AD NUMBER
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CRC 286

MANPOWER PLANNING HANDBOOK

Volume IV: NavCommSta Fleet Center Division

August 1976

Prepared for:

COMMANDER,
NAVAL TELECOMMUNICATIONS COMMAND

By:

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Office of Naval Research
Department of the Navy
Washington, D.C. 20350

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aug 75

02 028604.00

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: 14 CRC-286-Vol-4

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): 6 Manpower Planning Handbook, Volume IV. ~~Vol. IV:~~ NavCommSta Fleet Center Division, ~~(4 volume research contribution)~~

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): 10 Bernard H. Rudwick, Michael E. Melich, Janice L. Kofman, Catherine E. Anderson, Laura H. Nunn

8. CONTRACT OR GRANT NUMBER(s): 15 N00014-68-A-0091-0018

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
Center for Naval Analyses
1401 Wilson Boulevard
Arlington, Virginia 22209

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 9 Research contribution,

11. CONTROLLING OFFICE NAME AND ADDRESS:
Office of Naval Research
Department of the Navy
Washington, D.C. 20350

12. REPORT DATE: 11 August 1976

13. NUMBER OF PAGES: ~~244~~ 12 249p.

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
Naval Telecommunications Command Headquarters
4401 Massachusetts Avenue, N.W.
Washington, D.C. 20390

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Distribution limited to U.S. Government agencies only; Test & Evaluation Information contained. August 1975. Other requests for this document must be referred to Commander Naval Telecommunications Command.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES
This Research Contribution does not necessarily represent the opinion of the Department of the Navy.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
billets (personnel), communications control, maintenance, manpower, Navy, operation, personnel planning, requirements, sites, transmitting

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Results of the fleet center manpower planning analysis are presented. The work systematically relates manpower requirements at each Naval communications station to the communications services it provides.

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DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

270700

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Subj: Center for Naval Analyses Research Contribution 286

Encl: (1) CRC 286, "Manpower Planning Handbook, Volume IV: NavComSta Fleet Center Division," Unclassified, August 1976

1. Enclosure (1) is forwarded as a matter of possible interest. It describes the planning logic and the 1975 planning factors for application in calculating manpower requirements for a fleet center division whose communications service requirements have been specified.

2. This volume reports the final results of the manpower planning analysis conducted for Command Naval Telecommunications Command by the Operations Evaluation Group of the Center for Naval Analyses. Volumes I, II and III of the Manpower Planning Handbook which deal respectively with the transmitter site, the electronic maintenance division, and the receiver site, have been distributed previously.

3. Research Contributions are distributed for their potential value in other studies and analyses. They do not necessarily represent the opinion of the Department of the Navy.

4. Although enclosure (1) is unclassified, it is not approved for public release.

Phil E. DePoy

PHIL E. DePOY
Director
Operations Evaluation Group

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FOREWORD

This volume presents the final results of the manpower planning analysis of the fleet center division, including the primary ship-to-shore jobs done at a receiver site (but excluding the message center branch). The work was done for ComNavTelComm by the Operations Evaluation Group (OEG) of the Center for Naval Analyses. The objective of the work described here is to systematically relate billet requirements of each Naval communications station (NavCommSta, or NCS) to the communications services it provides.

Volumes I, II, and III cover similar analyses of the transmitter sites, electronic maintenance divisions, and receiver sites at the same NavCommStas considered here.

The authors gratefully acknowledge the help of Diego R. Roque of OEG, particularly his work in obtaining work measurements at NCS Norfolk.

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INTRODUCTION

To relate manpower requirements to communications services provided by a Naval communications station, representative NavCommSta sites were asked a number of questions concerning their work during calendar year 1974 and the personnel used to do it:

- What jobs were done at the site within the scope of operations, maintenance, and support?
- How often were these jobs done?
- How many man-hours were needed to do each job?
- When a job was not done properly (that is, according to acceptability standards) because of a manpower shortage, how many man-hours would have been required to do so?
- How many people are now "on board," and how many were there during the past year?

Communications functions analyzed were: the transmitter site, the receiver site, the electronics maintenance division, and the fleet center division. These functions were the ones that would be most affected by the transition from high-frequency (HF) equipment to satellites. To reduce the amount of data obtained to some reasonable size, only the 4 automated NavCommStas participated in the project: Honolulu, Guam, Norfolk, and Italy.

The data obtained from the 4 sites was structured so that the number of man-hours required to do identical work could be compared and a consensus arrived at to perhaps serve as a reasonable manpower standard for this unit of work. By determining the units of each type of work associated with a particular site, the manpower units required could then be calculated. Such calculations are needed when:

- The annual manpower budget at each station is being prepared.
- Realignment options are prepared as the communications system is changed.

Based on the data gathered from the 4 participating fleet center divisions, we were able to construct a 1975 ComNavTelComm Transmitter Site Planning Guide containing:

Planning Factors Data Base

- A set of all operations, maintenance, and support jobs and the manpower required during 1974.
- A set of work loads associated with the various ship-to-shore message processing jobs (such as full-period termination send or receive) for each fleet center site analyzed. These work loads are expressed in both message-handling units (such as the number of full-period termination messages

received per year) and circuit usage (such as circuit-days expended in 1974).

- A set of Navy-approved work standards that can be compared with the set of jobs and operating hours and used as a basis for establishing ComNavTelComm planning standards.

Planning Logic

- A method of calculating total man-hours required in these personnel categories:
  - Operators.
  - Various support categories.
- A method of calculating billets required, based on the number of man-hours required, standard work-week characteristics, and various operational constraints.

The entire manpower planning process, including the standards recommended, has been reviewed and informally approved by Op-124.

To properly use the planning system, ComNavTelComm must now make these policy decisions:

- It (and the sites) should validate the planning factors data base and make certain that no required jobs are missing.
- Review the numerical values associated with the planning factors, particularly with the unit man-hour requirements at each site, among all 4 sites and against all Navy standards available. Then, for each work activity, decide on either one standard that will be applicable to all NavCommStas, or separate standards for each site based on factors unique to that site.
- Confirm which jobs are to be included as part of the site's work load in the planning process. There are many jobs that are not done at every site. For example, analysis of the other departments showed that the NCS Public Works Department may service an outlying site; in other cases, the site may service itself. In the case of maintenance jobs, there is no common policy regarding which maintenance tasks are required. Consequently, certain sites do planned maintenance tasks beyond that required by the Maintenance Requirements Card (MRC).
- Decide whether the difference in manpower observed among sites for doing a given job during 1974 resulted from some distinguishable difference (such as quality of manpower or environment) or from "statistical variations" and, therefore, some mean value can be assumed as a ComNavTelComm-wide standard.

- Validate the planning logic proposed.

The results of this review will provide the required inputs to the planner regarding which planning factor values to use in his analyses.

STRUCTURE OF THIS HANDBOOK

The sequence of topics covered by this handbook is:

- Overview of the Planning System--describes the proposed manpower planning process in terms of the inputs the planner must provide and the various planning factors used to convert the inputs into billet requirements.

- Summary of Planning Factors Data Base--describes each planning factor generated.

- Planning Logic--contains the procedures for calculating the number of billets needed to operate, maintain, and support a given fleet center division; this section also includes a set of work tables useful in systematically implementing the procedures.

- Appendix A--contains the details of the analysis and derivation of the planning factors; annex 1 to the appendix contains the sets of tables containing the actual data used and derived. (The data in the maintenance tables is also available on cards or 7-track magnetic tape for computer processing.)

OVERVIEW OF THE PLANNING SYSTEM

Figure 1 is a diagram of the manpower planning process as envisioned. Inputs to the process are the characteristics describing a specific system configuration at each site being analyzed. These characteristics include:

- Numbers and types of equipment to be kept in inventory at the site.
- Maintenance policy to be implemented, including what types of non-corrective (planned) maintenance jobs are to be done and how often.
- Operational use of the equipment in terms of the communications circuit being operated, the number of messages per year each circuit handled, equipment layout, and the type and frequency of other operating jobs being done.
- Equipment layout, which is important in determining how many circuits and jobs one operator can handle in parallel.
- The type and frequency of support jobs, such as cleaning and field days.

The system characteristics are then combined with planning factors (table 1) to give the man-hours needed for the various jobs. These man-hours are then converted to billets, using Navy standards for a work week.

BASIC ASSUMPTIONS

This section describes the various assumptions underlying the results.

The planning factors (table 1) were derived from 1974 operational data and are based on the best data available from each site as well as other sources. However, each site has been asked to upgrade its record keeping (mainly with respect to maintenance) and ensure it is recording the data requested. This way, more accurate information can be obtained in the future to revalidate the planning factors and upgrade their accuracy. But it is assumed here that the planning factors are valid and that an annual revalidation of the factors, based on 1975 work experience, will amend the data base as needed.

USE OF PLANNING FACTORS

The context in which the planning factors are to be used can be summarized this way. The systems planner does a set of preliminary analyses. He examines the need for communications services of various types, including geographical coverage, number of messages per unit time to be handled by each communications circuit (such as full-period termination vs. broadcast), division of responsibilities among NavCommStas, operating loads to be accommodated for both peak operations and the entire year, and

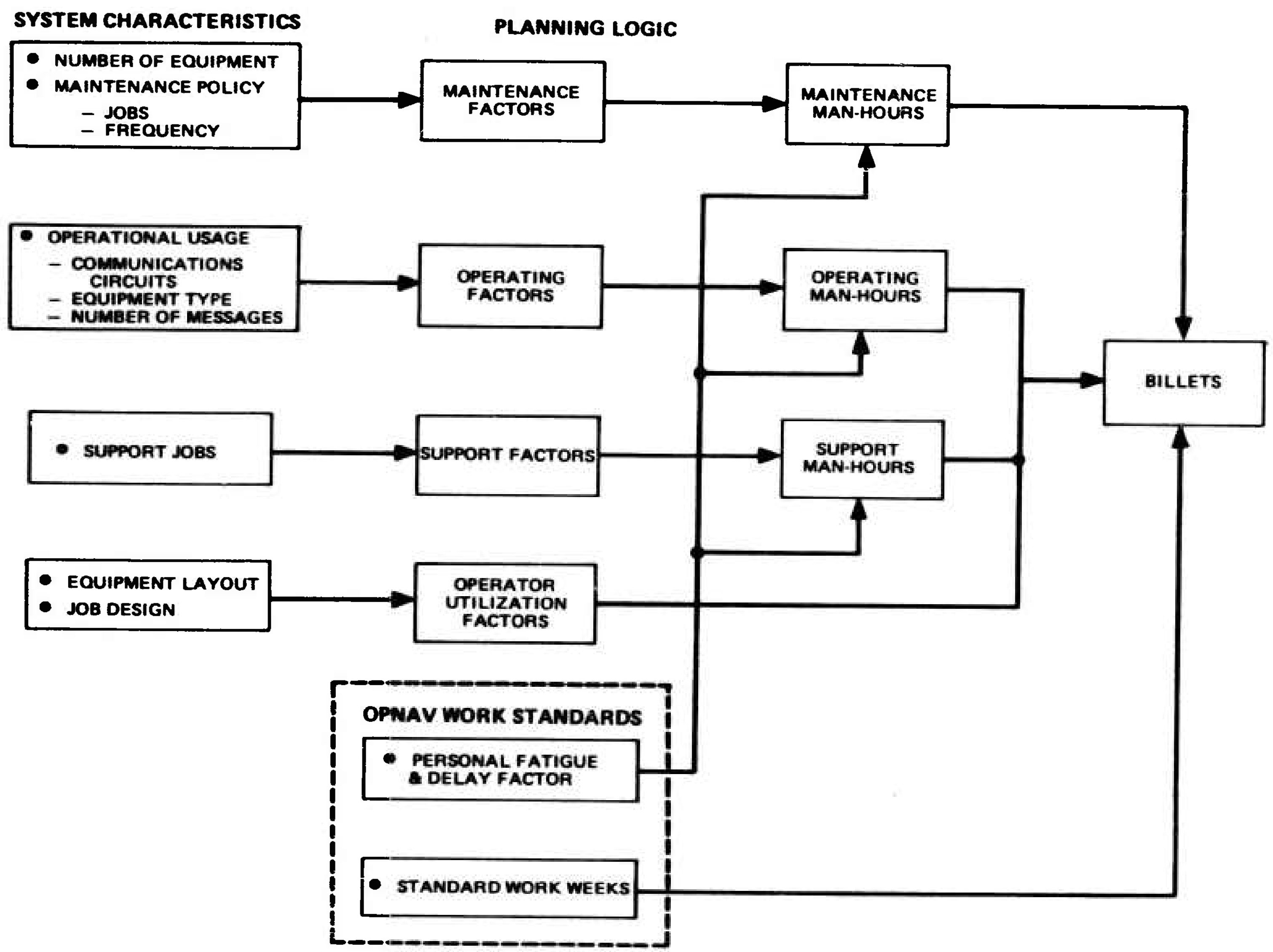

FIG. 1: MANPOWER PLANNING LOGIC

TABLE 1

FLEET CENTER PLANNING FACTORS

Maintenance

1. Operator planned maintenance subsystem (PMS) factors
2. Technician PMS factor
3. Make-ready, put-away time factor

Operations

4. Operational flow diagrams
5. Job activity time factors
6. Job activity frequency factors
7. Message length factors
8. Operator time ratios
9. Operational work load factors
10. Circuit usage factors
11. Additional operational activities factors

Support

12. Support collatoral duty factors
13. Supervisory overhead factors

OpNav work standards

14. Personal fatigue and delay (PF &D) factor
15. Standard work week

the division of these loads between satellite and HF equipment. Further system design considerations are then made, culminating in the configuration of alternative designs.

