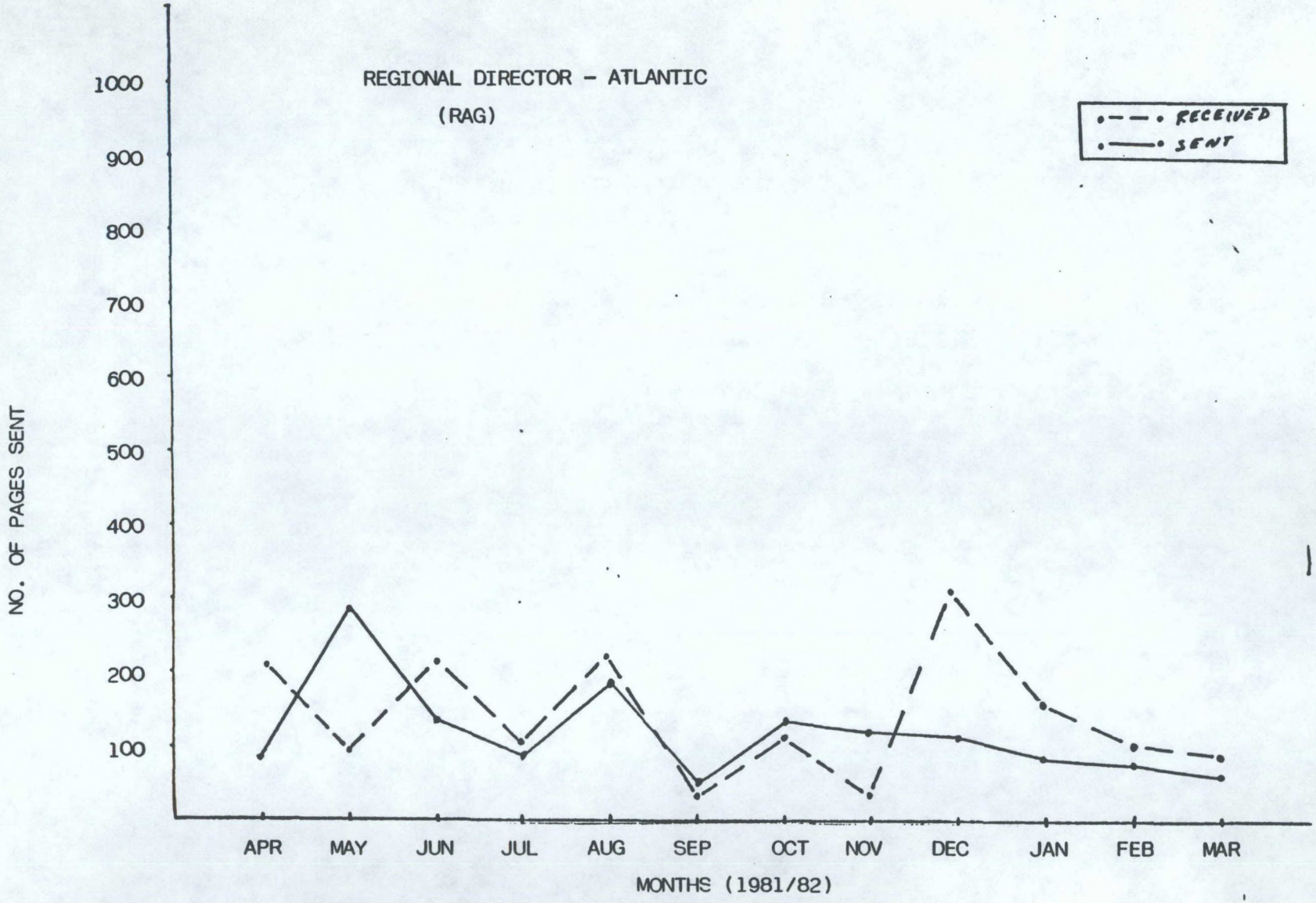

TRANSMISSION OF DCCUMENTS BY
TIME OF DAY




TRANSMISSION OF DOCUMENTS BY TIME OF DAY




MONTHLY BREAKDOWN OF PAGES SENT/RECEIVED BY LOCATION

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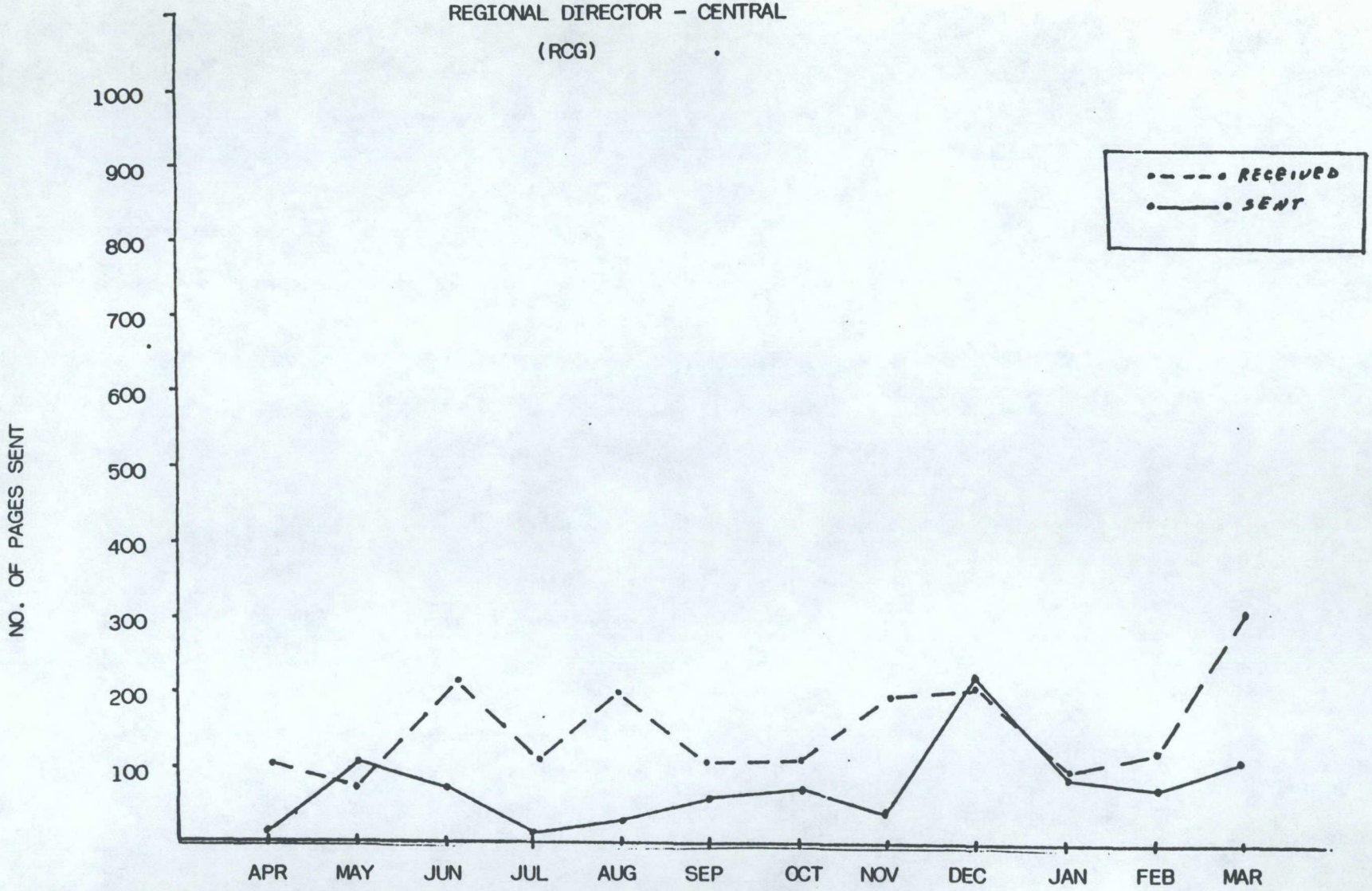
REGIONAL DIRECTOR - CENTRAL

(RCG)

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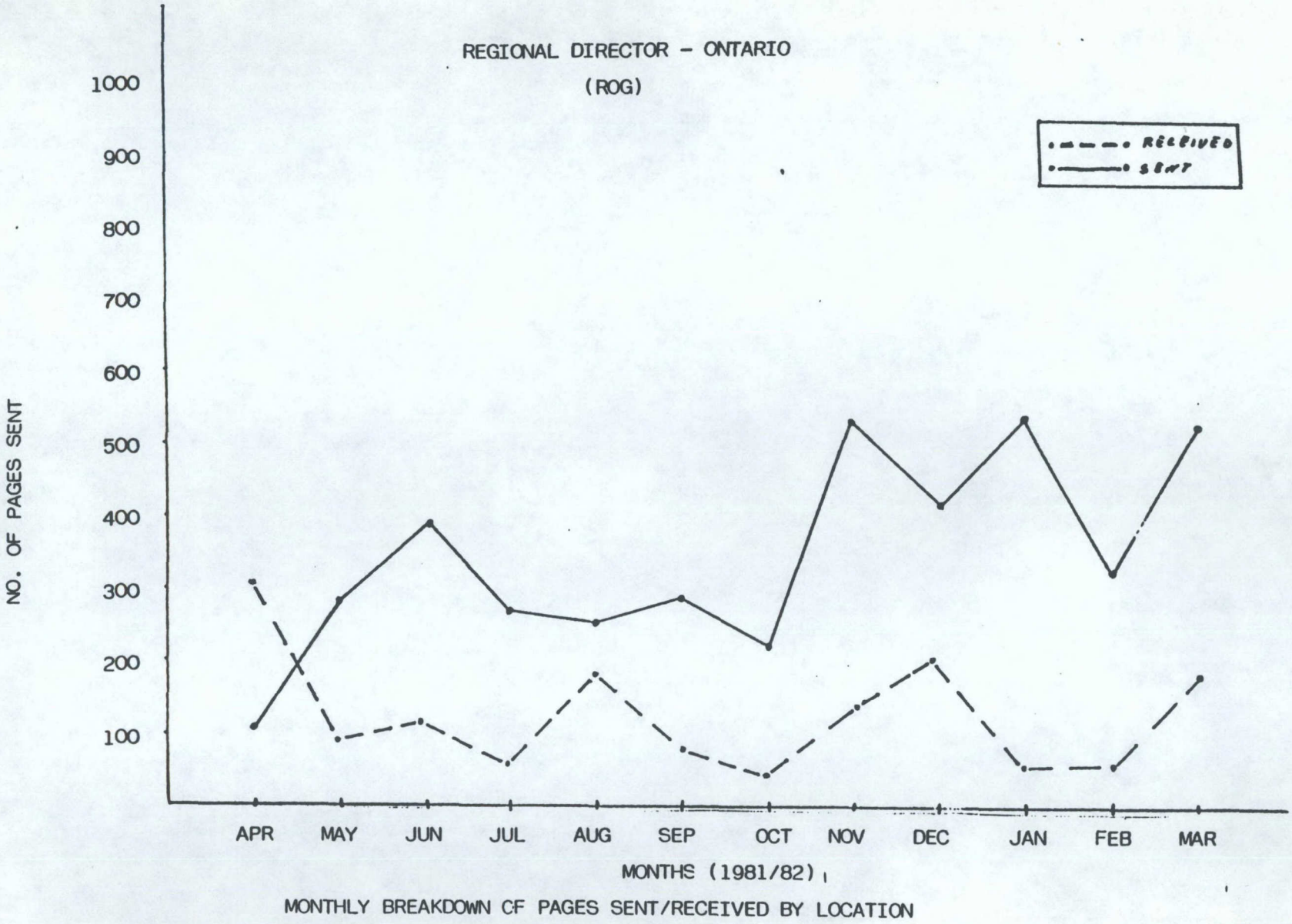


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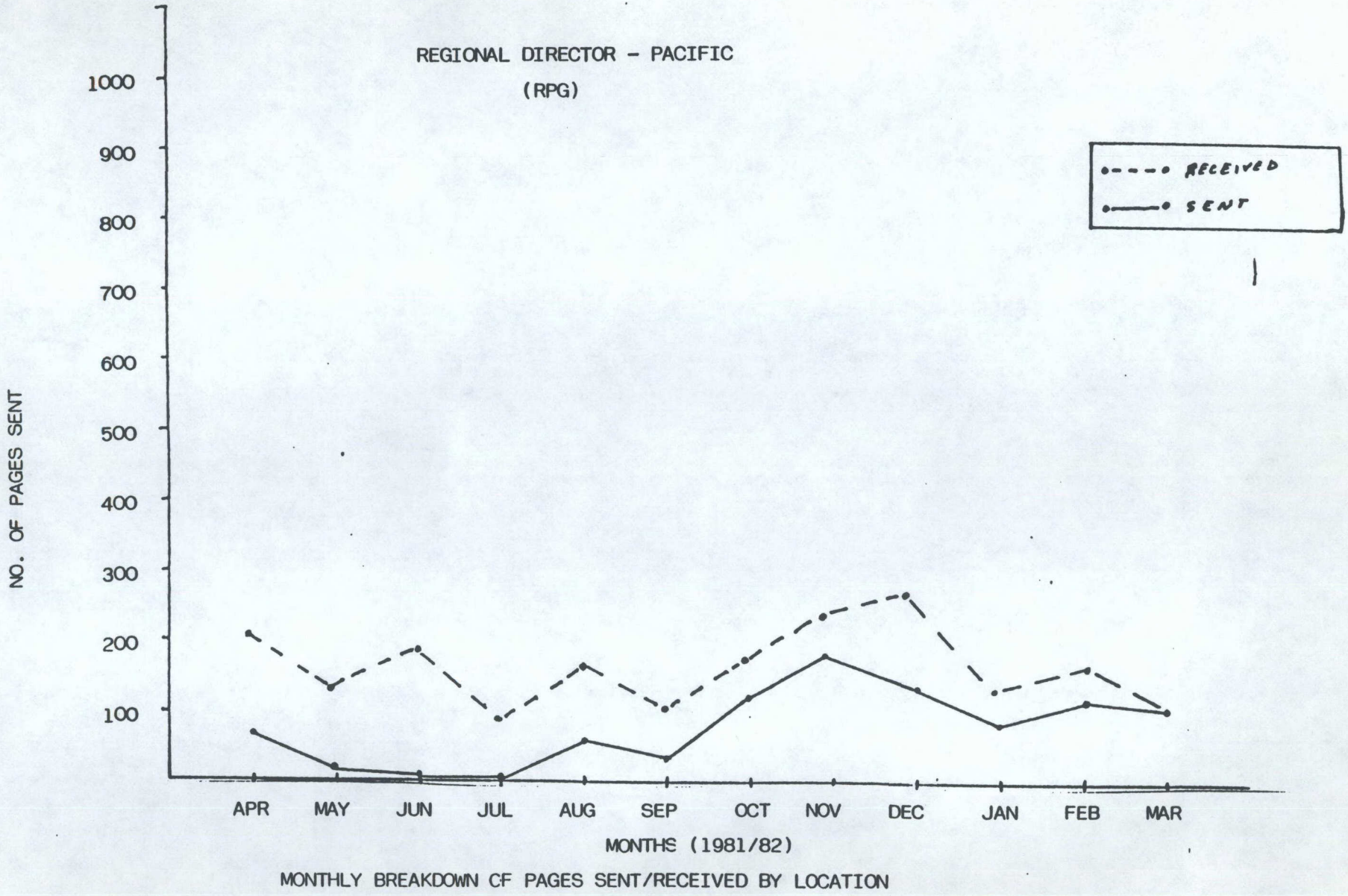