The types of data contained in this report are:

- Localized data--that is, the specific work characteristics at each of the 4 sites and the time it took during 1974 to do this work.

- Standard planning factors, which should be about the same from site to site for purposes of manpower planning. The main example of this is the time required to complete a given job; this time is derived as the "weighted mean" of the local times required to do the work, taking into account how often that job is done at each site.

- Planning factors that depend on the particular environment at a site. One example of this is the frequency with which a specific job is done at a site.

For each alternative being considered, this kind of information must be specified as inputs to the manpower planning system:

- The set of equipment to be in inventory at the station being considered, and their layout.

- Total maintenance policy to be followed; that is, whether the prescribed PMS schedule is being followed for each unit of equipment, PMS that the operator will handle, frequency of equipment overhaul, and the like.

- Specific operating procedures, as selected from the set of operational jobs listed in the data base.

- Operational use of the equipment; in the fleet center, this should be quantified in terms of the number of messages of a certain type handled each year, the number of circuit-days of operational use anticipated for each type of circuit, and the maximum number of circuits each operator can handle in parallel due to layout constraints.

- All support jobs required, as selected from the set of support jobs listed in the data base.

To help the planner estimate the amount of equipment operated, he may use the circuit usage planning factors. These include the number of circuit-days of operation last year for each communications circuit at each site.

The basic question is: For each system configuration being analyzed, how many billets of what type are required at each site for operation, maintenance, and support? The procedure followed is similar to the approach used by Op-124 and the Navy Manpower and Material Center (NavMMaC) in calculating billets required as a function of the average weekly work load at the site. Peak work loads that exceed the average are accommodated by:

- Using peak loaders for predictable peaks.

- Bringing maintenance and support personnel into operations activities if they can be trained to take on some of the simpler jobs during a peak.

- Working longer than the average standard shift or work week.

Overtime should be repaid with compensatory time off when work loads are below average. This policy is implicitly included in calculating billets based on the total annual work load because peaks are included in that total. All other assumptions are noted in appendix A.

SUMMARY OF PLANNING FACTORS DATA BASE

This section describes the planning factors derived. The values of these factors and the method used in deriving them appear in appendix A.

MAINTENANCE MANPOWER REQUIREMENTS

Table II-1[1] shows an inventory of all fleet center equipment being maintained. Unlike the transmitter and receiver sites, most of the maintenance jobs are done by civilian contractors or the electronics maintenance division. However, some maintenance is done by fleet center operators (and one electronics technician at Guam); see appendix A.

From this data, planning factors consisting of the man-hours per year needed to do the operator PM maintenance for each type of equipment at each site were derived. There are two types of maintenance manpower requirements:

- Site requirements--the number of operator PM maintenance man-hours that each site states it needs to achieve an acceptable performance level.
- Navy requirements--the number of operator PM maintenance man-hours that OpNav allows as acceptable for budgeting manpower.

Specific planning factors have been generated for all the maintenance jobs. These include Navy requirements, when available, for comparison.

PMS Factors

The allowable Navy requirement is to do the PMS actions specified on the MRC within the man-hours specified on the cards. The man-hours do not include make-ready and put-away time or personal fatigue and delay. The PMS man-hours for each equipment type are also given in table II-1.

Make-Ready, Put-Away Factor (No. 3)[2]

The allowable Navy requirement is 30 percent of the PMS time, as specified on the MRC.

Personal Fatigue and Delay Factor (No. 14)

The allowable Navy requirement is 17 percent of the PMS time.

Total Requirement for PMS

From the preceding considerations, the total allowable Navy requirement for each equipment unit is 1.47 times the PMS time. Table II-1 gives the site requirement for

[1] All tables cited in this section appear in annex 1 of appendix A.

[2] Planning factor number (see table 1).

each equipment type. The total site requirement is considerably under the Navy requirement, equaling or slightly above the PMS standard.

Operator PMS Factors (No. 1)

These make up that remaining portion of the total conventional PMS actions performed by operators, rather than by technicians. These times are given in table II-1.

Technicians PMS Factors (No. 2)

These make up that remaining portion of the total conventional PMS actions performed by a Guam fleet center technician. These times are given in table II-1.

OPERATIONS MANPOWER REQUIREMENTS

The planning factors relate the operator man-hours required to the work load for various message-processing jobs. Message-processing jobs that were analyzed and for which quantitative planning factors were derived are:

- Full-period termination, receive.
- Data speed reader.
- Full-period termination, send.
- Allied/NATO/SEATO, receive.
- Allied/NATO/SEATO, send.
- CW (continuous wave) broadcast.
- PG (patrol gunboat) broadcast.
- Encrypt message.
- Decrypt message.
- Service center.
- Data base operator.
- Router operator.
- In-router operator.

Operational Flow Diagrams (No. 4)

For each job analyzed, an operational flow diagram was constructed and used as the standard of comparison among sites. Planning factors 5 through 9 all relate to this standard.

Job Activity Times (No. 5)

Tables III-2 through III-46 include the average operator and total time to perform each activity associated with each job analyzed. In addition table IV-1a shows a comparison of times for what appears to be the same activity, although occurring in different jobs.

Job Activity Frequency Factors (No. 6)

Tables III-2 through III-46 include the average number of times each activity is performed per message processed for each job analyzed.

Message Length Factor (No. 7)

This consists of the average length of various messages associated with a job, including the incoming message, retransmission, service request, etc. These factors are also contained in tables III-2 through III-46.

Operator Time Ratios (No. 8)

Dividing the average operator time required per message by the average total time required per message yields operator time ratio, an important factor which will be used in calculating the average productivity of each operator. Sample calculations of these factors are given in tables III-2 through III-46.

Operational Work Load Factors (No. 9)

The primary characteristic of the work load is the total number of messages processed by each of the above jobs at each site during 1974. These factors are given in tables III-2 through III-46.

Circuit Usage Factors (No. 10)

Another characteristic (listed in table IV-1b) which quantifies the work load is the total number of circuit-days of usage associated with each message processing job, both during the entire 1974 and during a peak period of operation (an exercise). Dividing the former factor by 365 yields the average number of circuits used at each of the 4 sites. Dividing the latter by the number of days of the exercise yields the average number of circuits used during the peak. Factors 9 and 10 are given as a guide to estimating future work loads.

Additional Operational Activities Factors (No. 11)

Other operational jobs done by operators at any of the 4 sites are listed in table IV-2; this table includes all data describing these jobs, as submitted by the sites.

SUPPORT MANPOWER REQUIREMENTS

Support Collateral Duty Factors (No. 12)

These are concerned with the work done by nonsupervisory personnel in addition to their other duties. The man-hours required for these services are shown in tables IV-3 and IV-4.

Supervisory Factors (No. 13)

The supervisory overhead rates associated with each overall site and its subordinate components is given in tables I-3 and V-1.

OPNAV WORK STANDARDS

Personal Fatigue and Delay Factors (No. 14)

These total 17 percent of the working time applied to all jobs whose measurements consist only of productive work and do not include permissible breaks.

Standard Work Week (No. 15)

A standard work week of 40 hours and a "5-man-for-4-section"[1] watch is to be used. Taking into account service diversions, training, leave, and holidays, the hours available for work are 31.94 for military and 33.38 for civilian personnel.

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[1] Assigning 4 men for every watch position being manned continuously constitutes a 4-duty section watch. This results in a 42-hour work week (including meal time). Assigning a fifth man for each watch position allows for service diversions, training, leave, and holidays, and results in 33.6 hours per week available for work (including meal time).

PLANNING LOGIC

This section outlines the procedures for calculating the number of billets needed to operate, maintain, and support the equipment for the proposed alternative. Data used in making the calculations can be entered in the manpower planning work tables; suggested formats for these tables appear at the end of the section (work tables 1 through 3, page 25).

In summary the procedure is to calculate the man-hours per year required for all maintenance, operations and support jobs identified. These manpower requirements are then converted into billets by considering the standard work week, equipment layout constraints, and the operator utilization which results from such constraints.

MAINTENANCE MANPOWER REQUIREMENTS

Work Table 1

Equipment Needs

Decide on the numbers and types of equipment needed to be kept operationally ready for peak operations, such as major fleet exercises or contingencies. This information can be obtained from the users. The number includes spares. However, such needs should be confirmed by comparing the list of stated user needs with former usage under similar conditions. Such data, shown in table IV-1, includes the current COR (functions and number of circuits) as stated by each site, and the total circuit-days of usage for each COR function during the entire year as well as during the peak period. The average number of circuits used during the entire year was derived from this data (total circuit-days divided by 365). An estimate of the peak number of circuits used was also obtained by dividing the peak circuit-days by the length of the peak period. Additional data of this type should be collected as other exercises are conducted. List the equipment type in column 1 and the number required in column 2.

Planning Factors

Decide which planning factors are to be used for the realignment alternative under consideration. In general, these will consist of the ComNavTelComm-wide planning factors providing unit activity times, as well as those planning factors uniquely related to the particular geographic zone represented by one of the 4 sites.

Equipment Inventory

Decide on the equipment inventory to be maintained by fleet center personnel.[1]

PMS Man-Hours

Based on the PMS schedule that is to be followed by the fleet center operators, calculate the total PMS man-hours required for each equipment type. First, calculate the sum of the unit PM man-hours[2] needed for the total PMS schedule over the full year (from the list of all PMS jobs and their unit manpower requirements as included among the maintenance planning factors, see table II-1). List the unit PMS factors for operating personnel in column 3. The product of columns 2 and 3 gives the PMS man-hours required of operators; this number is listed in column 4. Find the total operator PMS man-hours (sum of column 4 entries).

The total operator man-hours required (column 4) should also include the appropriate "make ready and put-away" and PF&D factors. The OpNav requirements for these two factors are 30 and 17 percent, respectively. Thus, the OpNav requirement for operator PMS man-hours would be 1.47 times each of the totals shown in column 4.[3] This total should be listed as the last line of column 4.

CM Man-Hours

See volume II of this research contribution for the method of calculating the CM man-hours required for the electronics technicians at Guam.

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[1]Normal preventive and corrective maintenance is done by either the electronics maintenance division or civilian contractors; these manpower requirements are described in volume II. Volume IV (this volume) describes how to estimate the preventive maintenance done by the fleet center's operating personnel, as well as the PM maintenance for encrypting/decrypting equipment done by an electronics technician at Guam; see volume II on electronics maintenance for the method of calculating CM man-hours required.

[2]Unit PM man-hours is the annual man-hours needed to do PM for one piece of this equipment.

[3]This calculation is only valid when the Navy PMS standard is used, not when local standards are used.

OPERATING MANPOWER REQUIREMENTS FOR EACH JOB

This section shows how to calculate the man-hours required per year to operate each of the fleet center circuits and other jobs as analyzed. Appendix A gives several examples of this calculation. See particularly the analysis of the full-period termination, receive, job (table III-4). The logic to be followed may be summarized this way:

- Use as a work table format the particular table developed in appendix A to calculate the man-hours required for each job being analyzed (table III-4 for full-period terminations receive; table III-10 for DSR job; etc.).
- In column 1, list the major work functions involved for the job being analyzed.
- In columns 2 and 3, list the standard operator and total times required for each function.
- In columns 1, 2, and 3, also list any deviations from the standard times caused by the average message length at the particular time.
- In column 4, list the frequency factor associated with each function, following the formulas and planning factors listed for this job at this site.
- Calculate the average operator time required per message for each function as the product of the corresponding data of columns 2 and 4; list this in column 5.
- Calculate the average total time required per message for each function as the product of columns 2 and 4; list this in column 6.
- Calculate the average operator time and total time per message as the sum of columns 5 and 6, respectively.
- Estimate the total number of messages per year expected at the site for this (using the operational work load for factors as a guide); list this in the table as shown.
- Calculate the total operator man-hours required per year as the product of the operator time per message and the number of messages per year (converted to man-hours per year).

Adjusting for Operator Idle Time

In calculating the minimum number of man-hours required for each job, we assumed no operator (avoidable) idle time by using the average operator time per message rather than the average total time required per message. One major consideration affecting this idle time is the total number of circuits one operator can handle in parallel.

Referring to the FPT receiver example:

- Operator time per message = 101 seconds.
- Total time per message = 341 seconds.

From this, we calculated (in table III-4) the operator time ratio per circuit, defined as the ratio of average operator time to average total time per message (equal to 0.30 in the example).

Thus, if the operator were assigned only 2 FPT receive circuits to handle, his working time would be 202 seconds, and the total time would still be 341 seconds; operator idle time would be 139 seconds. Operator time ratio would then be 2 times 0.3, or 0.6. If the operator were assigned 3 circuits, the operator working time would be 303 seconds, and the operator time ratio would be 0.9.

But if the operator were assigned 4 FPT receive circuits, the operator time ratio would be 4 (101)/341, or 1.18. This ratio, however, can never exceed 1. So the calculation really means that the operator is fully utilized, and there is no idle time.

Consider another example. The operator is assigned 2 of these circuits, as well as a third circuit whose operator time ratio is 0.2. Thus, this operator's ratio is 2 (.32) + 1 (.2), or 0.84, and there is some idle time.

If the operator also had a fourth circuit of the second time, the ratio would be 2 (.32) + 2 (.2), or 1.04; the operator would be fully occupied and there would be no idle time.

Thus, in calculating the operator man-hours required for message processing, it is important that the operator time ratio be calculated as shown previously. If it is less than 1 (such as the Allied/NATO job, where the ratio is 0.1 for both send and receive jobs) the correct value of man-hours required be obtained (to include operator idle time) by dividing the first value obtained by the operator time ratio. Thus, if the operator handles M circuits of one type of job:

$$MH = \frac{(OT)\ (N)}{(OTR)\ (M)}$$

where MH = man-hours required;

OT = operator time/message;

N = number of messages per year;

OTR = operator time ratio per circuit;

and M = average number of circuits each operator handles in parallel.

When an operator handles more than one job, both the numerator and the denominator consist of the sum of the products indicated for each job. The denominator cannot exceed 1.

MANPOWER REQUIREMENTS FOR ADDITIONAL JOBS

Work Table 2

While the previous calculations determined the man-hour requirements for most operator positions, each of these positions have additional operating jobs as well as collateral support jobs as listed in tables IV-2, 3, and 4. Work table 2 relates each additional job to be done to each position doing it.

Additional Job Requirements

In columns 1 through 3 list information regarding all additional operational activities and support collateral duty jobs:

- In columns 1 and 2, list the job number and title of each of these jobs, using planning factors 11 and 12, (as approved by the command for each site, based on data in tables IV-2, and IV-4).
- In column 3, list the approved man-hours per year required for each job.

Positions Required

The next step is to allocate the total man-hours required among the position categories doing each job.

- Columns 4 through 7 of work table 2 list these positions:

  - Watchstander direct labor.
  - Watchstander supervisor.
  - Day worker.
  - Day supervisor.

- After consulting table I-1 and all other information available (as in appendix A), list, after column 7, all other position requirements, the titles of all other positions doing these jobs, but not included by columns 4 through 7.

- Allocate the total man-hours per year for each job (column 3) among the various position categories (columns 4 through 10).

TOTAL BILLET REQUIREMENTS

Work Table 3

The remainder of this section explains how to determine the billet requirements for each type of position analyzed--that is, full-period termination operator and allied operator. Unlike the other sites, where all operators do the same jobs, each fleet center operator is restricted to a specific set of jobs, and, therefore, a set of calculations must be made for each operator situation.

Two different methods were developed for making these calculations. The first method is to determine the total man-hours per year required to do all jobs associated with the position; using the standard work-week factor, calculate the number of billets required. Then various constraints are introduced, each tending to increase the number of billets. These include:

- The total number of billets required is, on the average, the number of circuits expected to be operating during the year divided by the maximum number of circuits one operator can handle in parallel because of the equipment layout at the site. That is, even if one operator could handle a given message rate, if these messages were distributed over a very large number of circuits, the extra walking time involved would probably require additional operators.

- A minimum of 5 billets per watchstanding position is required; (1 billet per watch).

The operator productivity is then calculated (the minimum number of billets required to do the actual work load divided by the number of billets required by layout considerations). If this productivity is low, consideration must be given to changing the equipment layout or job design so that one operator can operate more circuits.

The second method essentially goes through the same calculations, but in a different order. The first determination is the total number of operator billets required (the average number of circuits expected to be operating during the year divided by the maximum number of circuits one operator can handle). Again, a minimum of 5 billets per watchstanding position is required. Next, the operator productivity is calculated (as described previously) leading to equipment layout changes and job redesign for those positions having low utilization.

The first method was adopted and is described in greater detail.

Work Elements

List the operator position being analyzed at the top of work table 3, and, in column 1, list all work elements of that position which can be done in parallel by the operator while on watch:

- All operator message-processing jobs.
- Any operator PMS action (if applicable).
- All other operating activities.[1]
- Support collateral duty work done by operators.

Man-Hours for All Jobs

In column 2, list the operator man-hours per year required for each job in column 1. In the example shown in work table 4:

- A total of 4,076 man-hours (minimum) was calculated as being required for the full-period termination, receive, circuits.
- Assume that 408 man-hours are required to operate the full-period termination, send, automated circuits.
- No operator PMS is required for this position.
- Other jobs require 1,200 man-hours.

In all appropriate cases, the working man-hours must be converted into total man-hours by applying the PF&D factor (in column 3). Thus, the total number of man-hours for each work element is:

$$TOW = (1 + PF\&D)\ WMH,$$

where TOW is the total operator work load (listed in column 4), WMH is the working man-hours, and PF&D is the personal fatigue and delay factor.

[1] Any of these jobs that is done by an operator but that takes him away from his primary operating location may require a relief operator during the time the operator is away from his primary operating jobs. The relief operator could be the watch supervisor. In any case, if these additional jobs cannot be performed in parallel by the original operator, they must not be included in this operator billet calculation, but calculated separately in the same way as described here.

Generally, the PF&D factor is already included in the operator PMS and collateral support man-hours requirements; it therefore should not be listed in column 3 for these jobs. Obtain the total operator man-hours required (row 2 of the table) by adding the man-hours of all work elements; list the total in column 4.

Number of Watchstanders

The next step is to calculate the total number of billets required for each operator watchstander position considered. Because of layout and operational constraints, the planner must make a series of iterative calculations to arrive at the final value for watchstander billets.

Minimum Billets Required

The minimum number of operator billets, B_o, based on average work load, is determined first:

$$B_o = TOW/52\ (TAW),$$

where TOW is the total operator work load per year (as previously calculated);

and TAW is the time available for work per week.

According to the standard work week of 40 hours (where dependents are authorized), TAW should equal 31.94 hours per week for military and 33.98 hours per week for civilian personnel (reference 1). But a watchstander assigned to a 5-man-for-4-section watch is at his station 33.6 hours per week, less time out for meals. TAW therefore is based on a weighted average of these two factors, and it depends on the civilian-to-military mix at the fleet center.

For example, if there were 10 civilian to 40 military direct labor personnel at a site, the weighted average would be:

$$TAW = \frac{10\ (33.98) + 40\ (31.94)}{50} = 32.35 \text{ hours per week.}$$

Enter this value in row 3 and the results of the calculations B_o in row 4, column 5. Carry the billet calculations to the nearest 100th of a billet until all calculations are completed and round off fractional billets.

Equipment Layout

Another important consideration is equipment layout. Therefore, the average number of circuits expected to be used must be considered; (see table IV-1 for 1974 usage). Suppose that our illustration is for Guam, which used an average of 45.8 multichannel, single-channel, and dedicated circuits in 1974 for the work load calculated, as shown in table IV-1.

For the work load being considered, one man per watch could not handle all these circuits (even though he could handle the message work load if it were at 3 circuits) because of the extended layout of the circuits.[1] In fact, Guam recommends a manning of 7 billets per watch for its work load (considering both number of messages and circuits), as shown in table IV-1.

Additional billets per watch must be added, based on the maximum number of circuits one operator can handle (as opposed to message load, which has already been satisfied by the work load calculation). Guam's figure, 7 billets per watch (or a total of 35 billets) is the recommended manning for the 45.8 average circuits it states were active in 1974. This means one operator can handle an average of 6.5 circuits in parallel under relatively light loads.

List the total number of billets required in row 5, column 5.

Additional Constraint on Minimum Billets Per Watch

Check to ensure that there are at least 5 billets for each position (including supervisors). Also determine whether the safety requirement is satisfied (minimum of 2 men per watch in an isolated area).

Calculating Operator Productivity

Because Op-124 bases its billet allowance mainly on operator working time, and the compartmentalizing of jobs invariably leads to lower operator utilization because of all the factors described, it is up to each site to defend its billet recommendations for all positions in which there is considerable operator idle time. This may be done by calculating the operator productivity for each position, (defined as that proportion

[1] Our analysis assumes that the activity times submitted by the sites, from which the standard activity times and man-hours required are derived, include delays incurred in the operator's moving from one circuit to another during normal operation. If this assumption is incorrect, an additional average walking time would have to be added to the total time required for those operators whose work stations are separated by a substantial distance. Furthermore, our method of calculating man-hours would also show the extra man-hours required by the large number of circuits because we would add "walking from circuit to circuit"; thus, the average operator time required per message would increase.

of time the operator is actually working). For those positions whose operator productivity is low, consideration must be given by the site to:

- Changing the layout of the equipment so that the operator can handle more circuits in parallel.
- Redesigning the total set of positions to include the possibility of combining low productivity positions, thereby reducing the total number of positions required.
- Using working supervisors to accomplish the same effect.

If none of these can be done, the site has the responsibility to show that they were considered and why it cannot be done.

Operator productivity (OP) for each position may be calculated this way:

$$OP = \frac{B_o}{B_r} \quad ,$$

where OP = operator productivity;

B_o = minimum operator billets as originally calculated and; based on the total operator per work load;

and B_r = operator billets required, as finally calculated, based on the other constraints.

Fractional Manpower Cutoffs

After the number of billets for each function has been calculated to the nearest 100th of a billet, fractional manning problems may arise. In the past, this was solved by arbitrarily selecting the equivalent 0.5 as the cutoff point. Any work load that earned at least 0.5 space was awarded the next whole number without regard to the size of the work center. Those that earned less than 0.5 did not get the extra manpower (reference 2).

Overload factors are based on the premise that separate criteria should be applied to small and large work centers. A maximum individual work overload is established at 0.5 hour per working day and is cumulative until reaching a maximum of 0.5 billets. The cutoff point is the highest value the fractional manpower can equate to before the manpower requirement is rounded to the next higher integer. Table 2 shows the fractional manpower cutoff points for both military and civilian workers.

TABLE 2

FRACTIONAL MANPOWER CUTOFFS FOR COMPUTING STANDARDS

Manpower authorized		Fractional manpower cutoff Military	Civilian
1		1.081	1.078
2		2.162	2.155
3		3.243	3.233
4		4.324	4.310
5		5.405	5.388
6		6.486	6.466
7		7.500	7.500
Over 7	Authorized manpower	+0.500	0.500

Determine the number of other nonsupervisory watchstanders (such as computer operators and programmers) and watch supervisors required. Since no quantitative data regarding the work done by people in these positions was supplied by the sites, judgment must be used when allocating these positions. References 3 and 4 describe these positions and recommend a billet allocation; those references can be used as a guide. This allocation should be made uniformly unless environmental conditions at the different sites vary the work load for these positions.

Dealing with Periodic Peak Loads

Since the operator work load (number of messages or circuits, whichever is the limiting factor) is generally distributed unequally among the 4 watch sections) the total billets required should not be distributed equally throughout the watch sections. This, of course, is the peak loader concept, in which the total number of billets is distributed according to the work load on each of the 4 watch sections. The following example shows how to calculate total billet requirements from an operational viewpoint, that these watchstanders are required:

- Three watchstanders on each of the first and second watches over the 5 weekdays only; 30 watch-positions.

- One watchstander on each of the first and second watches, weekdays; 5 watch-positions.
- One watchstander on each of the 3 watches, weekends; 6 watch-positions.
- Total = 41 watch-positions.