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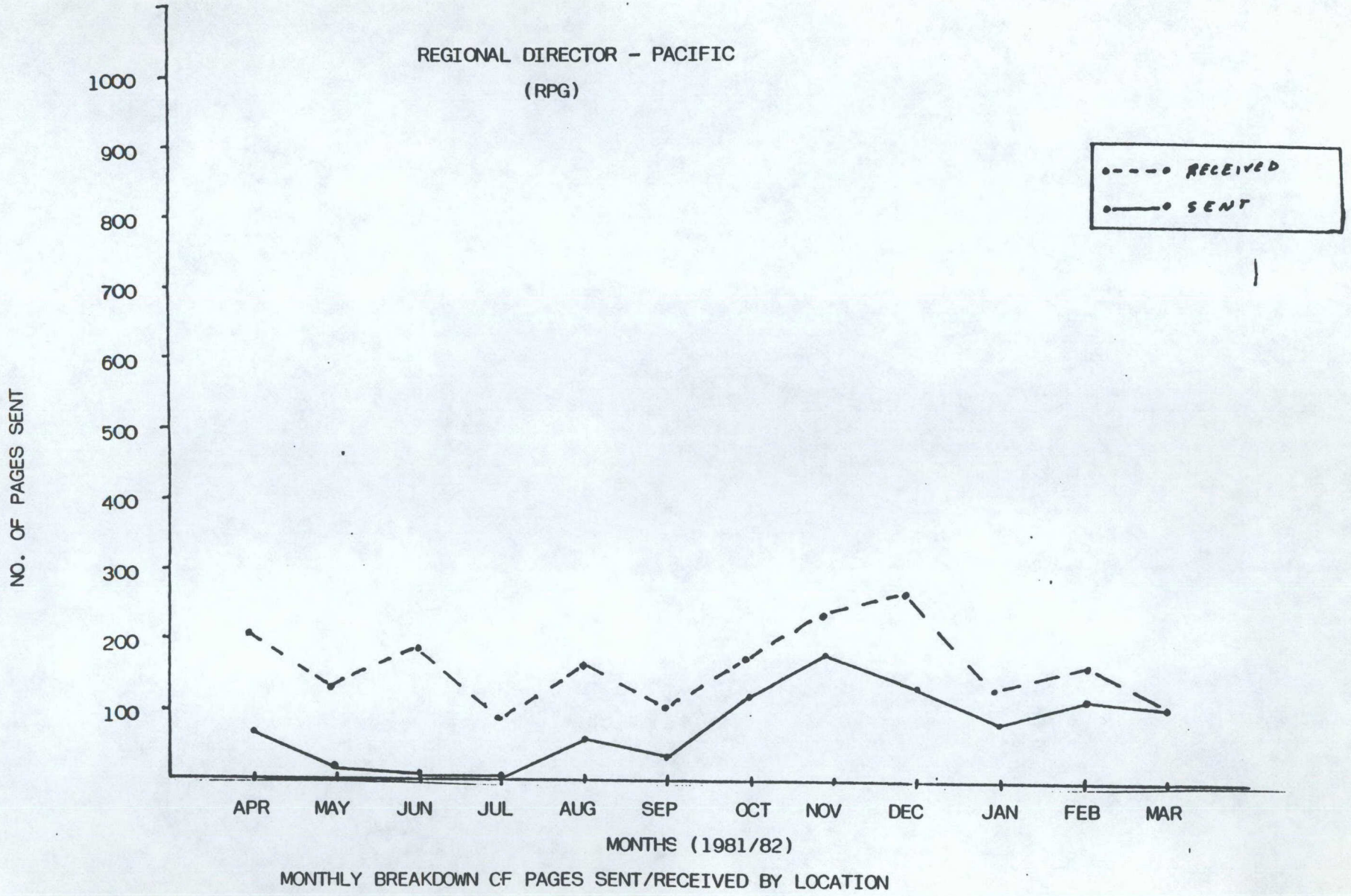


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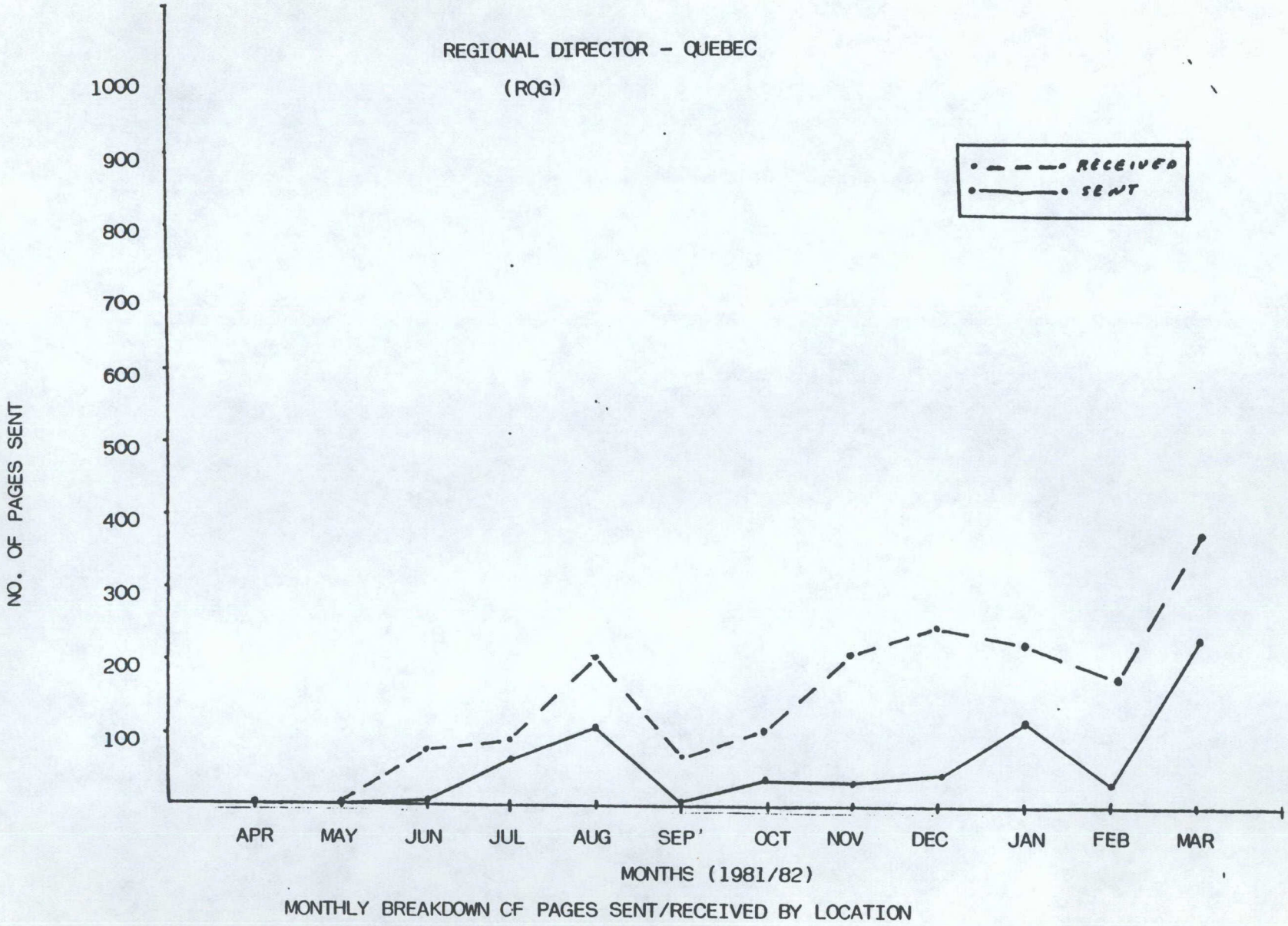



MONTHLY BREAKDOWN CF PAGES SENT/RECEIVED BY LOCATION

TRAFFIC MATRIX

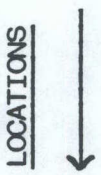
# OF PAGES REC'D FROM

EACH LOCATION TO REMOTE LOCATIONS

LEGEND FOR ENCLOSED DATA:-

REMOTE LOCATIONS

LOCATIONS



FROM APRIL 81 TO MARCH 82

MONTH= APRIL 1981

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| RDP | 0 | 0 | 5 | 3 | 4 | 10 | 59 | 8 | 0 | 118 | 0 | 207 |
| RDC | 0 | 0 | 8 | 0 | 4 | 83 | 1 | 18 | 0 | 0 | 0 | 114 |
| RDO | 1 | 2 | 0 | 0 | 7 | 199 | 58 | 37 | 5 | 0 | 0 | 309 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| RDA | 0 | 0 | 5 | 0 | 0 | 79 | 26 | 6 | 0 | 88 | 4 | 208 |
| DDE | 4 | 9 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| DAP | 0 | 5 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 |
| DGT | 0 | 0 | 9 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| DAS | 0 | 0 | 22 | 209 | 8 | 0 | 0 | 0 | 0 | 0 | 1 | 240 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= MAY 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 8 | 11 | 2 | 3 | 54 | 54 | 0 | 16 | 0 | 0 | 148 |
| RDC | 0 | 0 | 25 | 0 | 44 | 2 | 0 | 0 | 1 | 0 | 0 | 72 |
| RDO | 0 | 0 | 0 | 2 | 57 | 14 | 24 | 0 | 0 | 0 | 0 | 97 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| RDA | 8 | 0 | 14 | 2 | 0 | 21 | 32 | 1 | 11 | 8 | 0 | 97 |
| DDE | 0 | 0 | 11 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| DAP | 4 | 0 | 165 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 171 |
| DGT | 1 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| DAS | 10 | 53 | 102 | 190 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 440 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= JUNE 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 58 | 0 | 0 | 115 | 9 | 2 | 2 | 0 | 13 | 199 |
| RDC | 0 | 0 | 72 | 0 | 3 | 109 | 7 | 36 | 9 | 0 | 0 | 236 |
| RDO | 0 | 12 | 0 | 0 | 6 | 73 | 3 | 32 | 0 | 0 | 6 | 132 |
| RDQ | 0 | 0 | 43 | 0 | 0 | 13 | 2 | 7 | 6 | 0 | 4 | 75 |
| RDA | 0 | 0 | 19 | 0 | 0 | 151 | 45 | 8 | 0 | 0 | 0 | 223 |
| DDE | 0 | 0 | 59 | 4 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 148 |
| DAP | 7 | 2 | 34 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 69 |
| DGT | 5 | 10 | 15 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| DAS | 6 | 4 | 96 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 138 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= JULY 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 29 | 15 | 9 | 8 | 12 | 1 | 0 | 5 | 19 | 98 |
| RDC | 0 | 0 | 61 | 0 | 9 | 1 | 10 | 6 | 23 | 12 | 0 | 122 |
| RDO | 0 | 2 | 0 | 15 | 11 | 16 | 4 | 6 | 0 | 5 | 1 | 60 |
| RDQ | 0 | 0 | 28 | 0 | 7 | 7 | 15 | 1 | 0 | 24 | 0 | 82 |
| RDA | 0 | 0 | 26 | 15 | 0 | 7 | 22 | 10 | 0 | 55 | 3 | 138 |
| DDE | 0 | 0 | 19 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| DAP | 7 | 2 | 48 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 89 |
| DGT | 4 | 5 | 30 | 3 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 58 |
| DAS | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= AUGUST 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 1 | 43 | 0 | 19 | 75 | 31 | 7 | 9 | 0 | 11 | 196 |
| RDC | 4 | 0 | 41 | 22 | 29 | 79 | 21 | 7 | 16 | 0 | 9 | 228 |
| RDO | 4 | 1 | 1 | 23 | 37 | 75 | 30 | 3 | 0 | 0 | 13 | 187 |
| RDQ | 4 | 1 | 30 | 0 | 28 | 80 | 35 | 7 | 0 | 0 | 24 | 209 |
| RDA | 10 | 13 | 44 | 7 | 0 | 80 | 35 | 8 | 0 | 0 | 23 | 220 |
| DDE | 0 | 0 | 11 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| DAP | 9 | 5 | 7 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |
| DGT | 15 | 1 | 31 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 51 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 14 |

MONTH= SEPTEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 9 | 11 | 0 | 28 | 0 | 29 | 10 | 0 | 0 | 28 | 115 |
| RDC | 2 | 0 | 44 | 0 | 8 | 3 | 12 | 9 | 0 | 0 | 27 | 105 |
| RDO | 0 | 12 | 0 | 0 | 9 | 0 | 49 | 1 | 0 | 0 | 9 | 80 |
| RDQ | 0 | 7 | 19 | 0 | 8 | 0 | 29 | 1 | 0 | 0 | 9 | 73 |
| RDA | 4 | 0 | 27 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 37 |
| DDE | 0 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| DAP | 43 | 24 | 96 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 170 |
| DGT | 4 | 2 | 14 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

MONTH= OCTOBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 16 | 72 | 2 | 8 | 3 | 6 | 23 | 0 | 0 | 43 | 173 |
| RDC | 5 | 0 | 26 | 2 | 12 | 0 | 5 | 5 | 4 | 0 | 66 | 125 |
| RDO | 27 | 4 | 0 | 2 | 4 | 0 | 2 | 1 | 6 | 0 | 0 | 46 |
| RDQ | 3 | 4 | 67 | 0 | 8 | 0 | 2 | 1 | 0 | 0 | 44 | 129 |
| RDA | 6 | 0 | 42 | 2 | 0 | 0 | 27 | 1 | 0 | 0 | 54 | 132 |
| DDE | 0 | 0 | 25 | 4 | 6 | 0 | 0 | 0 | 0 | 0 | 4 | 39 |
| DAP | 36 | 13 | 62 | 13 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 163 |
| DGT | 22 | 12 | 33 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 86 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |

MONTH= NOVEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 13 | 61 | 5 | 0 | 8 | 22 | 90 | 2 | 0 | 38 | 239 |
| RDC | 6 | 0 | 88 | 5 | 1 | 0 | 20 | 38 | 6 | 0 | 36 | 200 |
| RDO | 14 | 6 | 0 | 8 | 0 | 24 | 20 | 36 | 3 | 0 | 30 | 141 |
| RDQ | 7 | 3 | 87 | 0 | 0 | 0 | 23 | 34 | 25 | 0 | 34 | 213 |
| RDA | 7 | 3 | 22 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 3 | 40 |
| DDE | 0 | 0 | 29 | 7 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| DAP | 51 | 19 | 97 | 2 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 206 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

MONTH= DECEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 9 | 81 | 17 | 16 | 0 | 63 | 24 | 13 | 0 | 48 | 271 |
| RDC | 10 | 5 | 58 | 13 | 6 | 15 | 55 | 18 | 0 | 0 | 48 | 228 |
| RDO | 20 | 37 | 0 | 19 | 1 | 0 | 60 | 17 | 7 | 0 | 53 | 214 |
| RDQ | 13 | 36 | 57 | 0 | 1 | 3 | 70 | 21 | 0 | 0 | 49 | 250 |
| RDA | 28 | 32 | 47 | 13 | 0 | 16 | 53 | 17 | 0 | 0 | 103 | 309 |
| DDE | 17 | 0 | 17 | 7 | 9 | 0 | 0 | 0 | 0 | 0 | 5 | 55 |
| DAP | 11 | 21 | 61 | 4 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 118 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

MONTH= JANUARY 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 2 | 84 | 0 | 0 | 0 | 30 | 11 | 1 | 0 | 4 | 132 |
| RDC | 5 | 0 | 71 | 0 | 0 | 0 | 21 | 3 | 6 | 0 | 3 | 109 |
| RDO | 7 | 2 | 0 | 0 | 2 | 25 | 24 | 2 | 6 | 0 | 2 | 70 |
| RDQ | 5 | 2 | 70 | 0 | 39 | 0 | 82 | 1 | 0 | 0 | 40 | 239 |
| RDA | 5 | 0 | 75 | 0 | 0 | 2 | 49 | 3 | 0 | 0 | 19 | 153 |
| DDE | 0 | 0 | 68 | 4 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 97 |
| DAP | 5 | 12 | 73 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 |

MONTH= FEBRUARY 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 3 | 36 | 0 | 0 | 0 | 19 | 67 | 2 | 0 | 27 | 154 |
| RDC | 1 | 0 | 44 | 12 | 1 | 0 | 14 | 10 | 3 | 0 | 53 | 138 |
| RDO | 0 | 3 | 0 | 13 | 0 | 2 | 6 | 31 | 9 | 0 | 8 | 72 |
| RDQ | 0 | 18 | 41 | 0 | 0 | 0 | 22 | 83 | 0 | 0 | 18 | 182 |
| RDA | 0 | 0 | 22 | 0 | 0 | 0 | 24 | 32 | 0 | 0 | 21 | 99 |
| DDE | 0 | 0 | 45 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 79 |
| DAP | 2 | 25 | 24 | 36 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 93 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

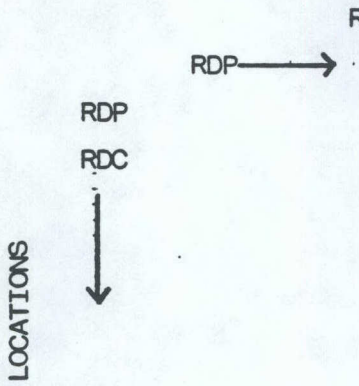
MONTH= MARCH 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 13 | 9 | 5 | 37 | 1 | 40 | 0 | 0 | 3 | 108 |
| RDC | 17 | 0 | 88 | 40 | 5 | 0 | 23 | 0 | 4 | 0 | 133 | 310 |
| RDO | 14 | 6 | 0 | 32 | 5 | 0 | 36 | 79 | 0 | 0 | 24 | 196 |
| RDQ | 14 | 9 | 74 | 0 | 14 | 0 | 59 | 17 | 0 | 0 | 197 | 384 |
| RDA | 12 | 3 | 22 | 0 | 0 | 0 | 29 | 6 | 13 | 0 | 7 | 92 |
| DDE | 0 | 0 | 33 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| DAP | 20 | 22 | 56 | 20 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 146 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

TRAFFIC MATRIX

# OF PAGES SENT FROM

EACH LOCATION TO REMOTE LOCATIONS




FROM APRIL 81 TO MARCH 82

MONTH= APRIL 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 67 | 0 | 68 |
| RDC | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |
| RDO | 5 | 8 | 0 | 11 | 11 | 9 | 49 | 2 | 1 | 0 | 9 | 105 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| RDA | 9 | 6 | 9 | 15 | 0 | 3 | 0 | 1 | 2 | 35 | 0 | 80 |
| DDE | 59 | 59 | 190 | 59 | 88 | 0 | 0 | 0 | 0 | 0 | 32 | 487 |
| DAP | 59 | 23 | 62 | 72 | 128 | 0 | 0 | 7 | 1 | 0 | 0 | 352 |
| DGT | 176 | 7 | 16 | 6 | 6 | 0 | 0 | 0 | 1 | 0 | 0 | 212 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= MAY 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 3 | 0 | 8 | 0 | 4 | 0 | 2 | 0 | 3 | 20 |
| RDC | 2 | 0 | 30 | 2 | 56 | 3 | 0 | 0 | 17 | 0 | 0 | 110 |
| RDO | 17 | 40 | 0 | 21 | 22 | 9 | 107 | 6 | 66 | 0 | 0 | 288 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| RDA | 9 | 67 | 57 | 65 | 0 | 7 | 9 | 0 | 68 | 0 | 0 | 282 |
| DDE | 55 | 3 | 13 | 17 | 13 | 0 | 0 | 0 | 0 | 0 | 3 | 104 |
| DAP | 62 | 13 | 22 | 35 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 185 |
| DGT | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 | 72 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= JUNE 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 6 | 0 | 4 | 13 |
| RDC | 0 | 0 | 9 | 0 | 0 | 40 | 5 | 9 | 11 | 0 | 0 | 74 |
| RDO | 58 | 73 | 0 | 57 | 55 | 58 | 18 | 18 | 49 | 2 | 11 | 399 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 4 |
| RDA | 3 | 10 | 9 | 3 | 0 | 51 | 32 | 17 | 16 | 0 | 0 | 141 |
| DDE | 111 | 112 | 102 | 84 | 173 | 0 | 0 | 0 | 0 | 0 | 0 | 582 |
| DAP | 7 | 7 | 2 | 7 | 10 | 0 | 0 | 0 | 1 | 0 | 0 | 34 |
| DGT | 5 | 32 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 8 | 0 | 51 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= JULY 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 3 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 11 |
| RDC | 0 | 0 | 5 | 0 | 0 | 0 | 2 | 4 | 7 | 0 | 0 | 18 |
| RDO | 33 | 80 | 0 | 29 | 29 | 16 | 44 | 29 | 6 | 0 | 8 | 274 |
| RDQ | 15 | 0 | 15 | 1 | 15 | 4 | 15 | 0 | 0 | 0 | 0 | 65 |
| RDA | 9 | 9 | 11 | 9 | 0 | 0 | 21 | 16 | 11 | 0 | 5 | 91 |
| DDE | 9 | 7 | 18 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 48 |
| DAP | 17 | 12 | 12 | 15 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 77 |
| DGT | 0 | 5 | 6 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= AUGUST 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 4 | 7 | 19 | 4 | 0 | 9 | 13 | 0 | 0 | 10 | 66 |
| RDC | 1 | 0 | 2 | 1 | 20 | 0 | 4 | 1 | 5 | 0 | 1 | 35 |
| RDO | 51 | 55 | 0 | 30 | 31 | 11 | 7 | 30 | 25 | 0 | 17 | 257 |
| RDQ | 22 | 22 | 22 | 0 | 15 | 6 | 15 | 0 | 0 | 0 | 5 | 107 |
| RDA | 55 | 29 | 34 | 36 | 0 | 5 | 2 | 4 | 29 | 0 | 0 | 194 |
| DDE | 75 | 75 | 75 | 75 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 375 |
| DAP | 31 | 25 | 30 | 35 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 156 |
| DGT | 7 | 7 | 5 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 4 | 4 | 4 | 4 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 21 |

MONTH= SEPTEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 0 | 0 | 0 | 4 | 0 | 35 | 0 | 2 | 0 | 0 | 41 |
| RDC | 7 | 0 | 12 | 7 | 7 | 0 | 25 | 2 | 7 | 0 | 0 | 67 |
| RDO | 17 | 30 | 0 | 19 | 28 | 6 | 119 | 18 | 11 | 0 | 49 | 297 |
| RDQ | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| RDA | 11 | 14 | 3 | 5 | 0 | 0 | 12 | 8 | 3 | 0 | 0 | 56 |
| DDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAP | 29 | 29 | 49 | 29 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 165 |
| DGT | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= OCTOBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 3 | 2 | 3 | 2 | 0 | 28 | 73 | 17 | 0 | 1 | 129 |
| RDC | 7 | 0 | 22 | 4 | 5 | 0 | 11 | 7 | 15 | 0 | 1 | 72 |
| RDO | 44 | 21 | 0 | 21 | 24 | 20 | 35 | 24 | 10 | 0 | 34 | 233 |
| RDQ | 2 | 2 | 2 | 0 | 2 | 4 | 13 | 3 | 2 | 0 | 13 | 43 |
| RDA | 7 | 8 | 6 | 8 | 0 | 6 | 39 | 33 | 38 | 0 | 0 | 145 |
| DDE | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| DAP | 2 | 2 | 2 | 2 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 36 |
| DGT | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

MONTH= NOVEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 7 | 20 | 8 | 7 | 0 | 51 | 75 | 13 | 0 | 0 | 181 |
| RDC | 3 | 0 | 3 | 3 | 3 | 0 | 18 | 9 | 9 | 0 | 0 | 48 |
| RDO | 96 | 84 | 0 | 77 | 87 | 30 | 95 | 18 | 22 | 0 | 31 | 540 |
| RDQ | 5 | 5 | 5 | 0 | 5 | 7 | 2 | 5 | 0 | 0 | 8 | 42 |
| RDA | 0 | 0 | 1 | 5 | 0 | 10 | 36 | 54 | 4 | 0 | 27 | 137 |
| DDE | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| DAP | 22 | 19 | 19 | 23 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 104 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 28 | 28 | 28 | 29 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 143 |

MONTH= DECEMBER 1981

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 13 | 20 | 12 | 10 | 2 | 8 | 95 | 11 | 0 | 0 | 171 |
| RDC | 34 | 0 | 36 | 36 | 40 | 0 | 51 | 8 | 19 | 0 | 3 | 227 |
| RDO | 74 | 57 | 0 | 57 | 57 | 32 | 63 | 20 | 34 | 0 | 27 | 421 |
| RDQ | 1 | 13 | 3 | 0 | 13 | 7 | 6 | 0 | 2 | 0 | 4 | 49 |
| RDA | 3 | 3 | 10 | 1 | 0 | 9 | 25 | 15 | 2 | 0 | 8 | 76 |
| DDE | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| DAP | 50 | 65 | 61 | 60 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 296 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 2 | 2 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |

MONTH= JANUARY 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 2 | 8 | 5 | -5 | 0 | 18 | 40 | 0 | 0 | 9 | 87 |
| RDC | 2 | 0 | 2 | 2 | 2 | 0 | 24 | 41 | 14 | 0 | 5 | 92 |
| RDO | 83 | 71 | 0 | 71 | 78 | 38 | 86 | 52 | 8 | 0 | 60 | 547 |
| RDQ | 0 | 7 | 0 | 0 | 0 | 5 | 6 | 71 | 0 | 0 | 32 | 121 |
| RDA | 0 | 0 | 8 | 38 | 0 | 25 | 1 | 14 | 0 | 0 | 1 | 87 |
| DDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAP | 34 | 56 | 40 | 83 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 264 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

MONTH= FEBRUARY 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 0 | 1 | 0 | 0 | 0 | 0 | 7 | 100 | 4 | 0 | 0 | 112 |
| RDC | 2 | 0 | 7 | 22 | 5 | 0 | 16 | 12 | 13 | 0 | 0 | 77 |
| RDO | 47 | 37 | 0 | 50 | 40 | 36 | 63 | 30 | 15 | 0 | 24 | 342 |
| RDQ | 0 | 2 | 5 | 0 | 0 | 5 | 11 | 5 | 0 | 0 | 15 | 43 |
| RDA | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 38 | 0 | 0 | 4 | 82 |
| DDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAP | 6 | 22 | 73 | 16 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 185 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 4 | 6 | 7 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |

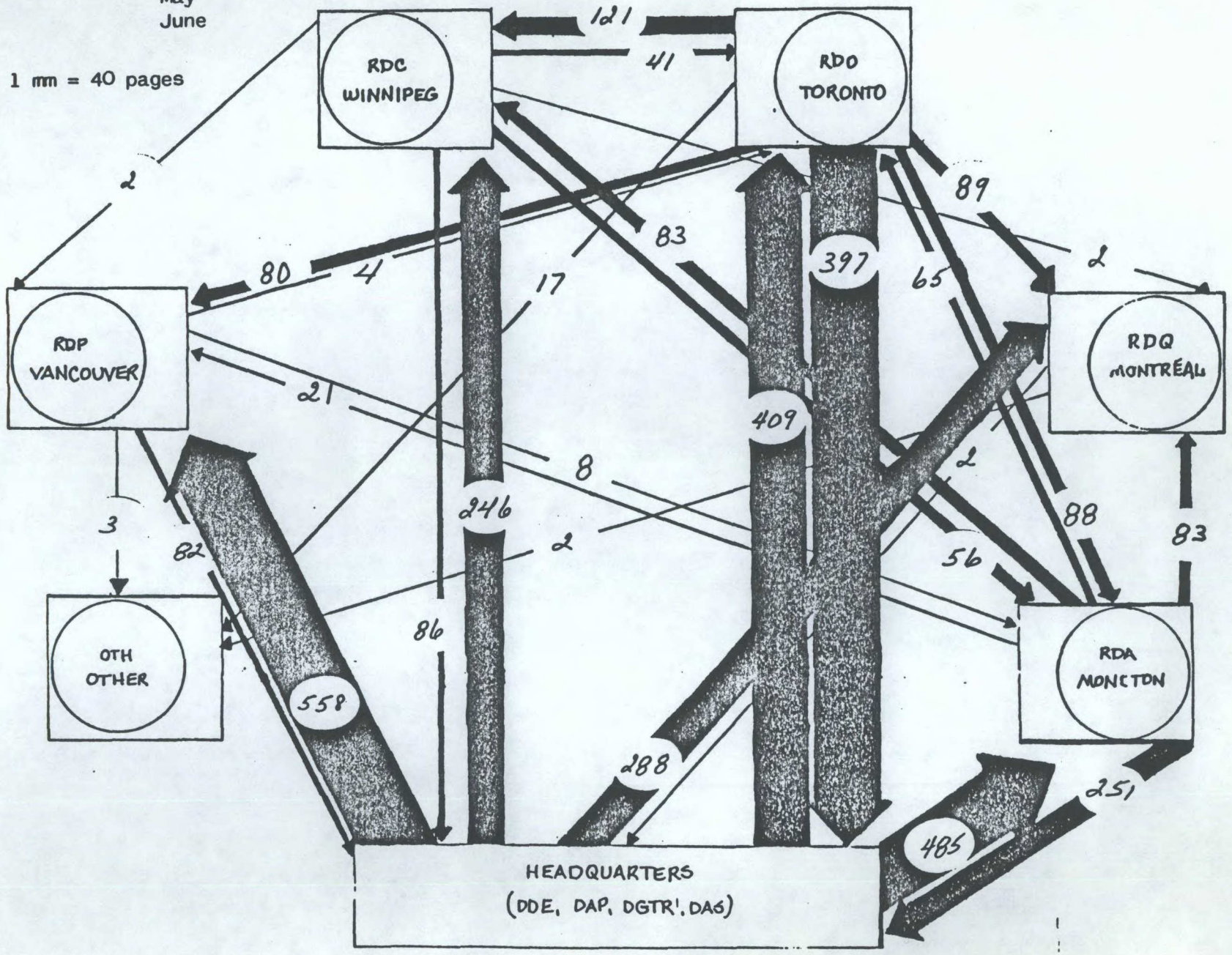
MONTH= MARCH 1982

| | RDP | RDC | RDO | RDQ | RDA | DDE | DAP | DGT | DAS | HQU | OTH | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDP | 2 | 3 | 0 | 0 | 25 | 0 | 15 | 59 | 0 | 0 | 4 | 108 |
| RDC | 6 | 0 | 6 | 9 | 9 | 0 | 18 | 9 | 37 | 0 | 21 | 115 |
| RDO | 62 | 98 | 0 | 76 | 62 | 0 | 55 | 90 | 20 | 0 | 62 | 525 |
| RDQ | 37 | 39 | 31 | 0 | 37 | 15 | 46 | 21 | 4 | 0 | 12 | 242 |
| RDA | 5 | 5 | 5 | 18 | 0 | 5 | 18 | 4 | 3 | 0 | 0 | 63 |
| DDE | 35 | 35 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| DAP | 27 | 30 | 28 | 41 | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 173 |
| DGT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DAS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HQU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTH | 4 | 4 | 10 | 9 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |

CWP TRAFFIC (NUMBER OF PAGES SENT)

1st quarter: April
May
June

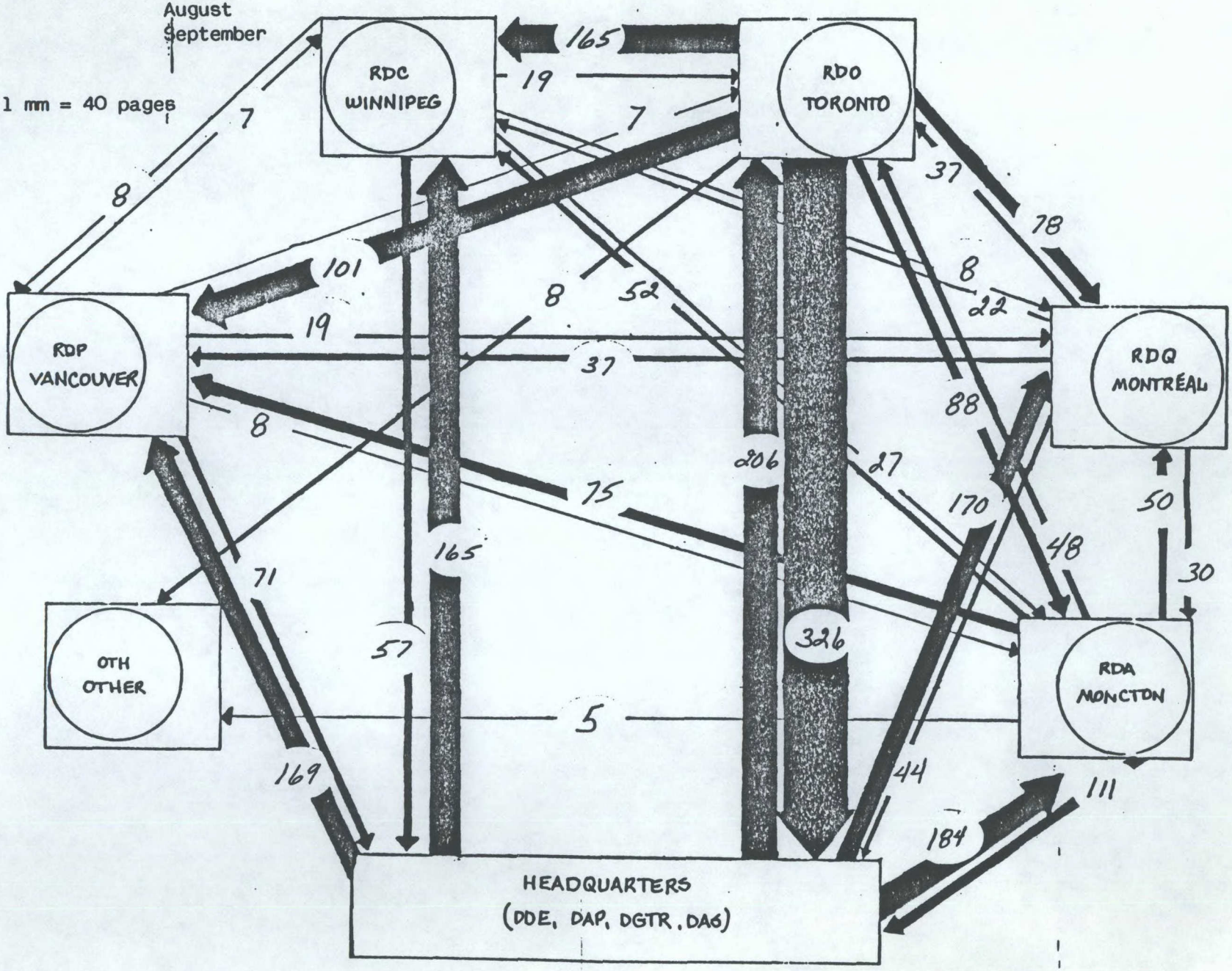
1 mm = 40 pages



CWP TRAFFIC (NUMBER OF PAGES SENT)

2nd quarter: July
August
September

1 mm = 40 pages



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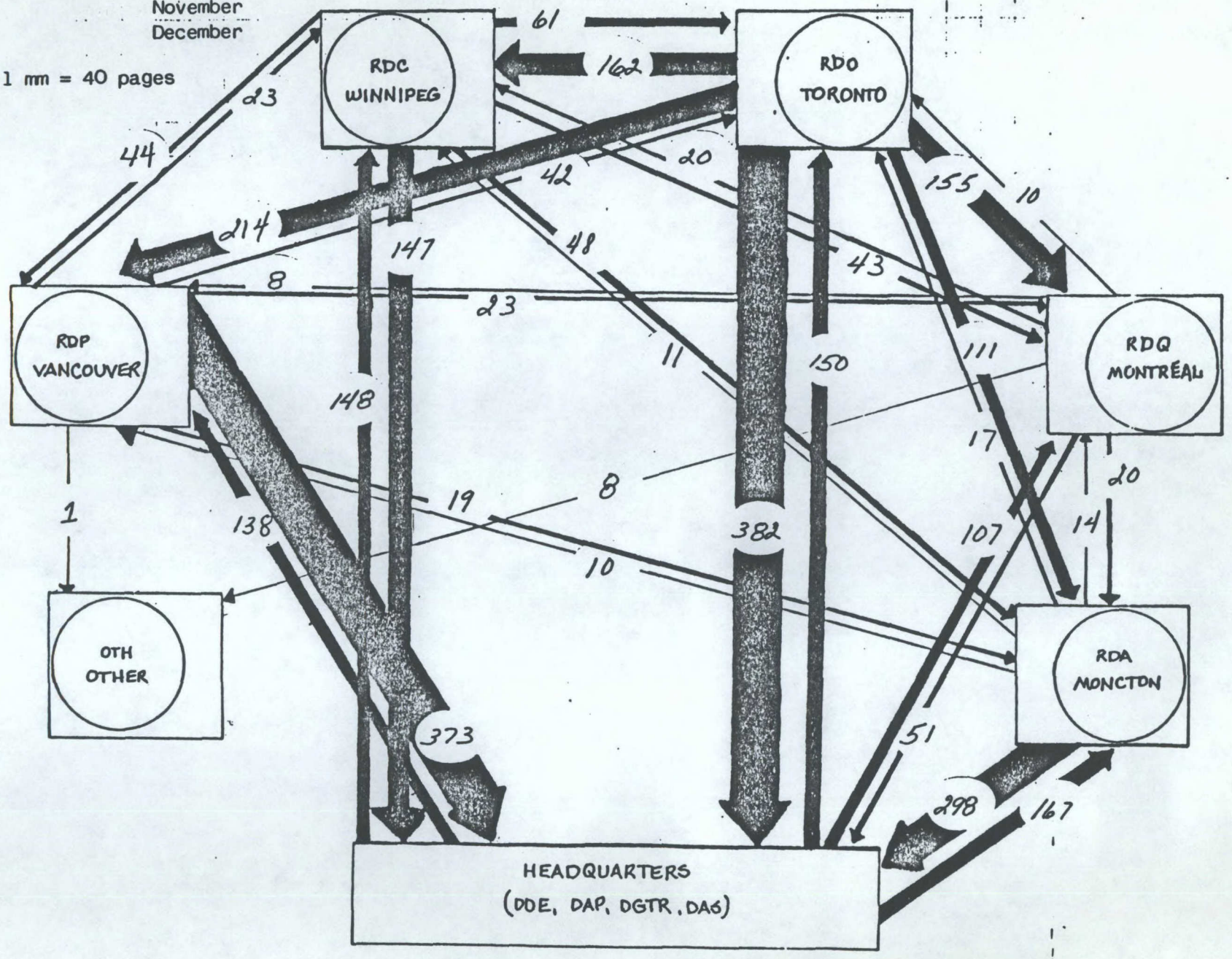

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4th quarter: January
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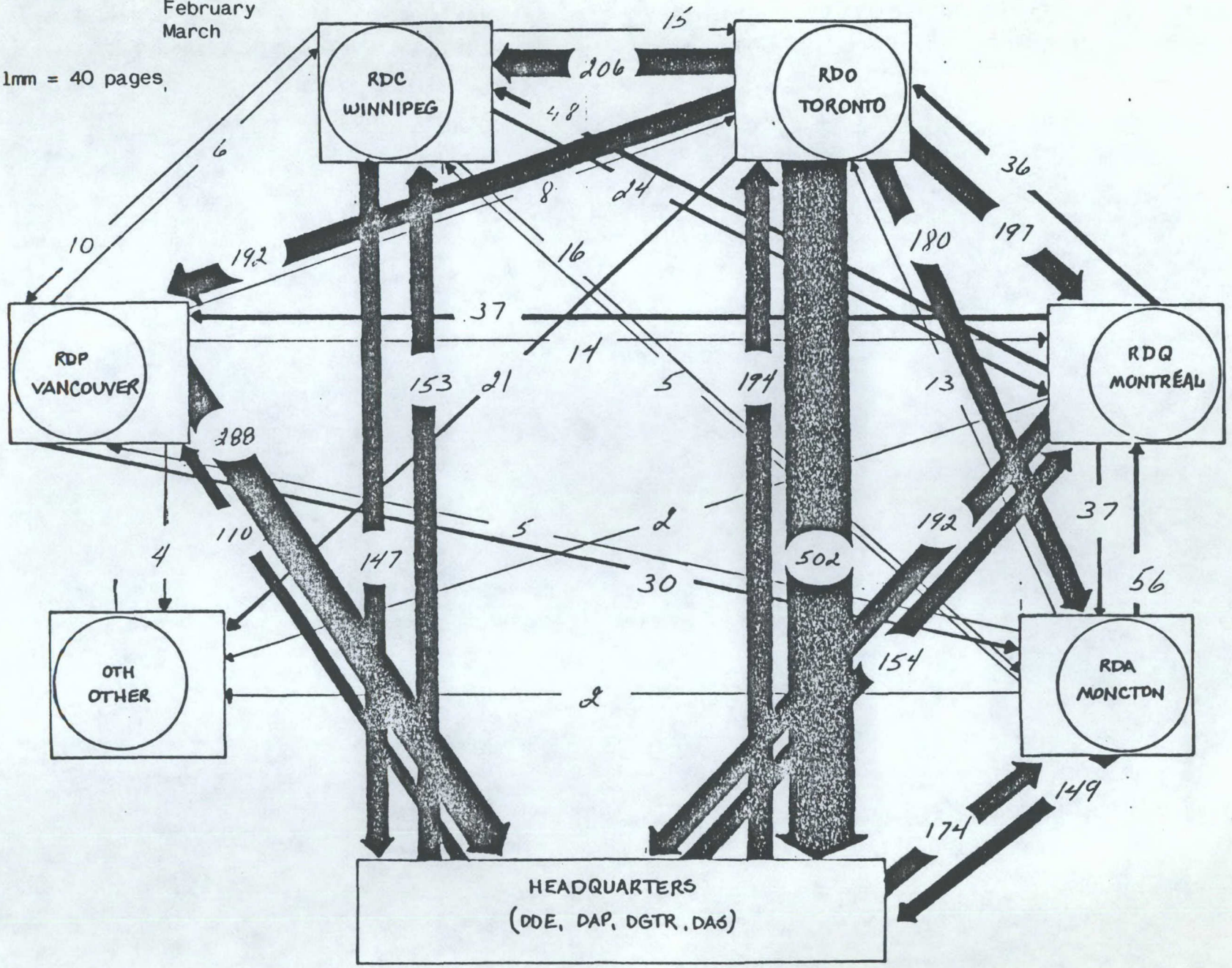
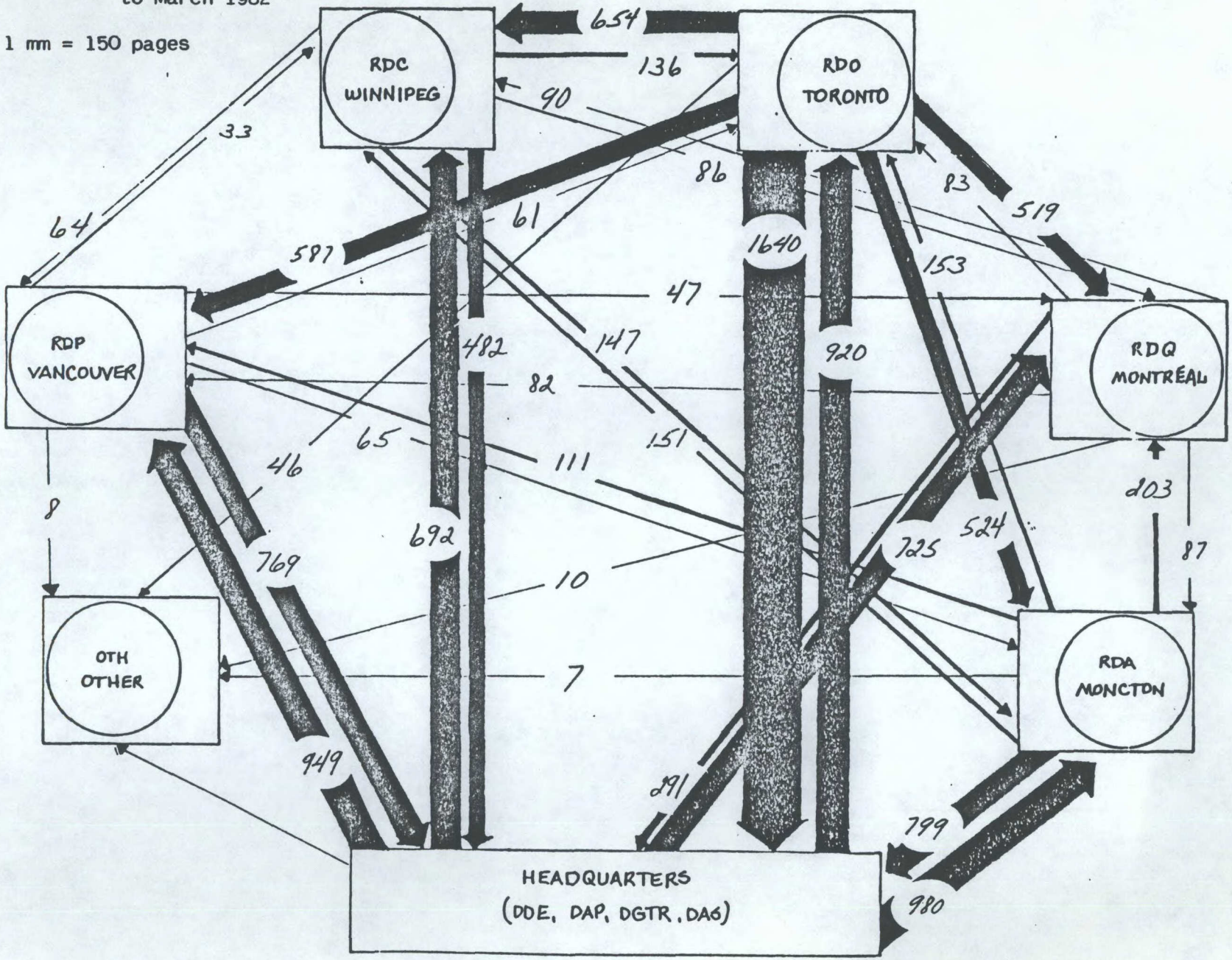