Since 5 billets equal 21 watch positions, a total of 9.8 billets is required.

DEALING WITH PEAK LOADS FROM FLEET EXERCISES AND CONTINGENCIES

In accordance with Op-124's billeting policies, peak work loads can only be handled by:

- Reducing the number of watch sections.
- Transferring men to the site from reserve components or from other sites not affected.
- Cross training individuals for less complex jobs in the fleet center and deferring some of the less critical jobs. These men thus may be used in the fleet center to handle some of the work load.

Dealing with Random Peak Loads

These peaks, which do not occur periodically, may be handled this way:

- The precedence system, which allows higher-precedence traffic to be handled first within allowable time lags at the cost of delays in lower-precedence traffic. If the higher-precedence traffic constitutes such a large proportion of the total traffic that the time delay standards are not met (as shown by work samples), a case can be made for an increase in billets.
- Any backlog at the end of each shift should be eliminated by extending the shift, thus doubling the manpower available. In a worst case, asking some watch personnel to come in an hour early may be possible sometimes. Obviously, the extra time spent by an operator should be compensated for when the work load is down.

The annual work load includes at least one fleet exercise containing a peak work load; therefore, the number of billets required already exceeds the normal average, excluding fleet exercise work loads.

Number of Support Personnel

Since no quantitative data regarding the work load of support personnel was submitted by the sites, the required number of billets for these positions must be determined by experience, as described previously for watchstanders.

Number of Watch Supervisors Required

Determine the number of watch supervisors, B_{ws}, assigned to the watch:

$$B_{ws} = B_{wo} S_{rw}$$

where B_{ws} = number of watch supervisor billets required;

B_{wo} = number of watch operator billets required;

and S_{rw} = watch supervisor overhead ratio.

Qualitative Requirements

Next, determine the qualitative requirements of each position in terms of designator, grade, rate, and series. This should be done uniformly, based on the total number of people required in each functional unit.

WORK TABLE 1

OPERATOR PREVENTIVE MAINTENANCE MAN-HOUR REQUIREMENTS

(1) Equipment required	(2)	(3) Total operator PMS factors	PMS operator man-hours
Type	Number		

WORK TABLE 2

RELATING MAN-HOUR REQUIREMENTS FOR ADDITIONAL OPERATING JOBS AND COLLATORAL SUPPORT TO POSITIONS FOR A SITE

Operational activities and collatoral support jobs			Postition categories			
(1)	(2)	(3)	Watch stander, direct labor	Watch stander supervisor	Day worker, direct labor	Day worker, supervisor
Job number	Job title	Total man-hrs/year	(4)	(5)	(6)	(7)

WORK TABLE 3

CALCULATING BILLET REQUIREMENTS: FULL-PERIOD TERMINATION OPERATOR (Illustration)

(1)	(2) Man-hrs required	(3) PF&D factor	(4) Total operator work load	(5) Numerical factor
1. Work elements				
• FPT receive	4,076	1.17	4,769	
• FPT send	408	1.17	477	
• Operator PMS	0	Included	0	
• Other operating activities	1,200	Included	1,200	
• collatoral support	0	Included	0	
2. Total operator man-hrs required			6,446	
3. Standard work week for labor mix (hours)				32.35
4. Minimum number billets required (B_o)				3.83
5. Number billets required by layout				35
6. Operator productivity				10.9%

REFERENCES

1. OpNav 12P-6, "Manpower Requirements Program," Unclassified, 29 May 1974

2. OpNav 12P-8, "Manpower Requirements Program," Chapter IV, Unclassified, 23 Jan 1973

3. Personnel Research Division, Bureau of Naval Personnel Report No. 90-73-2, "Personnel and Training Requirements for the Interim (leased) LDMX/NavComPars Systems," Unclassified, Sep 1972

4. Naval Ship Systems Command (Ships 0473) Report No. 047C-74, "Revised Manning Requirements and Personnel Cost Savings for the Leased LDMX/NavComPars Systems," Unclassified Jun 1974

APPENDIX A

ANALYSIS AND DERIVATION OF PLANNING FACTORS

APPENDIX A

ANALYSIS AND DERIVATION OF PLANNING FACTORS

This appendix describes the planning factors and how they were derived for the operations, maintenance, and support functions analyzed. Data as submitted by each site is on file at CNA. As table 1 of the main text shows, 15 basic planning factors have been derived for those functions. Each factor is described here, indicating:

- Numerical values of the recommended planning factors.
- How the original data submitted by the 4 sites was converted into planning factors.
- Existence of Navy work standards and their use in this analysis.
- Organization of the planning factors data base so that the planner, following the planning logic described in the main section, can retrieve desired values from the data base.
- Other planning information derived during the analysis.

PERSONNEL INFORMATION

The main objectives of this analysis was to:

- Compare current manning for each comparable position, at all 4 sites, to serve as a guide for ComNavTelComm in uniformly allocating billets to those positions for which the sites did not submit quantitative data.
- Determine the appropriate supervisory "overhead" factor now associated with each work function. However, one by-product was a list of all billet titles for all personnel at each site. A comparison of each station's billet titles with a master list was generated, and each station's title preferences given. This structure was generated to aid Code-01 in formulating a final, preferred set of standard billet titles.

Uniform Billet Titles

Table I-1 of annex 1 is a composite of all billets filled as of the survey date and as submitted by each of the 4 sites. Column 1 is a master list of practically all billets commonly associated with fleet centers. These billets are grouped into branches.

The billets reported at Honolulu, Guam, Norfolk, and Italy were then matched against this list, as shown in columns 2, 3, 4, and 5, respectively. As in the original data, the word "same" in place of a billet title indicates that the site uses the master position title; another title indicates the title now used there. Following the billet titles are several numerical designations appearing in parentheses:

- A number indicates the number of billets on duty holding this position.
- A percentage indicates the percent of time each person in this position spends in nonsupervisory (direct labor) work; 10 percent indicates this is a supervisor. No percent designation indicates this is a nonsupervisor.

Billets that do not correspond to the master list are also listed in the division in which they exist, with the same letter designation used in that site's original data. Billet A at one site need not be the same as billet A at another site, since the original data forms were completed independently with only the master billet list as a guide. Lettered billets from different sites apparently relating to one another, yet having different billet titles, are clustered near each other.

Although all billets in the master list appear in column 1, there are billets that do not exist at any of the 4 sites.

Table I-1 was created to help in developing a set of uniform billet titles. Titles now in use can be compared with those shown in this list and a decision made by the command concerning the preferred set of billet titles.

Annex 1 contains inputs from Honolulu (describing its billets), and Guam (indicating the tasks some of its nonstandard billets do).

Manning Distribution

Table I-2 of annex 1 gives total manning used for fleet center operations, maintenance, support, and general management (that is, the supervisors in the management group office) at the sites. The numbers of direct labor, functional support, and supervisory personnel are also indicated within each division, as is the military-civilian composition of each category.

Table I-3 also shows the manning distribution of labor between day workers and watchstanders. The purpose of tables I-2 and I-3 is to compare distributions of the fleet center personnel among sites, as well as provide a basis for deriving supervisory overhead rates (described under support manpower requirements).

MAINTENANCE MANPOWER REQUIREMENTS

The large majority of PM and CM actions are done by personnel from the electronics maintenance division, or, in the case of NavComPARs equipment, by civilian contractor personnel under a separate maintenance contract. However, Honolulu and Guam indicated their fleet center personnel also do this maintenance:

- Honolulu operators do PM on these types of UNIVAC 70/42 equipment:

Maintenance number	Equipment	Man-hours per year
26	12 magnetic tape stations	1,095
	2 card readers	182.5
	1 medium-speed printer	182.5
	1 mass-storage unit	91.25
	- filters	26
27	1 medium-speed printer	182.5
28	1 paper tape reader/punch	91.25

- Guam operators do operator PM on most of that site's equipment (with CM done by the electronic maintenance division).

- A Guam electronic technician does both PM and CM for its encrypting/decrypting equipment.

The analysis described here shows how the planning factors for fleet center personnel were derived. (See also table II-1 of volume II; that table shows the planning factors for the maintenance done on the same fleet center equipment by electronics maintenance personnel.)

Data Organization

Table II-1 of annex 1 deals with the maintenance planning factors associated with fleet center personnel, and are derived from the data submitted by the 4 sites.

Table II-1 gives numbers and types of all equipment being maintained at the 4 sites. This equipment is listed alphabetically and described in column 2 and numbered sequentially in column 1. As a cross-reference to locate the data in that table, the maintenance numbers as originally given by each site are listed in column 3.

Column 4 gives the number of units of equipment of each type at the sites. When the number maintained is different from the total number on hand, this is also indicated, and the latter figure is the one used in all calculations to determine unit times.

The total man-hours per year needed for both CM and conventional PMS maintenance for one unit of each piece of equipment is given in column 5. In all cases, time for breaks and make-ready, put away are included.

Columns 6, 7, and 8 list man-hours needed for different aspects of conventional planned maintenance. It is assumed (but not explicitly stated by Honolulu and Guam) that these times were taken from the MRC cards. Column 6 gives the standard times reported by the sites for planned maintenance by operator personnel on one unit of equipment (planning factor 1). Column 7 gives the equivalent standard times by maintenance technicians (planning factor 2). Column 8 gives the total of these two times, which is the annual man-hours required to perform minimum PMS on one unit of equipment.

Column 8 also includes the official MRC standards for PMS as obtained from Code-04 Readiness Department. In some cases, the standard differs from different models of the same equipment; the range of values separated by a slash is given for those instances.

Column 9 gives the annual man-hours the sites reported as necessary for conventional planned maintenance on one unit of equipment. These times usually were very close to the PMS standards. This was expected, since all sites indicated they did not keep records of PM work times; instead, they based their PM requirements on the PMS standards.

Another source of maintenance manpower standards was also examined -- the maintenance standards used by the Navy Security Group. These maintenance standards are important to this project because:

- The Navy Security Group has many kinds of equipment common to NavCommSta equipment at other sites being analyzed.
- The logic used to derive maintenance requirements correlates closely with the logic proposed in this analysis.
- The Navy Security Group's maintenance needs compare favorably with the U.S. Army's and Air Force's maintenance records for the same equipment; these have been officially approved as the Service Cryptologic Agencies (SCA) standard by the Director of Defense Research and Engineering (DDR&E).

The SCA standards obtained also appear in column 5. Use of this standard is described elsewhere in this analysis.

Column 10 is used to display corrective maintenance planning factors (number 5) for the encrypting/decrypting equipment reported by Guam. This is the average man-hours per year for one unit of equipment that the sites reported as required to do all corrective maintenance, including parts replacement during PM.

A review of Guam's maintenance data as submitted indicated inconsistencies. Both the PM required and the PMS standard for maintenance 11 (model 28 reperforators) was shown as 52 man-hours for 2 units. Thus, the PMS standard in table II-1 was shown as 52, but the unit PM required was shown as 26. Guam should correct this value if it is an error.

ANALYSIS OF MAINTENANCE DATA

Since only Honolulu and Guam reported maintenance requirements (but gave no specifics regarding what work was done), it is important that this interpretation of their data be validated by them:

- The PM they do follows MRC requirements. (If not, the specific jobs must be identified.)
- PM standards listed in columns 6 through 8 were obtained from the MRC card (source is cited).
- The same maintenance work is done for the other sites by the electronics maintenance division.

The analysis consisted of comparing the man-hours reported by each site to do PM or CM against official Navy standards, which were identified and approved by Op-124. In all cases, the site requirement for PM was equal to the PMS standard listed by the site. However, in most cases, the PMS standard could not be validated by CNTC Code-04, and this should be done.

These site maintenance requirements were then compared with Navy maintenance standards approved by Op-124. While these standards were constructed for communications equipment used by the fleet, they are the best data available to Op-124. The standards were obtained this way:

- The PMS standard listed on the MRC card is the official requirement for PM actions. But the PMS standard is for working time only; an additional 17 percent is allowed for PF&D (planning factor 14).
- The PMS standard does not include make-ready and put-away time, which is allowed as an additional factor (number 3); no official time has been set by the Navy. The exact amount of time is a function of the distance from where the tools and parts are kept to where the equipment is located, and how many times the same tools are used in maintenance at that location. Op-124 permits a factor of 30 percent for the fleet, and has indicated it will also permit a 30-percent factor for shore stations until a thorough study can be made.

Thus, the total Navy PM requirement for work specified on the MRC card is 1.47 times the PMS standard, exceeding the requirements stated by the sites.