CWP TRAFFIC (NUMBER OF PAGES SENT)

Overall: from April 1981
to March 1982

1 mm = 150 pages



# APPENDIX II

## COST COMPARISON CHARTS

## Pre-Trial Test

In addition to ensuring that the required data were available and providing an introduction to the CWP trials, the visit to the CWP sites at the beginning of the trials also provided an opportunity to measure the participant's perceptions of their present inter-office communications, such as their use of mail and telephone systems. This was done in personal interviews with each of the major participants at each site, during which they were asked to estimate a number of parameters of their communications.

The parameters that each participant was asked to estimate are shown in Table 1. The overall results of the questionaire are shown in the first three columns of Table 2. The first column is the arithmetic mean of the estimates of each parameter averaged over all participants. The second and third columns are the lower and upper limit of a confidence interval calculated with the Student's T statistic at 0.95. These define the range of values over which the mean could have varied with a probability of 95% due to the random selection of participants. Thus, the true mean value of the estimates should not be considered to be the arithmetic mean, but to fall somewhere within this confidence interval. The next three columns contain the same data, but only calculated for the regional offices, while the last three columns contain these results for headquarters. To facilitate comparisons, a summary of Table 1 and the means from Table 2 are combined in Table 3.

Overall, these tables show that there is a large amount of communication between headquarters and the regional offices using the existing telephone, mail and telex facilities. These data imply a need for further mail facilities. Many participants reported that they receive mail too late for the appropriate action. To some degree this is a consequence of the sender rather than the mail system itself. A frequent comment was that the mail often arrived before a deadline, but too close to the deadline to complete a proper response. Another frequent comment in the pre-trial interviews was that it was possible to compensate for delays in the mail by either mailing material early or by preceeding the regular mail with either a telex or a telephone call. Thus, the

CWPs may replace some regular mail by allowing a formal document to be sent immediately instead of placing a copy in the regular mail and backing it up with a less formal communication. This will only be true, however, if the documents are handled effciently at the word processor sites.

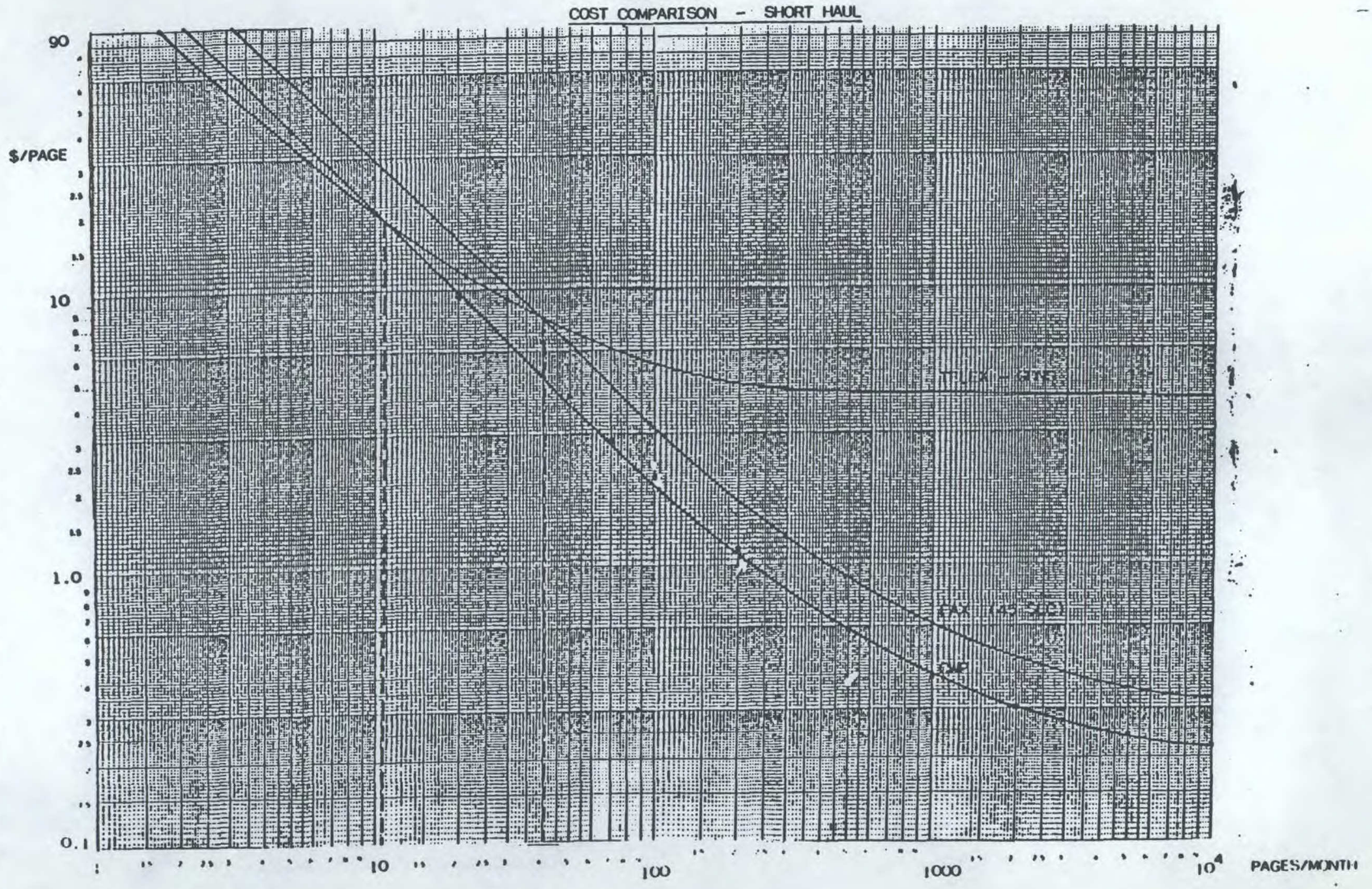
There is also some deficiency in the telephone system. More than 30% of the telephone calls that these participants make are not completed successfully. The most frequent reason reported for this is that the desired party is unavailable. This is also reflected in the number of telephone messages compared to the number of telephone calls received.

Furthermore, most of these messages required a return call, rather than containing the necessary information. If the CWPs are easily available, they may substitute for some of these telephone calls. This will probably depend upon whether the participants feel compelled to submit polished documents to the word processor operators, or if they will send brief, informal messages through the CWP network.

Thus, the possibility exists that the CWPs will offer a medium for communication which will alleviate some of these problems. Whether it will be used or not is still an open question. While analysis of the pre-test interview data raises such questions, there will not be any clear answers until these data can be compared to similar questions at the end of the trial, to the data being collected on the telephone survey and to the various logs. Some of these results will be available in a second interim report from the evaluation team before the end of the trial.

# APPENDIX III

## PRE-TRIAL TEST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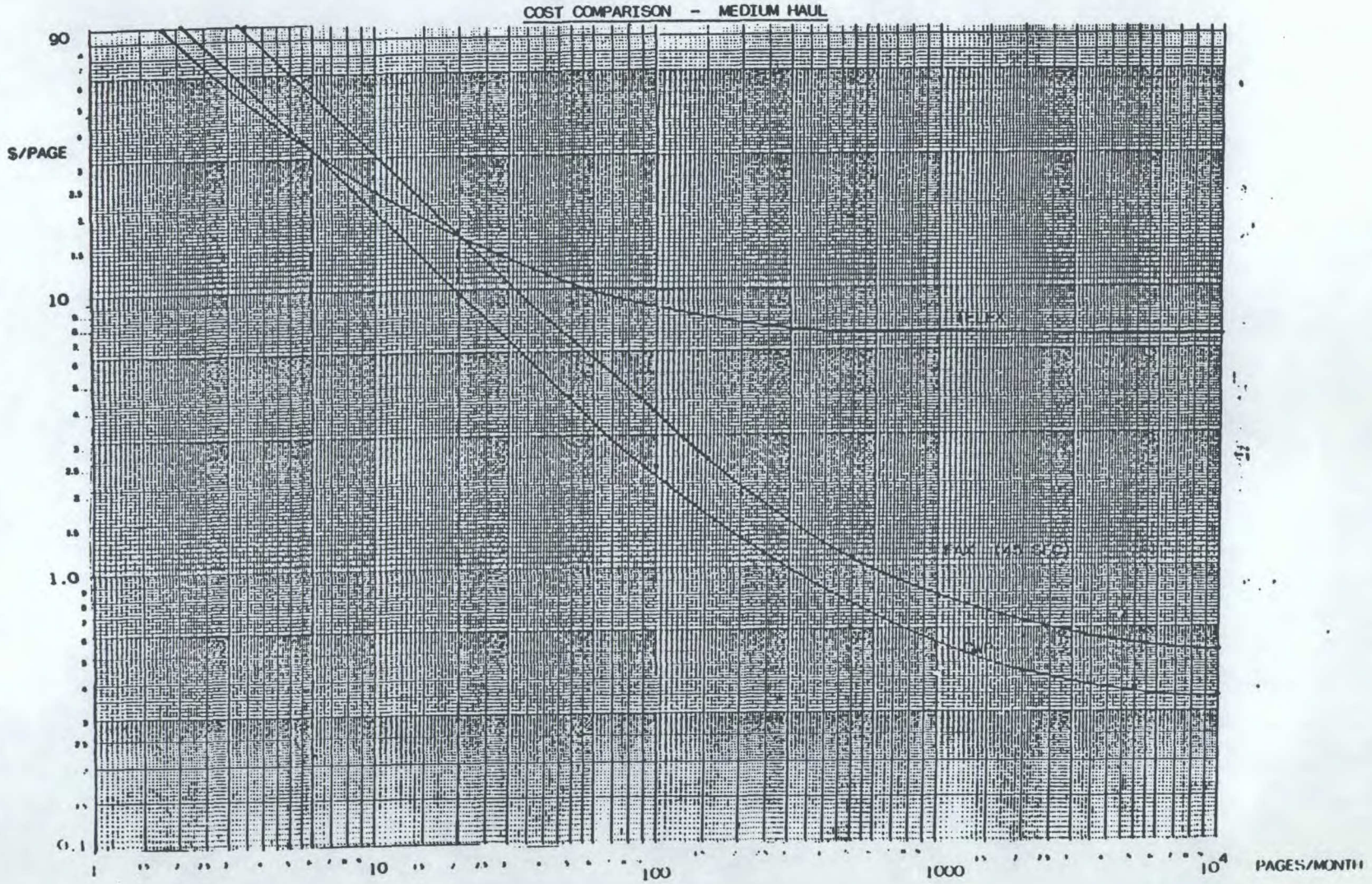
1.0
0.1
10
100
1000
$10^4$
PAGES/MONTH


COST COMPARISON - MEDIUM HAUL
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$/PAGE
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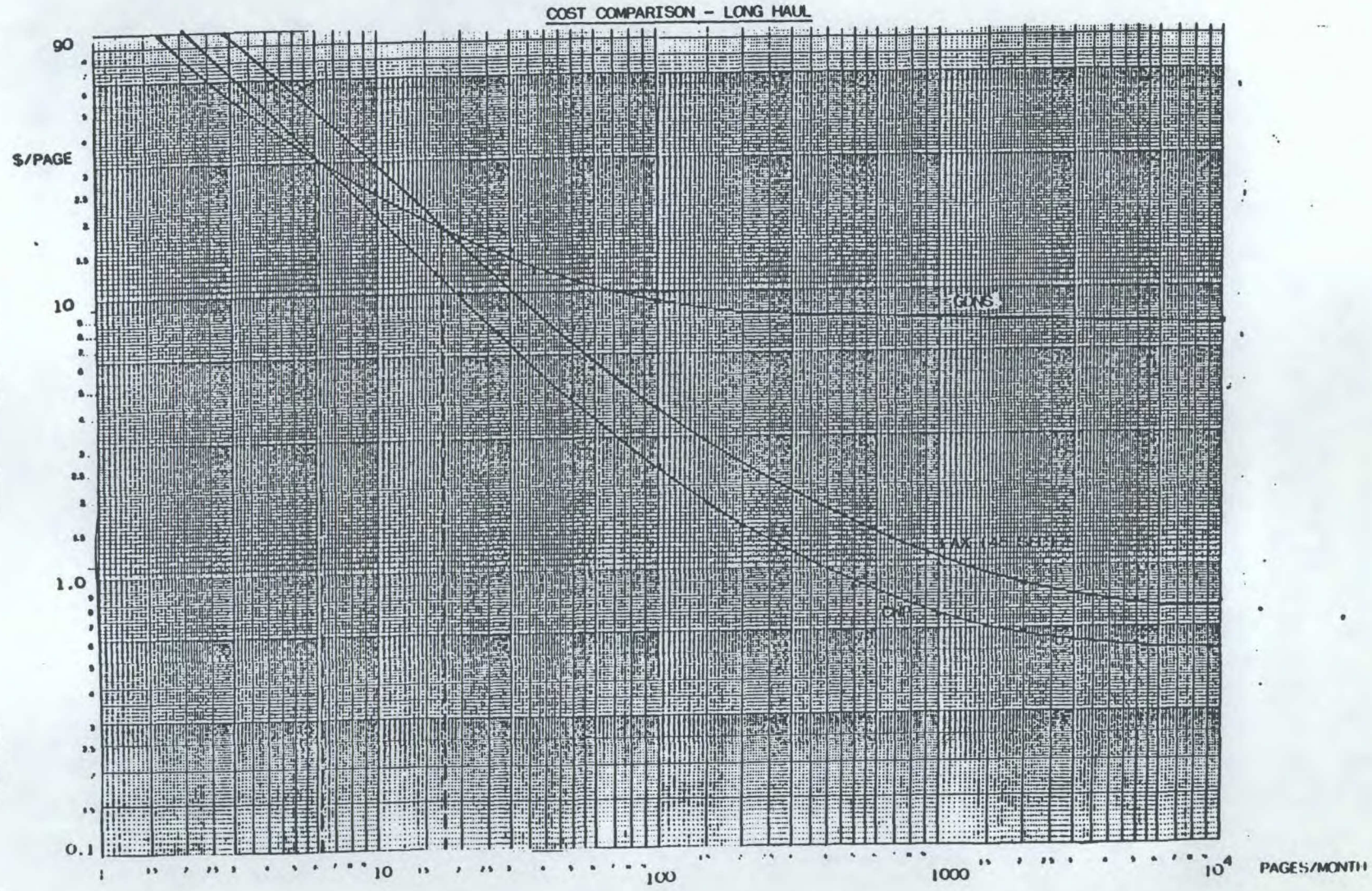
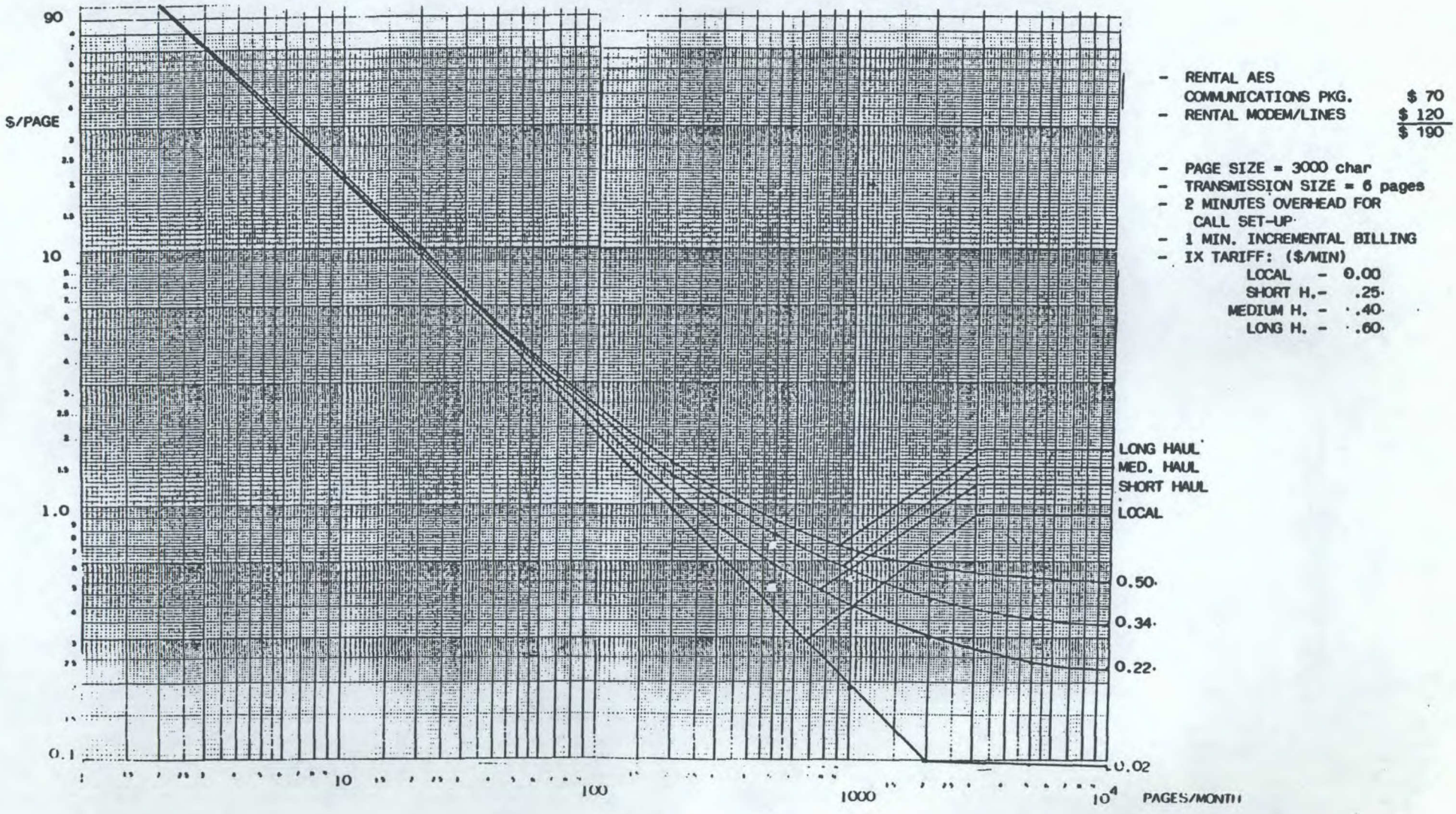
0.1
TELEX
1
10
100
1000
10^4
PAGES/MONTH


COST COMPARISON - LONG HAUL
90
$/PAGE
10
1.0
0.1
10
100
1000
$10^4$
PAGES/MONTH

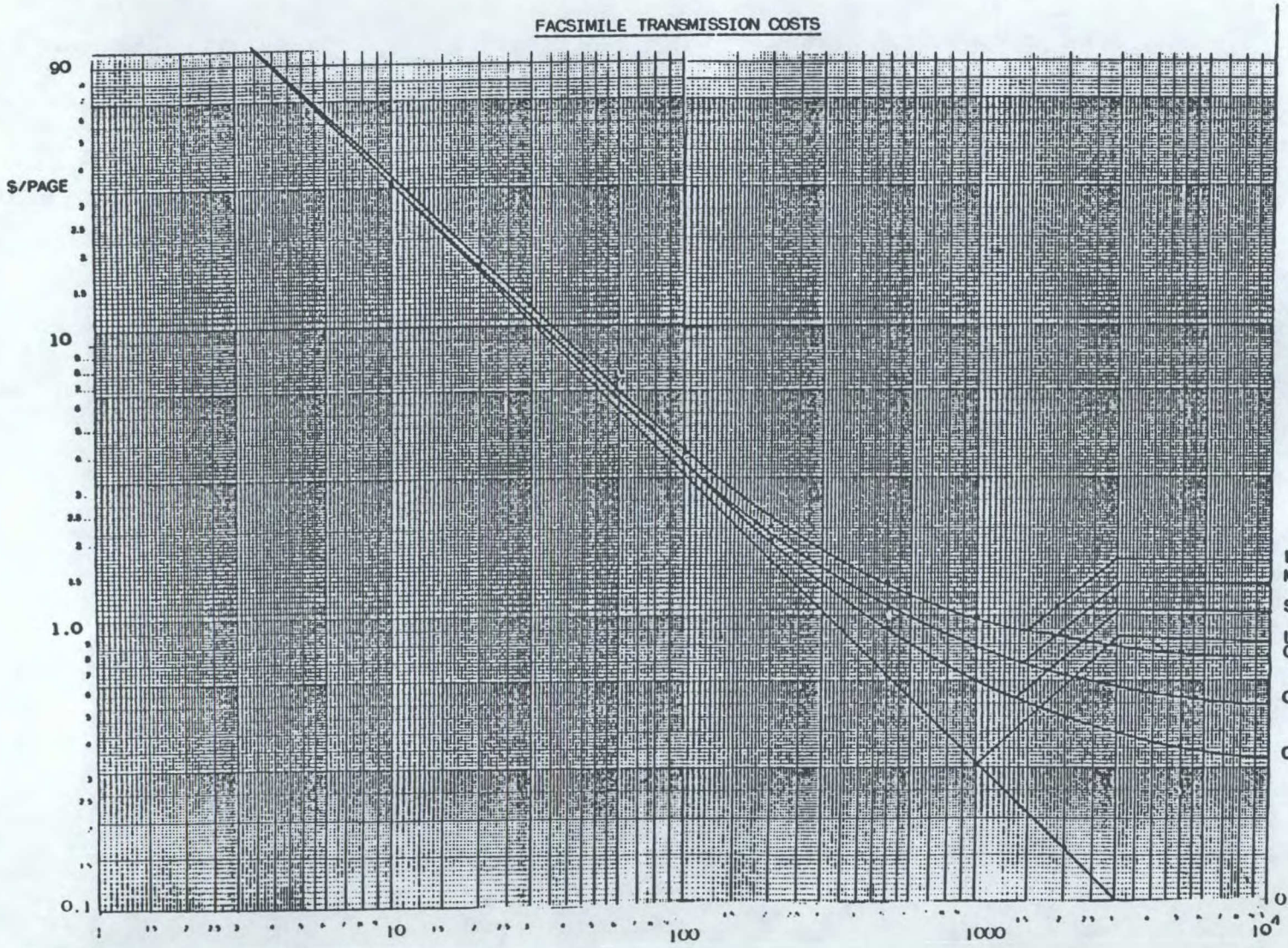
## CWP TRANSMISSION COSTS




- RENTAL AES COMMUNICATIONS PKG. $ 70
- RENTAL MODEM/LINES $ 120
  $ 190

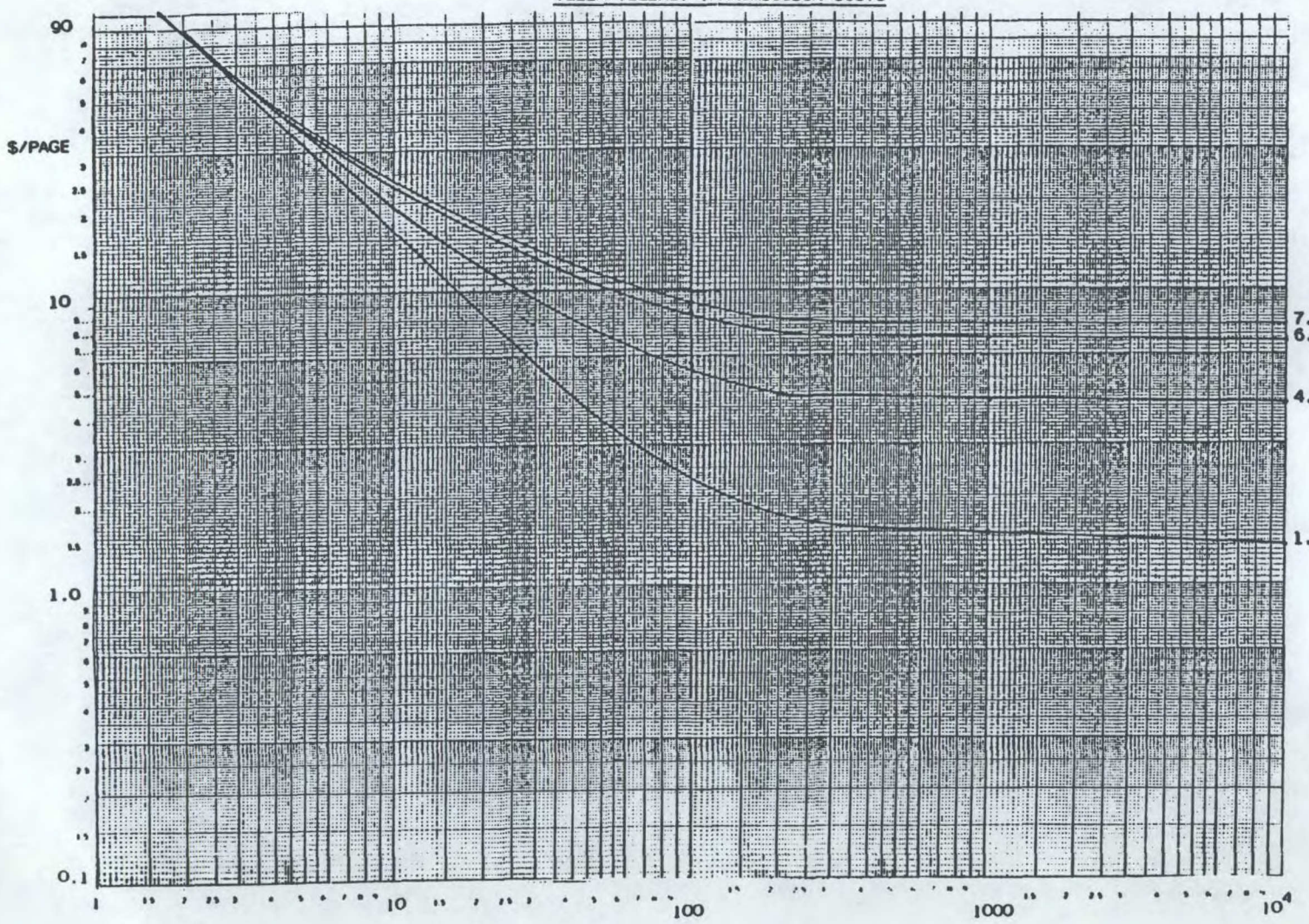
- PAGE SIZE = 3000 char
- TRANSMISSION SIZE = 6 pages
- 2 MINUTES OVERHEAD FOR CALL SET-UP
- 1 MIN. INCREMENTAL BILLING
- IX TARIFF: ($/MIN)
  - LOCAL - 0.00
  - SHORT H. - .25
  - MEDIUM H. - .40
  - LONG H. - .60

## FACSIMILE TRANSMISSION COSTS




- RAPICOM 800 - 45 sec/page
  - RENTAL (3 yrs) -$277/mth
  - DAA RENTAL -$ 10/mth
  - COMM. LINE -$ 25/mth
  - $312/mth
- 6 pages/transmission
- 2 min overhead for call set-up
- IX Tariff
  - LOCAL - $0.00 / min
  - SHORT H. - $ .25 / min
  - MED. H. - $ .40 / min
  - LONG H. - $ .60 / min

## TELEX/TELENET TRANSMISSION COSTS




- TELEX TERMINAL MONTHLY RENTAL $ 135
- TELENET STATION CHARGE (MTHLY) $ 20
- PAGE SIZE 3000 char
- USAGE CHARGES:
  - LOCAL: Ottawa/Montreal
  - SHORT HAUL: Montreal/Toronto
  - MEDIUM HAUL: Montreal/Winnipeg
  - LONG HAUL: Montreal/Vancouver

Table 1: This is a list of the parameters measured in the pretrial questionaire. An estimate of each parameter was requested of each patricipant in a personal interview.