While there is no Navy CM standard similar to the PMS standard, there is an OpNav policy used for fleet manning purposes--paragraph 106.1c (6) of reference A-2. This policy states that for every hour of CM action, one hour of PM action is needed for electronic equipment. Op-124 further interprets this policy for determining billet requirements by estimating the CM man-hours required for the fleet as being equal to the total PMS man-hours required. Again, it will permit this factor to be used as the Navy requirement for shore stations until a more thorough study can be made. The CM-to-PM man-hour ratio was therefore calculated for each station, using the PMS standard man-hours as a reference. An appropriate CM:PM ratio thus can be used as a standard for each site or for the entire command.

The total maintenance requirement for fleet operations is therefore 2.94 PMS time. Additional man-hours for extra non-CM maintenance appear on MRC cards when officially approved by NavMat.

The maintenance standard used by the SCA was found to be 3 times the PMS man-hours, reasonably close to the Op-124 standard.

With the preceding discussion in mind, we next compared Guam's CM requirements for its crypto equipment with the Navy requirement. We found the site requirement to be 1.23 times the PMS standard, whereas the Navy requirement was 1.47 times the PMS standard, a satisfactory situtation.

OPERATIONAL MANPOWER REQUIREMENTS

This section describes how to calculate the man-hours required to perform each of the message processing jobs at a fleet center. The method for converting these man-hours into the number of billets required is described in the planning logic.

The operational manpower planning factors derived to make the man-hour calculations are based on this model of fleet center operations (validated by the sites):

- The entire message-processing effort performed at a fleet center (or at a receiver site) can be divided into a set of operations, such as the full-period termination operation or the Allied/NATO/SEATO operation, as shown in column 1, table III-1.

- Each operation is done at a work station consisting of a set of equipment and manned by an operator, as shown in column 3.

- Each operation consists of one or more jobs, as shown in column 1. For example, the full-period termination operator handles both receive and send circuits, as does the Allied/NATO/SEATO operator. In addition, an operator may also have certain collateral support duties, such as cleaning.

- The total inventory at each site for each equipment type is listed in column 2.

- Each job can be modeled as a sequence of activities and illustrated as a flow diagram.

- The basic planning factors derived for each job consist of:

  - The sequence of activities associated with the job (that is, the procedure used). For manpower planning, this should be fairly standard within the command.

  - The average time required to do each activity associated with the job; this should also be standard within the command.

  - The average proportion of time each activity is done during the processing of a single message. With some activities, such as transmitting a send message or logging in the message, the activity is done exactly once for each message; therefore, the proportion equals one. With other activities, such as retransmissions or piecing of a message, the proportion may be less than one; with others, it may be greater than one. This factor often depends heavily on HF propagation characteristics or other local conditions, and is generally unique to a particular site.

  - The average message lengths; this can be unique to each site if large differences exist among sites, and it will influence certain activity times.

  - The number of messages processed by this job last year; this is unique to each site and may be used as an indicator of next year's traffic load.

- From these basic planning factors, two higher-level planning factors unique to each site have been calculated:

  - The average total time to satisfactorily complete all activities (both operator and machine) involved in one work unit of each job (such as one FPT-receive message). This time was obtained from an expected value calculation, taking into account all the activities involved in the job and and the proportion of time each activity is performed during an average message.

- The average total time the operator is occupied during completion of the work unit; this time is calculated the same as total time but, in this case, only those activities in which the operator is working on this job are considered.

• Thus, the annual operator man-hours required at a site to process the given number of messages per year can be calculated as the product of the average operator time required to process one message times the total number of messages to be processed by the particular site.

However, to obtain the total operator work load per year, these factors must also be considered:

- All the jobs handled by this operator.
- Any additional, unavoidable operator idle time not already included.
- PF&D factor.

These factors and how they are combined are described in that part of the planning logic dealing with calculating total billet requirements.

In the analysis that follows, the derivation and results of the basic planning factors associated with the following jobs are presented, plus some calculations for determining the operator man-hours required per year for each job.

- Full-period termination, receive.
- Data speed-reader job.
- Full-period termination, send.
- Primary ship-to-shore.
- Allied/NATO/SEATO receive.
- Allied/NATO/SEATO send.
- Continuous Wave (CW) broadcast.
- Patrol Gunboat (PG) broadcast.
- Encrypt message.
- Decrypt message.

- Service center.
- Data base operator.
- Router VDT operator.
- Inrouter VDT operator.

The last 2 operators are considered part of the message center; they are outside the scope of this report. However, quantitative data was submitted by Guam and the analysis of this data was presented.

Maximum detail is presented in the description of the full-termination, receive, job to illustrate the approach used. All subsequent jobs follow the same format, and the same amount of detail is not needed.

Correlation of Activity Times

A further check on the activity times submitted by the various sites was made by comparing the standard times derived for each similar activity regardless of which job the same activity was used. This comparison is given in table IV-1. From this data, any job containing an activity time that lies outside normally expected deviations may be detected. This information (and the reasons for it) will be important when this data is reviewed by the sites and the command.

ADDITIONAL OPERATIONAL ACTIVITIES FACTORS

Various sites submitted information concerning other operational tasks done by their operators in addition to primary message processing duties. Unfortunately, not enough quantitative data was provided to permit generating planning factors of the same accuracy as for the message processing jobs.

The data submitted is given in table IV-2, it constitutes planning factor 11, and lists:

- The operator position.
- Description of the job done.
- An indication of the percentage of the total productive time required, sometimes merely that he does the job; the latter is indicated by a check mark.

The sites should review the total set of data and, by taking further work samples, determine more accurately how many man-hours per year are required for each job. The data should be submitted in the same form as the collateral support data of table IV-4. Furthermore, by presenting the entire set of data to all sites, those sites that may have overlooked certain jobs that their operators do may now have an additional opportunity to include them.

SUPPORT MANPOWER REQUIREMENTS

Two types of support work loads are identified:

- Support collateral duty work load -- that work done by nonsupervisory personnel in addition to their primary duties.
- Supervisory work load -- that work done by nondirect labor supervisors.

Support Collateral Duty Factors

Table IV-3 is a composite of support collateral duty jobs now being done at the 4 sites and constitutes planning factor 12. Column 1 briefly describes the type of job involved, such as cleaning. This is followed by a list of support jobs, by number, as a cross reference to the data submitted by each site, and the total man-hours per year required to do each job clustered in that job category. A more detailed description of those collateral support jobs appears in table IV-4, including the method for calculating support.

Columns 1, 2, and 3 of the table describe the job and the work unit measure. Column 4 is the hours needed by one man to complete one work unit. Column 5 is the number of work units done per week by all the men involved; it is thus the product of the number of times each man does a work unit per week and the number of men doing them simultaneously. Column 6 is the total man-hours per year required for the job, and consists of 52 times columns 4 and 5.

A lack of submitted data prevented a detailed work analysis. As with qualitatively analyzed positions, it will be necessary for ComNavTelComm to review these lists and decide:

- Which collateral jobs must be done, and how often.
- How many man-hours are needed for each job. Op-124 stresses that requirements can include only working time; for "on-call" duty, only actual working time can be counted.
- Who should do the work, including the possibility of outside personnel.

Supervisory Factors

Another support planning factor is the supervisory overhead rate (planning factor 13), which is the total number of full-time equivalent nonsupervisory (now on board) personnel in the organizational unit being analyzed.

This calculation was made for each of these organizational components:

- Total site overhead.
- General management (percent of total direct labor).
- Watch operations (including maintenance personnel on watch).
- Total operations division (total watch and day operations personnel).

The data shown in table I-3 is organized into the above components and arranged into total full-time equivalent direct labor and supervisors and the calculated supervisory overhead factors within these components. The results of these calculations are part of table I-3, and extracted in V-1. The most important set of numbers is the overall site supervisory overhead ratio. There is no Navy requirement as to what this ratio should be.

OTHER POSITION REQUIREMENTS

A number of positions are required at the sites, but we were not able to analyze these quantitatively in the same way as was done in the preceding sections. No quantitative data describing the work by those positions was submitted by any of the sites.

To systematically assign these billets, the command must analyze these positions and determine:

- The work functions being done and whether they are required at each site that has the billet listed. It must also be confirmed that this work cannot be done by any other of the station's components or other Navy support activities because of the site's distance from a regular Navy base. (Appendix B of reference A-3 contains the set of tasks relating to the master billets listed.)

- How many full-time equivalent workers are really required for this work function at each site. This depends on the size and layout of each site and whether the function is (or can be) provided to any extent by the main station or by other Navy support services (such as regional medical services).

To aid the command in making these judgments, this information is provided:

- References 3 and 4 of the main text contain independent recommendations of the number of billets required based primarily on the judgment of the authors, rather than an objective analysis. In many cases, the recommendation is for one billet per watch section or for the day shift and, therefore, should satisfy Op-124. However, care should be taken to determine whether any of these positions can be combined with a low operator utilization position (if there is any question regarding operator utilization).

- Table I-1, which shows the number of people now manning each position.
- The list of tasks associated with each position, as given in appendix B, volume II of reference A-1, and the job description for each position as available at the command.
- The existing supervisory overhead rates, as shown in table I-3.

Based on this information, plus the experience of the command, a recommended billet number for each position can be made on a uniform basis for a "typical site," in which plus and minus deviations can be made, taking into account considerations such as the size of the site, its layout, etc.

OP-124 WORK STANDARDS

Work standards provided by Op-124 as planning factors are described in this section.

Personal Fatigue and Delay (PF&D) Factor (Planning Factor 15)

Op-124 allows a PF&D factor of 17 percent of productive work time for blue-collar workers for all work stoppages, including personal relief. When deriving the total man-hours, it is necessary to determine whether the measure consisted of only productive work time (such as would be obtained through work samples), or whether the time also included various work stoppages--such as coffee breaks--as in the corrective maintenance times recorded.

Standard Work Week (Planning Factor 16)

Standard Work Week for Military Personnel Ashore

The standard work week (reference 1 of the main text) for military personnel at CONUS activities and overseas bases where dependents are authorized is 40 hours. Included in this work week is an allowance for service diversions; this allowance provides for quarters, sick call, personal business, etc. The 40-hour standard work week for military consists of:

	Hours per week
Service diversion training	4.83
Leave	1.85
Holidays	1.38
Time available for work	31.94
Total	40.00

The standard work week for military ashore at CONUS activities and overseas where dependents are not authorized should be computed this way:

	Time available for work	Nonavailable hours	Total
Continuous shift watchstander	60.0	6.0	66.0
Duty status watchstander	61.7	6.0	67.7
Nonwatchstander	51.1	6.0	57.0

The work week for military firefighters and other watchstanding personnel using the 72-hour work week is:

	Hours per week
Service diversions training	4.83
Leave	5.07
Available for work	62.10
Total	72.00

Standard Work Week for Civilians

The standard work week for civilians is 40 hours. Training includes classroom lectures, on-the-job instructions, and safety indoctrination. Diversions include minor unavoidable delays such as fire drills, chest X-rays, voting, blood donations, etc. The 40-hour standard work week for civilians consists of:

	Hours per week
Leave	4.60
Holidays	1.38
Training	0.22
Diversions	0.44
Time available for work	33.38
Total	40.00

The standard work week for civilian supervisory firefighters using the 56-hour work week is:

	Hours per week
Leave	6.37
Training	0.20
Diversions	0.44
Available for work	48.99
Total	56.00

The standard work week for civilian firefighters using the 72-hour work week is:

	Hours per week
Leave	8.21
Training	0.20
Diversions	0.44
Available for work	63.15
Total	72.00

REFERENCES

A-1. Navy Manpower Shore Survey Team, Norfolk #2, Navy Manpower and Material Analysis Center, Atlantic, "Shore Manning Document, NCS Washington, Cheltenham Survey Dates: 12 Sep-13 Oct 1972, " Unclassified; "NCS San Francisco Survey Dates: 7 Nov-1 Dec 1972, " Unclassified

A-2. OpNav 12P-4, "Guide to the Preparation of Ship Manning Document, " Unclassified, 1971

A-3. Center for Naval Analyses Memorandum, (CNA) 74-1822, (Vol. I) and (CNA) 74-1823 (Vol. II) "NAVCOMMSTA Manpower Planning Analysis, Fleet Center Division" Unclassified, 18 Nov 1974

APPENDIX A

ANNEX 1

DATA

BILLET REQUIREMENTS PROVIDED
BY FLEET CENTER DIVISIONS

HONOLULU

FLEET CENTER BRANCH

BILLET

Full-period termination operator (FPT) -- receives messages from ships via either single channel or multichannel terminations, and oversees the sending of messages to ships terminated with the NavCommStas. This command utilizes the NavComPars to key outgoing traffic addressed to terminated units. When it becomes necessary for the ship/shore operator to talk to the terminated ship, he asks the command VDT operator to hold the appropriate termination LRN, and then the operator talks directly to the ship using a UGC-6J keyboard. At this station, the FPT also enters received traffic into the data speed reader. One operator handles two termination channels, and two data speed readers are operational at this command.