1. Minutes on telephone per day
2. Number of calls made out per day
3. Proportion of calls resulting in wrong numbers
4. Proportion of calls resulting in no answer
5. Proportion of calls for which the desired party was unavailable
6. Proportion of calls to DOC headquarters
7. Proportion of calls to other regional offices
8. Proportion of calls to district offices
9. Proportion of calls elsewhere
10. Number of calls received per day
11. Proportion of calls for wrong number
12. Number of telephone messages received per day
13. Proportion of messages which require a return call
14. Minutes per day when phone is unattended
15. Proportion of calls from DOC headquarters
16. Proportion of calls from other regional offices
17. Proportion of calls from district offices
18. Proportion of calls from elsewhere
19. Number of pieces of mail sent per day
20. Proportion of mail sent which are long reports
21. Proportion of mail sent which are short reports
22. Proportion of mail sent which are memos
23. Proportion of mail sent which are letters
24. Proportion of mail sent which are forms
25. Proportion of mail sent which are types other than these
26. Number of Telexes sent per month
27. Number of facsimiles sent per month
28. Proportion of mail sent which may arrive too late
29. Proportion of mail sent which requires a signature
30. Proportion of mail which is sent at regular intervals
31. Proportion of the mail which is sent to DOC headquarters
32. Proportion of the mail which is sent to the regional offices
33. Proportion of the mail which is sent to the district offices
34. Proportion of the mail which is sent elsewhere
35. Number of pieces of mail which are received per day
36. Proportion of mail received which are long reports
37. Proportion of mail received which are short reports
38. Proportion of mail received which are memos
39. Proportion of mail received which are letters
40. Proportion of mail received which are forms
41. Proportion of mail received which are types other than these
42. Number of Telexes received per month
43. Number of facsimiles received per month
44. Proportion of mail received which requires a signature
45. Proportion of mail received which requires an action or response

46. Proportion of this mail which arrives too late for an action
47. Proportion of the mail which is received at regular intervals
48. Proportion of mail which arrives from DOC headquarters
49. Proportion of mail which arrives from regional offices
50. Proportion of mail which arrives from district offices
51. Proportion of mail which arrives from elsewhere
52. Number of minutes spent in meetings per day
53. Number of meetings per day
54. Proportion of meetings held at DOC headquarters
55. Proportion of meetings held at regional offices
56. Proportion of meetings held at district offices
57. Proportion of meetings held elsewhere

Table 2: These are the results of the pre-trial questionaire. The first three columns are the mean and 95% confidence intervals of the estimates of each of the paramaters listed in Table 1 for all participants. The other columns show the same results for the regional offices and for headquarters independently.

| | Overall Results | | | Regions | | | Headquarters | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean, | Confidence | Interval | Mean, | Confidence | Interval | Mean, | Confidence | Inter. |
| 1. | 62.182 | 53.045 | 71.319 | 58.232 | 48.742 | 67.721 | 73.750 | 49.983 | 97.517 |
| 2. | 7.514 | 6.158 | 8.869 | 6.884 | 5.500 | 8.268 | 9.357 | 5.767 | 12.947 |
| 3. | 0.015 | 0.005 | 0.026 | 0.015 | 0.002 | 0.027 | 0.017 | -0.005 | 0.040 |
| 4. | 0.029 | 0.008 | 0.050 | 0.021 | -0.004 | 0.046 | 0.052 | 0.016 | 0.088 |
| 5. | 0.313 | 0.253 | 0.374 | 0.278 | 0.203 | 0.353 | 0.416 | 0.342 | 0.490 |
| 6. | 0.382 | 0.309 | 0.455 | 0.337 | 0.254 | 0.419 | 0.514 | 0.366 | 0.663 |
| 7. | 0.117 | 0.071 | 0.164 | 0.061 | 0.038 | 0.083 | 0.283 | 0.135 | 0.432 |
| 8. | 0.227 | 0.163 | 0.291 | 0.291 | 0.217 | 0.365 | 0.040 | -0.012 | 0.092 |
| 9. | 0.279 | 0.204 | 0.353 | 0.317 | 0.222 | 0.412 | 0.166 | 0.105 | 0.228 |
| 10. | 10.020 | 7.755 | 12.285 | 9.332 | 7.274 | 11.389 | 12.036 | 4.071 | 19.111 |
| 11. | 0.019 | 0.008 | 0.030 | 0.018 | 0.004 | 0.032 | 0.023 | 0.006 | 0.041 |
| 12. | 3.167 | 2.187 | 4.148 | 2.987 | 2.314 | 3.660 | 3.697 | 0.074 | 7.320 |
| 13. | 0.988 | 0.975 | 1.002 | 0.984 | 0.966 | 1.002 | 1.000 | 1.000 | 1.000 |
| 14. | 0.013 | 0.0 | 0.026 | 0.0 | 0.0 | 0.001 | 0.049 | -0.001 | 0.100 |
| 15. | 0.338 | 0.268 | 0.408 | 0.258 | 0.208 | 0.362 | 0.494 | 0.357 | 0.630 |
| 16. | 0.098 | 0.050 | 0.146 | 0.041 | 0.027 | 0.055 | 0.265 | 0.100 | 0.430 |
| 17. | 0.271 | 0.197 | 0.345 | 0.359 | 0.276 | 0.441 | 0.014 | -0.003 | 0.030 |
| 18. | 0.283 | 0.210 | 0.355 | 0.359 | 0.276 | 0.441 | 0.225 | 0.129 | 0.321 |
| 19. | 11.040 | 8.075 | 14.005 | 11.314 | 7.665 | 14.964 | 10.238 | 5.093 | 15.383 |
| 20. | 0.046 | 0.025 | 0.068 | 0.035 | 0.017 | 0.054 | 0.079 | 0.011 | 0.147 |
| 21. | 0.148 | 0.093 | 0.203 | 0.105 | 0.058 | 0.152 | 0.275 | 0.114 | 0.436 |
| 22. | 0.324 | 0.260 | 0.387 | 0.340 | 0.264 | 0.416 | 0.277 | 0.153 | 0.400 |
| 23. | 0.198 | 0.135 | 0.261 | 0.237 | 0.157 | 0.317 | 0.084 | 0.035 | 0.133 |
| 24. | 0.163 | 0.090 | 0.236 | 0.178 | 0.091 | 0.265 | 0.118 | -0.022 | 0.259 |
| 25. | 0.135 | 0.071 | 0.190 | 0.122 | 0.047 | 0.197 | 0.174 | 0.042 | 0.306 |
| 26. | 15.507 | 6.312 | 24.703 | 18.729 | 6.689 | 30.768 | 6.074 | -0.354 | 12.501 |
| 27. | 4.611 | 1.756 | 7.467 | 4.223 | 1.647 | 6.798 | 5.750 | -3.365 | 14.865 |
| 28. | 0.386 | 0.275 | 0.497 | 0.422 | 0.288 | 0.557 | 0.287 | 0.081 | 0.493 |
| 29. | 0.117 | 0.049 | 0.185 | 0.105 | 0.027 | 0.183 | 0.150 | -0.007 | 0.307 |
| 30. | 0.152 | 0.087 | 0.218 | 0.174 | 0.090 | 0.259 | 0.089 | 0.007 | 0.172 |
| 31. | 0.353 | 0.271 | 0.436 | 0.312 | 0.219 | 0.404 | 0.475 | 0.300 | 0.650 |
| 32. | 0.102 | 0.055 | 0.149 | 0.067 | 0.026 | 0.107 | 0.205 | 0.065 | 0.344 |
| 33. | 0.300 | 0.121 | 0.479 | 0.375 | 0.154 | 0.597 | 0.018 | -0.022 | 0.059 |
| 34. | 0.356 | 0.268 | 0.445 | 0.378 | 0.276 | 0.480 | 0.293 | 0.101 | 0.485 |
| 35. | 17.308 | 12.701 | 21.916 | 18.026 | 12.229 | 23.822 | 15.207 | 8.292 | 22.123 |
| 36. | 0.082 | 0.038 | 0.125 | 0.069 | 0.019 | 0.118 | 0.119 | 0.021 | 0.218 |
| 37. | 0.107 | 0.066 | 0.148 | 0.097 | 0.061 | 0.133 | 0.135 | 0.002 | 0.268 |
| 38. | 0.300 | 0.234 | 0.366 | 0.307 | 0.282 | 0.382 | 0.279 | 0.124 | 0.434 |
| 39. | 0.173 | 0.115 | 0.231 | 0.199 | 0.125 | 0.272 | 0.099 | 0.019 | 0.178 |
| 40. | 0.140 | 0.084 | 0.195 | 0.156 | 0.087 | 0.225 | 0.092 | 0.003 | 0.182 |
| 41. | 0.193 | 0.120 | 0.265 | 0.166 | 0.085 | 0.247 | 0.270 | 0.100 | 0.440 |
| 42. | 14.297 | 6.825 | 21.769 | 16.908 | 7.201 | 26.615 | 6.649 | 0.111 | 13.186 |
| 43. | 4.288 | 2.424 | 6.151 | 4.270 | 2.099 | 6.441 | 4.339 | 0.312 | 8.367 |
| 44. | 0.313 | 0.213 | 0.413 | 0.345 | 0.223 | 0.467 | 0.222 | 0.041 | 0.403 |
| 45. | 0.550 | 0.473 | 0.627 | 0.534 | 0.448 | 0.620 | 0.597 | 0.415 | 0.780 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 46. | 0.148 | -0.019 | 0.315 | 0.176 | -0.047 | 0.399 | 0.065 | 0.006 | 0.124 |
| 47. | 0.213 | 0.147 | 0.280 | 0.196 | 0.119 | 0.272 | 0.263 | 0.113 | 0.414 |
| 48. | 0.355 | 0.277 | 0.433 | 0.311 | 0.229 | 0.392 | 0.481 | 0.284 | 0.678 |
| 49. | 0.101 | 0.052 | 0.150 | 0.054 | 0.035 | 0.074 | 0.235 | 0.061 | 0.409 |
| 50. | 0.215 | 0.153 | 0.277 | 0.269 | 0.199 | 0.339 | 0.018 | -0.022 | 0.059 |
| 51. | 0.313 | 0.234 | 0.391 | 0.328 | 0.239 | 0.417 | 0.268 | 0.088 | 0.449 |
| 52. | 136.142 | 109.389 | 162.896 | 139.146 | 108.114 | 170.178 | 127.561 | 67.680 | 187.442 |
| 53. | 8.290 | 4.232 | 12.348 | 8.891 | 3.442 | 14.340 | 6.571 | 3.453 | 9.670 |
| 54. | 0.210 | 0.109 | 0.310 | 0.041 | 0.015 | 0.067 | 0.824 | 0.633 | 1.014 |
| 55. | 0.025 | 0.003 | 0.047 | 0.013 | 0.004 | 0.021 | 0.070 | -0.034 | 0.174 |
| 56. | 0.032 | 0.019 | 0.045 | 0.038 | 0.022 | 0.054 | 0.011 | -0.002 | 0.024 |
| 57. | 0.725 | 0.618 | 0.831 | 0.886 | 0.825 | 0.948 | 0.137 | -0.049 | 0.322 |

Table 3: This is a summary of Tables 1 and 2 showing the name of the dependent variable and the arithmetic means for the regions, headquarters and overall.