Dedicated circuits operator -- five of the eight dedicated circuits at this command are operated directly on-line with the NavComPars. Two circuits with Australia and one with New Zealand are operated on a torn-tape basis, interfacing termination style circuits with an AUTODIN access terminal. Operation is similar to the full-period termination.

CW broadcast operator -- converts teletype messages into CW format, and places them on proper broadcast schedule (that is, at proper time).

Allied interchange operator -- basically handles the duties outlined in description for dedicated circuits operator. Also works full-period terminations with allied ships, and assists in keying the allied broadcast, when activated.

Off-line crypto operator -- encrypts and decrypts messages from or to commands for which this station has crypto guard. Handles all classified messages which require special handling during his watch.

Command VDT operator -- monitors and controls all input/output lines to and from NavComPars including the fleet broadcasts and the shore send side of terminations. Maintains status board and helps fleet center supervisor in his duties.

Fleet center supervisor -- oversees the operation of all circuits in fleet center. Operates orderwire, with tech control and ship/shore supervisor, for coordination of circuit difficulties.

COMPUTER CENTER BRANCH

Computer center supervisor -- operates and controls the UNIVAC 70/45 series computer and associated peripheral equipment that makes up the NavComPars system. Supervises one other computer operator, and serves as liaison point for computer operations and communications functions.

Computer operator -- performs the same job as computer center supervisor, less the supervisory functions.

DATA BASE BRANCH

NavComPars chief -- incorporates the duties of data base supervisor and communications EDP center supervisor. Oversees the day-to-day operations of computer and data base personnel, and liaisons with civilian software and hardware engineers in the updating and maintenance of the NavComPars system. Is responsible for training and supervising of civilian and military workers in both areas.

Data base watch operator -- codes changes to NavComPars data base, keypunches cards, and does on-line updates of routing for a command.

Data base watch supervisor -- supervises efforts of data base watch operators and carries out standard operating procedures as promulgated by NavComPars chief.

Data base quality control operator -- dayworkers who coordinate efforts of watch personnel and put together final data base update program for new raday. Make alterations to all data base files, and double check changes that have been made by watch personnel.

Data base quality control supervisor -- coordinates efforts of dayworking and watch personnel, to ensure proper operation of data base. Assists data base assistant supervisor in coordinating data base/fleet locator interface.

Data base assistant supervisor -- acts as command fleet locator and oversees interface between fleet routing requirements and data base capabilities. Serves as advisor to NavComPars chief on matters concerning such routing functions.

GUAM

FLEET CENTER BRANCH

BILLET

1 -- traffic officer performs all tasks except 15, 19, 20, 22, 25, 27, 28, 32. 33. Plus 48, 57, 58, 84, and 101.

A -- assistant traffic officer performs tasks 1-14, 16-18, 21, 23, 24, 26, 30, and 31.

B -- leading chief performs tasks 6, 8, 9-14, 18, 26, 30, 31, 32, 53, 63, and 106.

C -- administrative assistant performs tasks 6, 9, 10, 13, and 63.

D -- training petty officer performs tasks 6, 9, 10, 12-14, 18-20, 26, 38, 51, 65, and 87.

E -- division yeoman performs tasks 6, 13, 38, 83, 93, 98, and 104.

F -- supply petty officer performs tasks 6, 29, and 103.

G -- maint/burn detail performs tasks 80, maintains the general cleanliness outside the direct working spaces. Burns all classified material. (Not only for fleet center but also for other activities such as painting and outside building upkeep.)

H -- barracks maintenance assigned TAD to billeting office for cleanliness and upkeep of personnel living quarters.

I -- customs inspector assigned TAD to ComNavMar customs office.

5 -- traffic analysis performs all tasks plus 4.

J -- traffic chief performs tasks 1, 3, 4, 7-11, 13-15, 26, 31, 34, 36-40, 42-49, 58, 59, 86, 89, 98, and 106.

7 -- traffic watch chief performs all tasks except 81, 84, 85, 96, 101, 103-106. Plus 20, 70, and 111.

K -- assistant traffic chief performs tasks 86, 93, 100 and 121. Assists watch supervisor, monitors fleet broadcast watch and ship terminations.

9 -- fleet center supervisor performs all tasks plus 82, 86, 94, 96, and 100

10/21 -- assistant fleet center supervisor performs tasks 82 and 121 and orderwire watch.

13 -- off-line petty officer performs all tasks except orderwire watch. Plus 18-20, and 109.

17 -- data speed reader operator

18 -- ship/shore/ship term operator

19 -- C-sub operator

19 -- broadcast QC/GSPG operator

19 -- GABN operator

20 -- GCMP/wireroom operator

21 -- file clerk performs all tasks.
Plus 79 and 80, (except orderwire operator.)

L -- ComTac pub/GMF custodian performs tasks 33, 83, 84, and 97.

M -- commercial traffic clerk performs tasks 75, 76, 81, 83, and 97.

24 -- NavComPars system chief performs all tasks except 113, 118-122. Plus 81-84, 88, 89, 94-103.

N -- systems researcher/LPO performs tasks 81-84, 87-89, 94-103, 111, 112, 114, 117, and 123.

O -- systems analyst performs tasks 116 and 117.

25 -- programmer performs all tasks except 111, 113, 115, 117-123.

26 -- assistant programmer performs all tasks except 111-113, 117-123.

27 -- console operator performs all tasks except 111-115, 117-123.

P -- fleet locator performs tasks 74, 81, 114, 116, and 122.

Q -- NavComPars assistant deck supervisor performs tasks 16, researches system problems, trains new personnel, maintains statistics for and makes required reports.

29 -- inrouter VDT operator performs all tasks except 111-117, and 120-123.

30 -- router VDT operator performs all tasks except 111-118, and 120-123.

31 -- MDC/OCR operator performs all tasks except 111-117, and 121-123.

33 -- ADP officer performs all tasks except 113-116, and 118-123. Plus 1-14, 16-18, 21, 23, 24, 26, 30, and 31.

34 -- NavComPars watch supervisor performs all tasks except 112-115, and 117-122.

44 -- service supervisor performs tasks 111 and 122.

45 -- service VDT operator performs task 122.

51 -- data base operator performs task 116.

ITALY

Chief of the watch -- performs tasks 7, 8, 9, 10, 12, 14, 20, 24, 37, 45, 47, 51, 52, 58, 67, 73, 75, 76, 84, 86, 93, 111, and 123.

Relay supervisor -- performs task 107.

TABLE I-1

FLEET CENTER DIVISION

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
Management Group (Office)				
1. Fleet Center Data Communications Officer	Traffic Officer (0%)	Traffic Officer (0%)	Same (0%)	Same
	Asst. Traffic Officer (A) (0%)	Asst. Traffic Officer (A) (0%)		
	Traffic Division Chief(B) (0%)			
		Leading Chief(B) (0%)		
	Admin. Chief (C) (50%)			
		Admin. Assistant(C)		
	Operations Chief(D) (50%) Fleet Center Chief(E) (0%)			
		Training Petty Officer (D) Division Yeoman(E) (2)		
	Secretary(F) Communications Clerk(G) Supply Clerk(H)			
		Supply Petty Officer(F) Maint/Burn Detail(G) (2) Barracks Maint. (H) (7) Customs Inspectors(I) (2)		
2. Fleet Center/ Autodin Officer				

TABLE I-1 (cont'd)

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
3. Traffic Processing Officer				
4. Comm. Management Specialist	Comm Specialist (0%)			
5. Analysis/Statistics	Same (4)	Traffic Analysis (6)		Same (4) (0%)
6. Asst. for Communications Automation				Same
Fleet Center Branch				
		Traffic Chief (J) (0%)		
7. Fleet Center Chief of the Watch	Traffic Chief of Watch (4) (4%)	Traffic Watch Chief (4) (60%) Asst. to Traffic Chief (K) (3) (80%)	Communications Watch Officer (4) (20%)	Communications Watch Officer (4
8. Fleet Center Traffic Checker	Same		Same (0%)	
9. Watch Supervisor	Fleet Center Supervisor (4) 20%)	Fleet Center Supervisor (5)	Fleet Center Supervisor (4) (20%)	Same (4) Chief of the Watch (A) (4)
10. Fleet Center Command VDT Operator	Same (4) (80%)	Asst. Fleet Center Supervisor (4)	Same (4)	Same (4)
11. Operator (Watch)				Same (4)
12. Fleet Broadcast				
13. Off-Line Crypto	Same (4)	Off-Line Petty Officer Commercial Traffic Clerk (M) (20%)	Off-Line Crypto Operator (4)	

TABLE I-1(cont'd)

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
14. Router/Traffic Checker				
15. Segregator Operator				
16. Recap Cutter				
17. Data Speed Reader Operator		Same (4)	Same (4)	
18. Full Period Termination Operator (Watch)	Full Period Term Supervisor(I) (4) (10%) Same (12)	Ship/Shore/Ship Operator (11)	Same (16)	Same (4)
19. Broadcast Operator		GABN Broadcast Operator (4) C-Sub Operator (4) Broadcast Quality Control/GSPG OPR (4) COMTAC Pub/GMF Custodian(L) (0%)		Same (4) Relay Supervisor(B) (4)
20. CW Broadcast Operator	Same (4)	GCMP/Wireroom Operator (4)	Same (4)	
21. Orderwire Operator/ File Clerk		File Clerk	Same (4) (90%)	
22. NATO Operator	Allied Interchange Operator (10)			NATO/MODE V Operator (4) Rome Circuit Operator (C) [a]

[a]Billet not included in analysis; assume not filled.

TABLE I-1(cont'd)

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
23. Fleet Center CPOW			Same (4) (20%)	
Computer Center Branch				
24. Communication EDP Center Supervisor		NAVCOMPARS System Chief (0%)/ System Researcher/ LPO(N) (0%) System Analysis (0)		
25. Programmer/Systems Analysis	NAVCOMPARS Chief (0%)	Programmer (20%)	Leading P.O. (25%)	Same
26. Assistant Programmer	Same (50%)	Same	Supply P.O./Tape Librarian/Programmer (75%)	Same
27. Computer Operator	Same (6)	Console Operator (4)	Computer Operators (military) (7) Computer Equip. Operators (civilian) (4)	Same (12)
28. Internal Router/Editor				
29. Internal Router/(In-Router)	Same (4)	Inrouter VDT Operator (4)		Same (4)
30. Router	Same (4)	Router VDT Operator (5)		Same (5)
31. OCR Operator		Same (4)		Same (4)
32. Editor				
33. Data Communication Support Branch Officer		ADP Officer (0%)	Computer Center O-In-C (4) (0%)	
34. Computer Center Supervisor	Same (5) (50%)	NAVCOMPARS Supervisor (4) (80%)	Computer Equip. Operator Supervisor (0%)	
35. Autodin Supervisor				

TABLE I-1(cont'd)

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
36. 360-20/PG6-73 Receiver Operator				
37. 360-20 Send Operator				
38. Operator (fill-in)				
39. Traffic Checker				Same (3)
40. Tracer Clerk				Same
41. Chief in Charge				
42. Service Clerk				
43. NATO Operator				
Service Center Branch				
44. Service Center Supervisor	Same (4) (70%)	Same (4)		Same (4)
45. Service Clerk	Same (12)	Service VDT Operator (9)		Same (4)
	Service Center Traffic Checker (N) (4)			
Data Base Maintenance Branch				
			Data Base Maint. Branch Head (A) (10%)	
46. Data Base Supervisor		Same	Same (25%)	Data Base Chief
	Data Base Asst. Supervisor (J) (50%) Data Base Quality Control Supervisor (K) (70%) Data Base Quality Control Operator (L) (3)			

TABLE I-1(cont'd)

CURRENT BILLETS USED

Master Billet or Position Title	Honolulu	Guam	Norfolk	Italy
47. ACP/Alt. Spells File			Same	Same [a]
48. AIG File			Same (2)	Same [a]
49. Ships Guard/Task Type			Q.C. Task Type (SFTS/SFRU) (2)	Same [a]
50. MAR File Maintenance				Same [a]
	Data Base Watch Supervisor(M) (4) (50%)		Data Base Watch Supervisors(B) (25%)	
51. Data Base Watch Operator	Same (8)	Data Base Operator (4)	Same (8)	Same (4)
52. Keypunch/EAM Operator			Keypunch/files operator	
		Fleet Locator(P) (14) NAVCOMPARS Asst Deck Supervisor(Q) (60%)		
			Training/Publications(C) Leading P.O. (D) (25%)	

[a]Billet not included in analysis; assume not filled.

TABLE I-2

MANNING DISTRIBUTION

	Operations				Support				Total			
	Hono	Guam	Norfolk	Italy	Hono	Guam	Norfolk	Italy	Hono	Guam	Norfolk	Italy
Direct labor												
#Military	68.3	97.2	60.25	84	5.5	16	0	0	73.8	113.2	60.25	84
#Civilian	18	7	6.35	0	2	0	0	0	20	7	6.35	0
#Total	86.3	104.2	66.6	84	7.5	16	0	0	93.8	120.2	66.6	84
General management												
#Military									4	3	1	1
#Civilian									1	0	0	0
#Total									5	3	1	1
Supervisors												
#Military	16.7	10.8	16.75	0	.5	1	0	1	21.2[a]	14.8[a]	17.75[a]	2[a]
#Civilian	3	0	5.65	0	.5	0	0	1	4[a]	0	5.65	0
#Total	19.7	10.8	22.4	0	.5	1	0	1	25.2[a]	14.8[a]	23.4[a]	2[a]
All												
#Military									95	128	78	86
#Civilian									24	7	12	0
#Total									119	135	90	86

[a]Includes General Management.

TABLE I-3

MANNING DISTRIBUTION AND SUPERVISORY OVERHEAD RATES

	Operations				Support				Total			
	Hono	Guam	Norfolk	Italy	Hono	Guam	Norfolk	Italy	Hono	Guam	Norfolk	Italy
Direct labor												
#Day	6.7	12.6	5.6	8	7.5	16	0	0	14.2	28.6	5.6	8
#Watch	79.6	91.6	61	76	0	0	0	0	79.6	91.6	61	76
#Total	86.3	104.2	66.6	84	7.5	16	0	0	93.8	120.2	66.6	84
General management									5	3	1	1
Supervisors												
#Day	3.3	8.4	5.4	0	.5	1	0	1	8.8[a]	12.4[a]	6.4[a]	2[a]
#Watch	16.4	2.4	17	0	0	0	0	0	16.4	2.4	17	0
#Total	19.7	10.8	22.4	0	.5	1	0	1	25.2[a]	14.8[a]	23.4[a]	2[a]
%Day	49.3	66.7	96.4	0	6.7	6.3	0	0	62.0	43.4	114.3	25.0
%Watch	20.6	2.6	27.9	0	0	0	0	0	20.6	2.6	27.9	0
%Total	22.8	10.4	33.6	0	6.7	6.3	0	0	26.9	12.3	35.1	2.4
All												
#Day									23	41	12	10
#Watch									96	94	78	76
#Total									119	135	90	86

[a]Includes General Management.

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
1	CARD PUNCH(UNIVAC)								
	INCOMING CARD PUNCHER								
	GUAM	33	1	1.7	1.7	-	1.7	1.7	-
	ITALY	4	1	-	-	-	-	-	-
2	CARD READER (UNIVAC)								
	READS CARDS + SENDS CARD TRFC								
	GUAM	30	2	3.2	3.2	-	3.2	3.2	-
	ITALY	5	2	-	-	-	-	-	-
3	COMMAND VDT								
	T-S TERMINAL + CRT SCREEN								
	HONO	23	1	-	-	-	-	-	-
	GUAM	21	1	2.0	2.0	-	2.0	2.0	-
	NORFOLK	1	1	-	-	-	-	-	-
4	CONSOLE KEYBOARD								
	COMPUTER COMMAND CONSOLE								
	GUAM	31	2	3.2	3.2	-	3.2	3.2	-
5	CUMMINS TALLY PRINTER								
	CARD COUNTER								
	HONO	29	1	-	-	-	-	-	-
6	DISC CONTROLLER								
	CONTROLS DISC								
	GUAM	38	3	.3	.3	-	.3	.3	-
7	DISC DRIVES								
	DISK STORAGE PACK								
	GUAM	28	15	3.2	3.2	-	3.2	3.2	-
8	INROUTER VDT								
	TS TERMINAL + CRT SCREEN								
	GUAM	23	1	2.0	2.0	-	2.0	2.0	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
9	MAGNETIC TAPE DRIVES								
	MAGNETIC TAPE RECORDER								
	GUAM	29	12	16.3	16.3	-	16.3	16.3	-
10	MODE V								
	AUTODIN SEND/RECEIVE TERMINALS								
	HONO	17	2	-	-	-	-	-	-
11	MODEL 28								
	REPERFORATORS								
	GUAM	44	2	26	52.0	-	52.0	26.0	-
12	OCR PROGRAMMING INPUT TELETYPE								
	EIGHT LEVEL TELETYPEWRITER								
	GUAM	27	1	8.1	8.1	-	8.1	8.1	-
13	OCR SCANNER AND SCREEN								
	OPTICAL CHARACTER READER								
	GUAM	26	1	156	156.0	-	156.0	156.0	-
	ITALY	3	1	-	-	-	-	-	-
14	OUTROUTER VDT								
	TS TERMINAL + CRT SCREEN								
	GUAM	24	1	2	2.0	-	2.0	2.0	-
15	PAGE PRINTER								
	PROVIDES READABLE COPY								
	GUAM	35	3	30.4	30.4	-	30.4	30.4	-
16	PRINTER(UNIVAC)								
	MEDIUM SPEED PRINTERS								
	ITALY	2	3	-	-	-	-	-	-
17	PROCESSOR								
	-								
	GUAM	34	2	3.2	3.2	-	3.2	3.2	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
18	QUERY VDT								
	TS TERMINAL + CRT SCREEN								
	HONO	25	7	-	-	-	-	-	-
	GUAM	25	6	2.0	2.0	-	2.0	2.0	-
	NORFOLK	2,27	2	-	-	-	-	-	-
19	ROUTER VDT								
	TS TERMINAL + CRT SCREEN								
	HONO	24	1	-	-	-	-	-	-
20	TAPE CONTROLLER								
	CONTROLS TAPE DRIVE								
	GUAM	39	2	3.2	3.2	-	3.2	3.2	-
21	TAPE PUNCH (UNIVAC)								
	RECEIVE TAPE PUNCH								
	ITALY	6	1	-	-	-	-	-	-
22	TAPE READER (UNIVAC)								
	SEND TAPE READER								
	ITALY	7	1	-	-	-	-	-	-
23	VDT(UNIVAC)								
	VIDEO DATA TERMINAL								
	GUAM	22	1	2.0	2.0	-	2.0	2.0	-
	ITALY	1	10	-	-	-	-	-	-
24	1600								
	PROCESSORS ON-LINE OPERATION								
	NORFOLK	31	2	-	-	-	-	-	-
25	1600 DEVICES								
	AUTODIN INTERFACE								
	GUAM	32	2	1.7	1.7	-	1.7	1.7	-
26	1710(UNIVAC)								
	CARD PUNCH								
	HONO	30	2	-	-	-	-	-	-

CONTINUED ON NEXT PAGE

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) PLANNED MAINT. STD. BY MAINT. PERS.	(8) PLANNED MAINT. STD. TOTAL	(9) REQUIREMENT PM	(10) REQUIREMENT CM
26	1710(UNIVAC)			(CONTINUED)					
	NORFOLK	26	1	-	-	-	-	-	-
	ITALY	8	1	-	-	-	-	-	-
27	70/227 (UNIVAC)								
	PAPER TAPE READER/PUNCH								
	HONO	28	1	91.3	91.3	-	91.3	91.3	-
28	70/234								
	CARD PUNCHER OFF-LINE								
	NORFOLK	37	1	-	-	-	-	-	-
29	70/237								
	CARD READER OFF-LINE								
	NORFOLK	32,35	2	-	-	-	-	-	-
30	70/242								
	MEDIUM-SPEED PRINTER PLUS(OFFLINE) ASSOC. CONTROL								
	NORFOLK	38	3	-	-	-	-	-	-
31	70/42 (UNIVAC)								
	MEDIUM SPEED PRINTER(SVC)								
	HONO	27	1	182.5	182.5	-	182.5	182.5	-
32	70/432								
	MAGNETIC TAPE UNITS (ON-LINE/OFF-LINE)								
	NORFOLK	36	12	-	-	-	-	-	-
33	70/45 COMPUTER (UNIVAC)								
	NAVCOMPARS CENTRAL PROCESSOR								
	HONO	26	2	788.6	788.6	-	788.6	788.6	-
	NORFOLK	28	2	-	-	-	-	-	-
34	70/568								
	MASS STORAGE UNIT ON-LINE OPERATION								
	NORFOLK	38	1	-	-	-	-	-	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
35	70/590								
	DISK DRIVES OFF-LINE								
	NORFOLK	29,34	15	-	-	-	-	-	-
36	70/668								
	CCM-COMM CONTROLLER MULTI-CHNL ON LINE OP								
	NORFOLK	33	3	-	-	-	-	-	-
37	AN/FCC-79								
	SECURITY ALARM MONITOR								
	GUAM	15	4	52.0	52.0	-	52.0	52.0	-
38	AN/FGA-10								
	-								
	HONO	12	7	-	-	-	-	-	-
	SCA STD			78					
	CODE 04 STD						2.0		
39	AN/FGC-100								
	PAGE COPY SET TELETYPE								
	HONO	4	10	-	-	-	-	-	-
	GUAM	1	8	51.3	51.3	-	51.3	51.3	-
	NORFOLK	14	6	-	-	-	-	-	-
	CODE 04 STD						112.0		
40	AN/FGC-100/101								
	PAGE COPY REC TTY EQUIP								
	ITALY	15	7	-	-	-	-	-	-
41	AN/FGC-79								
	PAGE COPY W/KBD SET, TELETYPE								
	HONO	5	3	-	-	-	-	-	-
	NORFOLK	18	9	-	-	-	-	-	-
	CODE 04 STD						112.0		

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) PLANNED MAINT. STD. BY MAINT. PERS.	(8) PLANNED MAINT. STD. TOTAL	(9) REQUIREMENT PM	(10) REQUIREMENT CM
42	AN/UGC-20								
	TELETYPEWRITER								
	GUAM	13	1	26.0	26.0	-	26.0	26.0	-
	CODE 04 STD						28.0		
43	AN/UGC-25								
	PAGE COPY, TELETYPE								
	HONO	10	7	-	-	-	-	-	-
	NORFOLK	6	16	-	-	-	-	-	-
44	AN/UGC-48								
	TELETYPEWRITER								
	GUAM	14	2	23.0	23.0	-	23.0	23.0	-
45	AN/UGC-5								
	ASR SET W/O REPERF. TELETYPE								
	HONO	8	2	-	-	-	-	-	-
	GUAM	20	1	104.0	104.0	-	104.0	104.0	-
	CODE 04 STD						54.0		
46	AN/UGC-6								
	ASR SET W/ REPERF. TELETYPE								
	HONO	19	4	-	-	-	-	-	-
	NORFOLK	9	7	-	-	-	-	-	-
	ITALY	12	2	-	-	-	-	-	-
	CODE 04 STD						54.0		
47	AN/UGC-6K								
	TELETYPEWRITER								
	GUAM	5	5	104.0	104.0	-	104.0	104.0	-
	CODE 04 STD						54.0		
48	AN/UGC-61								
	PAGE COPY W/KBD SET, TELETYPE								
	HONO	6	5	-	-	-	-	-	-
	GUAM	16	10	52.0	52.0	-	52.0	52.0	-