| | Variable | Arithmetic means | | |
|---|---|---|---|---|
| | | Overall | Regions | Headquarters |
| 1. | Minutes on telephone | 62.182 | 58.232 | 73.750 |
| 2. | Telephone calls out | 7.514 | 6.884 | 9.357 |
| 3. | Wrong numbers obtained | 0.015 | 0.015 | 0.017 |
| 4. | No answer obtained | 0.029 | 0.021 | 0.052 |
| 5. | Party unavailable | 0.313 | 0.278 | 0.416 |
| 6. | Calls to headquarters | 0.382 | 0.337 | 0.514 |
| 7. | Calls to other regional offices | 0.117 | 0.061 | 0.283 |
| 8. | Calls to district offices | 0.227 | 0.291 | 0.040 |
| 9. | Calls to elsewhere | 0.279 | 0.317 | 0.166 |
| 10. | Telephone calls received | 10.020 | 9.332 | 12.036 |
| 11. | Calls for someone else | 0.019 | 0.018 | 0.023 |
| 12. | Messages received | 3.167 | 2.987 | 3.697 |
| 13. | Proportion requiring return call | 0.988 | 0.984 | 1.000 |
| 14. | Proportion of day telephone is unattended | 0.013 | 0.0 | 0.049 |
| 15. | Calls from headquarters | 0.338 | 0.258 | 0.494 |
| 16. | Calls from other regional offices | 0.098 | 0.041 | 0.265 |
| 17. | Calls from district offices | 0.271 | 0.359 | 0.014 |
| 18. | Calls from elsewhere | 0.283 | 0.359 | 0.225 |
| 19. | Amount of mail sent | 11.040 | 11.314 | 10.238 |
| 20. | Long reports sent | 0.046 | 0.035 | 0.079 |
| 21. | Short reports sent | 0.148 | 0.105 | 0.275 |
| 22. | Memos sent | 0.324 | 0.340 | 0.277 |
| 23. | Letters sent | 0.198 | 0.237 | 0.084 |
| 24. | Forms sent | 0.163 | 0.178 | 0.118 |
| 25. | Other mail sent | 0.135 | 0.122 | 0.174 |
| 26. | Telexes sent per month | 15.507 | 18.729 | 6.074 |
| 27. | Facsimiles sent per month | 4.611 | 4.223 | 5.750 |
| 28. | Mail which arrives too late | 0.386 | 0.422 | 0.287 |
| 29. | Mail sent which requires a signature | 0.117 | 0.105 | 0.150 |
| 30. | Mail sent at regular intervals | 0.152 | 0.174 | 0.089 |
| 31. | Mail to headquarters | 0.353 | 0.312 | 0.475 |
| 32. | Mail to other regional offices | 0.102 | 0.067 | 0.205 |
| 33. | Mail to district offices | 0.300 | 0.375 | 0.018 |
| 34. | Mail sent elsewhere | 0.356 | 0.378 | 0.293 |
| 35. | Amount of mail received | 17.308 | 18.026 | 15.207 |
| 36. | Long reports received | 0.082 | 0.069 | 0.119 |
| 37. | Short reports received | 0.107 | 0.097 | 0.135 |
| 38. | Memos received | 0.300 | 0.307 | 0.279 |
| 39. | Letters received | 0.173 | 0.199 | 0.099 |
| 40. | Forms received | 0.140 | 0.156 | 0.092 |
| 41. | Other mail received | 0.193 | 0.166 | 0.270 |
| 42. | Telexes received per month | 14.297 | 16.908 | 6.649 |
| 43. | Facsimiles received per month | 4.288 | 4.270 | 4.339 |
| 44. | Mail received which requires a signature | 0.313 | 0.345 | 0.222 |
| 45. | Mail received requiring action | 0.550 | 0.534 | 0.597 |

| | | | | |
|---|---|---|---|---|
| 46. | Mail which arrives too late | 0.148 | 0.176 | 0.065 |
| 47. | Mail received at regular intervals | 0.213 | 0.196 | 0.263 |
| 48. | Mail from headquarters | 0.355 | 0.311 | 0.481 |
| 49. | Mail from other regional offices | 0.101 | 0.054 | 0.235 |
| 50. | Mail from district offices | 0.215 | 0.269 | 0.018 |
| 51. | Mail from elsewhere | 0.313 | 0.328 | 0.268 |
| 52. | Time spent in meetings | 136.142 | 139.146 | 127.561 |
| 53. | Number of meetings per day | 8.290 | 8.891 | 6.571 |
| 54. | Meetings at headquarters | 0.210 | 0.041 | 0.824 |
| 55. | Meetings at other regional offices | 0.025 | 0.013 | 0.070 |
| 56. | Meetings at district offices | 0.032 | 0.038 | 0.011 |
| 57. | Meetings held elsewhere | 0.725 | 0.886 | 0.137 |

# APPENDIX IV

## EVALUATION DESIGN

The information in this Appendix has been included as a guide for the evaluation of similar projects where one is interested in measuring the full impact of a new piece of equipment (or as in the present case, in the organization or network).

## 1. Evaluation Design

In order to determine the effects of installing communicating word processors (CWPs) in the Department of Communications, it is necessary to compare measures of the participant's communications when they have this equipment available with their communications when they do not. Measuring various aspects of the participant's communications after the installation of the equipment is a futile exercise if the values of these measurements in the absence of the CWPs is unknown. For example, knowing that an executive makes three telephone calls a day when he has access to a CWP is useless, unless you know that he made eight when the CWP was not available.

Thus, it is necessary to begin collecting data before the equipment is installed. This will then be compared with similar data collected after the equipment is installed. In order to ensure that the difference in the two sets of data is due only to the equipment, it is necessary to ensure that everything else remains the same. A single measurement before and after the installation of the CWPs will not be adequate, however, to demonstrate that there is an actual difference in the two cases. It is possible, for example, that the way people communicate with each other changes constantly as time passes. It would be incorrect to interpret these changes as being caused by the introduction of the CWPs. In order to be able to draw meaningful conclusions, it is necessary to make frequent measurements before and after the installation of the equipment. Changes which are unrelated to the introduction of the CWPs will be revealed as changes between the measurements before the CWPs are installed and as changes between the measurements after they are installed. In order to conclude that there is some effect due to the introduction of the CWPs, we must take a number of measurements before the CWPs are installed, and see small changes, install the equipment, and see a sudden large change, and then continue taking measurements, to see if this sudden change gets bigger or smaller as the participants learn to use the CWP network effectively.

This procedure will require between six and eight weeks of measurement before the equipment is installed, and then several months of measurements after the equipment is installed. The exact duration of the interval required after the equipment is installed is somewhat flexible, and will depend heavily on the rate at which the participants learn to use the equipment effectively.

It would be very useful to remove the equipment at the end of this time to determine whether any of the changes that were observed were permanent changes which persist in the absence of the availability of the CWP network. For example, it is possible that the participants will simply learn to communicate better with each other, no matter what technology is available as a carrier. If there are equipment failures, the introduction of untrained staff, or any other natural event which disrupts the CWP network for a brief period, very useful data could be obtained at this time.

2. Behavioural Analysis

The behavioural analysis examines personal attitudes, feelings, concerns and perceptions of people in today's offices, from the most senior level of management to the most junior office employee, towards the expected changes in the office environment caused by the introduction of new electronic office equipment.

One of three methods will be used to assess user concerns, attitudes, etc: (a) a short, 15 - minute questionnaire (some version of the questionnaire attached as Appendix A ), (b) short interviews with individual users, or (c) a small group discussion. The method employed in the pilot will depend upon a number of factors such as time and resources and, therefore, will be chosen later.

The purpose of this questionaire is (a) to evaluate current attitudes and feelings with respect to new office communications systems and (b) to identify employee concerns that should be considered in any introduction of new office equipment and systems.

In the past, new equipment was often designed by engineers and introduced into the work environment without considering either the potential problems foreseen by employees or their concerns. Identifying employee concerns can be beneficial to both employers and employees.

3. The Assessment of Need in Office Communications

Creating a network of communicating word processors between DOC headquarters and the Regional Offices provides a unique opportunity to assess the extent to which the introduction of this kind of equipment can alter the perceived communication needs of the participants. This requires that the participants be queried about the nature and extent of their communication needs before the equipment is installed, and then queried on exactly the same items after the equipment is installed. A comparison of the responses to these two queries will show the extent to which the equipment affects the perception of the communication needs of the participants.

This procedure is necessitated by two opposing effects which will be found. The first effect is a re-testing effect. If the query is administered too often, the participants will remember their answers to previous queries and tend to answer in the same way every time, simply because it is easier than re-examining their needs. Thus, it is important to minimize the number of queries and to maximize the interval between them. The second effect is known as the Hawthorn effect. People will change their behaviour simply as a result of a change in their environment, regardless of the nature of the change. This effect is strictly a result of the change and will disappear after a time. We could most effectively monitor the fading of this unwanted effect by having very frequent, identical queries as indicated above, however, frequent queries are not advised. Rather, another approach is recommended. The time interval between the installation of the equipment and the second query should be maximized so that most of the Hawthorn effect has disappeared. Then the results of the queries should be compared with the results of the other measures taken so that it can be determined that sufficient time has passed. For example, if participants said that they needed better overseas telephone links before the equipment was installed, but not after, and if it was determined that their pattern of communicating overseas had not changed, it would be assumed that their answers to the queries were still affected by the novelty of having the communicating

word processors, rather than by any actual use of the equipment.

The query could be either a questionnaire filled out by the participant or a strictly structured interview with the participant. An unstructured or open-ended interview would be inappropriate because it would make a comparison of the two queries impossible. A decision between the questionnaire and the interview must be made on practical and economic grounds, rather than as a matter of scientific necessity. Mailing a paper questionnaire would be much less expensive than interviews, but it would be impossible to guarantee a high response rate, particularly to the second query which occurs after the equipment is installed and is in use. The best compromise would be a telephone interview in which the answers to a few carefully chosen questions are solicited directly from each participant. Not only would this save considerable travel expenses, but would make it possible to have the same people conduct all of the interviews. This is desirable to ensure a standard procedure across both queries.

Further work will be required to develop the content of the queries because they must conform to the objectives of the study and must have some relationship to the other measures of communications which will be taken. In particular, a conceptual estimate of the user's needs based on an examination of present office procedures must guide this development. However, a first approximation to the content is appropriate at this time. The participants must have an opportunity to indicate the areas in which they have communications needs and whether these needs are satisfied. Thus, the query will consist of a series of questions of the following form:

Do you have to communicate by telephone constantly, most of the time, sometimes, seldom or never?

Is your access to telephone services better than you require, rarely inadequate, sometimes inadequate, often inadequate, or non-existent?

A similar pair of questions would be asked about each area of communications possible. This might include local and long distance telephones, internal and national mail services, inter-office memos, technical memos and reports, group meetings, individual visits, long-distance traveling, and other kinds of communications services.

Similar questions may also be asked about other aspects of communications, such as querying the need for communications within the office, to other offices in the region, to other regions, to headquarters, and to persons outside DOC. Finally, the query should end with an open-ended question, such as: What further information can you give us about the need for communications in your job? This will probably not provide measurable data, but will provide concrete cases which can be used as examples of the results.

4. User Participation

User participation in the field trials is essential if the full potential of the new system is to be exploited successfully. Moreover, user participation may even prevent system failure.

User participation in managing the process of change serves several useful purposes:

1. It is the single most effective means of minimizing resistance to change.

2. It ensures user co-operation in implementing the changes.

3. It can lead to better systems design through continuous feedback to systems designers and the administration.

4. It increases morale and motivation on the job.

Stages in the participation process:

1. General meeting of all people in a given region or HQ who are likely to be affected by the new system.
   (a) Give general background on pilot trial.
   (b) Explain that this is really just an experiment to see if it can help people do their jobs, etc. Tell them that if it doesn't work out (eg, a lot of problems), the new system will be thrown out. (Hawthorne effect)
   (c) Explain that you cannot carry out this "test" without their comments and suggestions.
   (d) Explain that you'd like a few users to participate in the process of designing new office procedures, evaluating the new system, suggesting changes and improvements. These users will meet and / or teleconference with systems design people and other program members.
   (e) Ask group to select a few people to represent them. Emphasize that it is not necessarily the bosses who should be on this committee but the people whose jobs will be most affected.

2. Hold first meeting with selected users right after other users have left, if possible.
   (a) Discuss terms of reference
   (b) Open discussion of impending changes, implications, and possible responses to change, etc.

3. Future meetings with both evaluation and systems staff.

5. Issues of Procedure

In order to determine the exact methodology required, a number of questions arise concerning the present and proposed communications procedures in the offices participating in this study. These questions center around the general issues of determining the present system of communications used, whether this system will be changed more than is absolutely required by the introduction of the communicating word processors, and whether we will have a direct influence on these changes.

1. What are the stages that most communications progress through?

2. How do these stages vary for different types of communications?

3. Do they vary from one region to the other?

4. Would we require the assistance of someone who is well versed in office procedures to understand this?

5. What changes will become necessary when word processors are introduced?

6. Will these changes occur naturally, or will they be deliberately directed in an organized fashion?

7. Will further changes be made which may be useful, but are not absolutely required?

8. Who will make such changes?

9. Will the same people make all the changes, or will there be inter-office and inter-regional differences?

10. Will we be able to talk to the people who make such decisions?

11. Will we be expected to make suggestions?

12. Can we influence any changes in procedure if they are required for an effective evaluation?

13. Will interim results of the evaluation be used to improve the communications procedures during the course of the evaluation?

6. Performance Measurement

Performance measurement can be subdivided into a number of stages:

A. BEFORE IMPLEMENTATION

1. Determine Players
2. Determine Objectives
3. Document Present System, Procedures, Layout
4. Determine Measures To Be Taken
5. Measure Performance

B. AFTER IMPLEMENTATION

6. Document New System, Procedures, Layout
7. Measure Performance

Before discussing these substages in depth, however, some general considerations will be presented that are important in the measurement of performance.

General Measurement Considerations

1. Validity and reliability checks. Measures will have to be checked to ensure (a) that they measure what they are purported to measure and (b) that the measures are reliable (repeatable).

2. Convergent measures. Whenever possible two or more measurement techniques or methods should be used to measure performance or behaviour. The second measure provides a check on the first to ensure that the measures are really measuring what they are purported to measure.

3. Non-reactive measures. Ways to measure the participants' behaviour which do not interfere with their activity must be discovered. These will be used in conjunction with the other measures which are easier to administer.

4. Levels of measurement. Measures of performance must be taken at three different levels of organization: machine, individual, and section (organizational unit). Restricting measurement to only one of the levels can be misleading when evaluating a new system.

5. Objective and goals. The objectives and goals for the pilot trial must be identified in order to determine the measures to be taken during the pilot trial.

6. Subjective versus objective measures. Both subjective judgments and objective measures will be taken during the trial. In general objective measures are to be preferred because they are less likely to be biased. Subjective measures, however, will be indispensible in some situations where no acceptable objective measure is available or practical.

7. Efficiency and effectiveness.

It is essential to distinguish between efficiency and effectiveness in the office.

1. Efficiency is the cost per unit output.
2. Effectiveness is production of the "right" output.

Productivity is just the inverse of efficiency; it is the amount of output per unit input (investment, work).

| | | | MEASURED IN |
|---|---|---|---|
| Efficiency | = | $\frac{\text{INPUT}}{\text{OUTPUT}}$ | # $ / UNIT |
| Productivity | = | $\frac{\text{OUTPUT}}{\text{INPUT}}$ | # UNITS / $ |
| Efficiency | = | $\frac{1}{\text{PRODUCTIVITY}}$ | |

Effectiveness differs from both efficiency and productivity in that:

1. it is a measure of the quality of a product,
2. it is a measure of the utility to the user, and
3. it represents a measure which is external to the office unit concerned.

Effectiveness is a measure of quality whereas efficiency and productivity are measures of quantity.

Effectiveness can be judged or measured on several different dimensions of utility:

1. timeliness
2. format
3. correspondence to client expectations
4. correspondence to market demands
5. packaging
6. costs
7. delivery
8. support services

8. Quantity vs quality. There is often a trade-off between quantity and quality: as quantity is increased quality decreases and vice versa. In evaluating the impact of office automation, it is essential to measure both quantity and quality to ensure that one is not increasing while the other is decreasing. A true improvement will either increase one factor without affecting the other or increase both factors simultaneously.

9. Value added versus cost displacement. Improvements in efficiency produce displacement of costs within the organization whereas improvements in effectiveness produce added value for the organization. Improvements in efficiency can usually be translated into savings whereas improvements in effectiveness are usually translated in better quality output. Both types of improvements must be investigated.

10. Direct versus indirect benefits and costs. Direct benefits are cost savings resulting from the elimination or increased efficiency of some process. Indirect benefits include all other types of benefits such as improved quality of product. Direct costs represent expenditures that are a direct result of the proposed system. Indirect costs are overhead costs not easily associated with the proposed change such as salaries. All types of costs and benefits must be assessed.

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