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TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
48	AN/UGC-61			(CONTINUED)					
	CODE 04 STD						80.4		
49	AN/UGC-61/79								
	PAGE COPY/SEND TTY EQUIP								
	ITALY	16	10	-	-	-	-	-	-
50	AN/UGR-10								
	PAGE COPY SET TELETYPE								
	HONO	18	8	-	-	-	-	-	-
	GUAM	6	12	18.7	18.7	-	18.7	18.7	-
	CODE 04 STD						80.4		
51	AN/UGR-11								
	TAPE PUNCH AND TAKE UP REEL								
	GUAM	7	3	52.0	52.0	-	52.0	52.0	-
52	AN/UGR-14								
	HIGH SPEED TELETYPE R/O								
	NORFOLK	12	3	-	-	-	-	-	-
	CODE 04 STD						1.9		
53	AN/UGT-5								
	TRANSMITTER/DIST. SET. TELETYPE								
	HONO	3	6	-	-	-	-	-	-
	GUAM	11	3	52.0	52.0	-	52.0	52.0	-
54	AN/WRR-3								
	RECEIVER								
	NORFOLK	24	1	-	-	-	-	-	-
55	ASR-28								
	ASR TERMINAL								
	HONO	32	4	-	-	-	-	-	-
56	CCM								
	INTERFACE DEVICE								
	GUAM	37	2	1.0	1.0	-	1.0	1.0	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
57	CV-2015								
	MORSE CODE CONVERTOR								
	HONO	13	2	-	-	-	-	-	-
	NORFOLK	15	2	-	-	-	-	-	-
58	CV-2015A								
	CONVERTOR								
	GUAM	3	2	1.7	1.7	-	1.7	1.7	-
	NORFOLK	16	4	-	-	-	-	-	-
59	DSR								
	PAPER TAPE DATA SPEED READER								
	HONO	7	2	-	-	-	-	-	-
	GUAM	18	2	14.7	14.7	-	14.7	14.7	-
	NORFOLK	8	2	-	-	-	-	-	-
	ITALY	9	2	-	-	-	-	-	-
60	DT-325A								
	TONE DETECTOR								
	HONO	14	2	-	-	-	-	-	-
	NORFOLK	17	4	-	-	-	-	-	-
61	HL-1								
	ENCRYPTING + DECRYPTING EQUIP								
	HONO	21	1	-	-	-	-	-	-
	GUAM	42	3	18.3	-	16.0	16.0	16.0	2.3
	NORFOLK	19	3	-	-	-	-	-	-
62	HL-2								
	ENCRYPTING + DECRYPTING EQUIP								
	HONO	22	1	-	-	-	-	-	-
	GUAM	43	3	72.7	-	58.0	58.8	58.0	14.7
	NORFOLK	20	3	-	-	-	-	-	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) BY MAINT. PERS.	(8) TOTAL	(9) REQUIREMENT PM	(10) CM
63	IBM 29								
	-								
	NORFOLK	39	-	-	-	-	-	-	-
64	IBM 557								
	-								
	NORFOLK	40	-	-	-	-	-	-	-
65	MSU								
	MESSAGE STORAGE UNIT								
	GUAM	36	1	30.4	30.4	-	30.4	30.4	-
66	MSU CONTROLLER								
	CONTROLS MSU								
	GUAM	40	1	4.2	4.2	-	4.2	4.2	-
67	R1051								
	RECEIVER								
	NORFOLK	22	3	-	-	-	-	-	-
68	R-390A/URR								
	RECEIVER								
	HONO	15	1	-	-	-	-	-	-
	CODE 84 STD						6.3		
69	TSEC/KL-47								
	ENCRYPTING / DECRYPTING EQUIP								
	GUAM	41	3	42.3	-	18.0	18.0	18.0	24.3
	NORFOLK	21	7	-	-	-	-	-	-
	SCA STD			42					
70	TSEC/KLB-47								
	ENCRYPTING/DECRYPTING EQUIP								
	HONO	28	2	-	-	-	-	-	-
	CODE 84 STD						12.0		

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(6) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) PLANNED MAINT. STD. BY MAINT. PERS.	(8) PLANNED MAINT. STD. TOTAL	(9) REQUIREMENT PM	(10) REQUIREMENT CM
71	TT-171								
	RECEIVE TELETYPEWRITER								
	GUAM	19	2	4.1	4.5	-	4.5	4.1	-
	NORFOLK	25	9	-	-	-	-	-	-
	ITALY	10	3	-	-	-	-	-	-
72	TT-176								
	TELETYPE DEVICE								
	NORFOLK	5	8	-	-	-	-	-	-
73	TT-187								
	TAPE DISTRIBUTOR								
	HONO	11	4	-	-	-	-	-	-
	GUAM	2	10	26.0	26.0	-	26.0	26.0	-
74	TT-192								
	PAPER TAPE DRIVER (PUNCHES)								
	NORFOLK	7	12	-	-	-	-	-	-
75	TT-192A/UG								
	REPERFORATOR TYPING, TELETYPE								
	HONO	9	5	-	-	-	-	-	-
76	TT-253								
	REPERFORATOR TYPING								
	GUAM	17	1	2.0	2.0	-	2.0	2.0	-
77	TT-331								
	TAPE PUNCH								
	GUAM	4	9	104.0	104.0	-	104.0	104.0	-
	NORFOLK	23	10	-	-	-	-	-	-
78	TT-331A/UG								
	REPERFORATOR SET TELETYPE								
	HONO	1	10	-	-	-	-	-	-
	CODE 04 STD						64.0		

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CONV. CM+PM REQ.	(6) PLANNED MAINT. STD BY OPER. PERS.	(7) PLANNED MAINT. STD BY MAINT. PERS.	(8) PLANNED MAINT. STD TOTAL	(9) REQUIREMENT PM	(10) REQUIREMENT CM
79	TT-331/403/404								
	TAPE RECEIVE TTY EQUIP								
	ITALY	13	13	-	-	-	-	-	-
80	TT-332								
	PAPER TAPE DRIVER (PUNCHES)								
	NORFOLK	3	8	-	-	-	-	-	-
81	TT-332A								
	REPERFORATOR SET								
	GUAM	9	2	104.0	104.0	-	104.0	104.0	-
82	TT-332A/UG								
	REPERFORATOR SET, TELETYPE								
	HONO	16	6	-	-	-	-	-	-
	CODE 04 STD						64.0		
83	TT-333								
	PAPER TAPE DRIVER (PUNCHES)								
	NORFOLK	4	8	-	-	-	-	-	-
84	TT-333A								
	TAPE DISTRIBUTOR								
	HONO	2	5	-	-	-	-	-	-
	GUAM	8	11	58.5	58.6	-	58.6	58.5	-
85	TT-333/405								
	TAPE SEND TTY EQUIP								
	ITALY	14	9	-	-	-	-	-	-
86	TT-462								
	NATO/MODE V TTY EQUIP								
	ITALY	17	1		-	-	-	-	-
87	TT-47								
	RELAY/TECH CONT. ORDERWIRE								
	NORFOLK	13	19	-	-	-	-	-	-
	ITALY	11	1	-	-	-	-	-	-

TABLE II-1

MAINTENANCE MANPOWER REQUIREMENTS (Cont'd)

(1) MAINT. NO.	(2) EQUIP. TYPE	(3) ORIG. MN. NO.	(4) NO. ON HAND/ACTIVE	(5) CURV. CM+PM REQ.	(6) PLANNED MAINT. STD. BY OPER. PERS.	(7) PLANNED MAINT. STD. BY MAINT. PERS.	(8) PLANNED MAINT. STD. TOTAL	(9) REQUIREMENT PM	(10) REQUIREMENT CM
88	TT-470								
	TELETYPEWRITER								
	GUAM	12	8	26.0	26.0	-	26.0	26.0	-
89	TT-576								
	REPERFORATOR SET								
	GUAM	10	3	104.0	104.0	-	104.0	104.0	-
90	WU-321								
	ASR TERMINAL								
	HONO	31	1	-	-	-	-	-	-

TABLE III-1

EQUIPMENT INVENTORY AND NEEDS FOR EACH OPERATING JOB

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
1. Full period termination								
Job								
Send message								
Equipment								
VDT	10				1			
AN/UGC-61		10				1		
AN/FCC-79		2						
TT-192			12				3	
TT-333			8				1	
TT-176			8				1	
AN/UGC-25			16				2	
TT-332			8				2	
TT-331/403/404				13				1
TT-333/405				9				1
AN/UGC-61/79				10				1
Receive message								
DSR	2				1			
AN/FGC-100	10				3			
VDT	10				1			
AN/UGC-61	5		7		1		1	
AN/UGC-6	4			2	2			1
AN/UGC-5		1				-		
AN/UGR-10		12				1		
AN/FGC-100		8						
TT-331A	10	9			4			
TT-332A		2				3		
TT-333A		11						
TT-576/UG		3				3		
AN/UGR-11		3						
AN/UGC-48		2				-		

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
1. Full period termination (cont'd)								
TT-331			10				1	
AN/UGC-25			16				2	
TT-176			8				1	
TT-331/403/404				13				1
AN/FGC-100/101				7				1
AN/UGC-61/79				10				1
2. Command VDT operator								
Monitors and controls all transmissions								
VDT	10	10	2	10	1	1	1	2
TT-47		8				1		
TT-171		3	9	3		1	1	1
AN/FGC-100			6				5	
3. Data speed reader								
Feeds received message to computer								
DSR		2	2	2		1	2	1
4. NATO/Mode V								
Send/receive message								
TT-331/403/404			a	13			a	1
AN/FGC-100/101				7				1
TT-333/405				9				1
Mode V terminal				1				1
AN/UGC-6				2				1

[a] Same as full period termination (including equipment).

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
5. Fleet center supervisor								
Monitors fleet BCST, allied interchange, ship/shore terms and CW BCST, and coordinates with Tech Control								
AN/UGC-61	5				1			
6. File clerk								
Maintains monitor rolls of all ship terminations and broadcast								
--		b	b			b	b	
Files all message traffic								
--		b	b			b	b	
7. Orderwire operator								
Coordinates between fleet center and tech control via orderwire all circuit difficulties								
TT-47		8	19			1	1	
AN/UGC-6			7				1	
8. CW BCST operator								
Receives teletype message in tape and page copy								
TT-331A	10				1			
AN/UGC-25	7				1			
Converts message into CW format								
AN/UGC-5	2				1			
TT-331A		9				1		
AN/FGC-100		8				1		

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
8. CW BCST operator (cont'd)								
Converts message into CW format								
CV-2015A		4	4			2	1	
DT-325A			4				2	
CV-2015			2				1	
AN/WRR-3			1				1	
Places on appropriate scheds and transmits at appropriate time								
TT-187	4	b			2	b		
CV-2015	2				2			
R-390	1				1			
DT-325A	2				2			
AN/UGC-25	7				1			
R-1051			3				1	
TT-192			12				1	
AN/UGC-6			7				4	
Performs quality control checks								
R-1051		b	3			b	1	
DT-801			1				1	
Spectrum analyzer 8553B			3				1	
Operates unclas point-to-point circuit changing message format when required		b				b		
9. Off-line crypto operator								
Encrypts message								
HL-1	1	3	3		1	1	3	
HL-2	1	3	3		1	1	3	
KL-47	2	3	7		2	1	3	

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
9. Off-line crypto operator (cont'd)								
AN/UGC-6	4				2			
TT-47		8	19			1	3	
TT-172		2				1		
TT-192			12				3	
Decrypts message								
HL-1	b	3	3		b	1	3	
HL-2	b	3	3		b	1	3	
KL-47	b	3	7		b	1	3	
AN/UGC-6	b	8	7		b	1	2	
TT-192A	b				b			
Paper tape reader		1				1		
TT-47		8	19			1	3	
TT-172		2				1		
DSR			2				2	
10. PG/USNS broadcast								
Sends messages								
TT-331/403/404				13				1
TT-333/405				9				1
AN/UGC-61/79				10				1
11. Primary ship/shore								
Receives messages								
TT-331/403/404				13				1
AN/UGC-61/79				10				1

[b] Job listed but no equipment given.

TABLE III-1 (Cont d)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
12. Allied interchange operator								
Sends messages to allied subscribers								
AUTODIN Mode V terminal	2				2			
ASR-28	4				2			
AN/UGT-5	6				6			
TT-333A	5				5			
AN/FGC-79A	3				1			
AN/UGC-61	5				1			
Receives messages from allied subscribers								
AN/UGR-10	8				4			
TT-332A	6				6			
TT-331A	10				6			
ASR-28	4				2			
AUTODIN Mode V	2				1			
13. Data base watch-supervisor and operator								
Screens source information for changes to data base files	b		b		b		b	
VDT		10				1		
Initiates service action when discrepancies are found on source info	b	b	b	b	b	b	b	b

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
13. Data base watch-supervisor and operator (cont'd)								
Performs on-line updates ot the data base, for any changes which cannot wait for normal raday data base update	b	b	b	b	b	b	b	b
Keypunches data base update cards								
UNIVAC 1710-04	1				1			
Assists in placing data base files on-line at beginning of new radio day		b	b	b		b	b	b
Compares data base input received from the primary data base update facility against the data base input prepared locally	b				b			
Initiates difference message to primary data base update facility	b				b			
Proofreads all data base update cards and the data base update difference message	b				b			
Assists the computer operator in accomplishing data base updates	b				b			
Files traffic and data base listings	b				b b			

[b]Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
14. Computer operator and comm equip operator								
Monitoring on-line NAVCOMPARS system								
UNIVAC spectra	2	b	b		2	b	b	
Monitoring AUTODIN channel operations (1600 unit)								
20/45 computer	b	b	b		b	b	b	
Off-line data base updates	b	b	b		b	b	b	
Off-line/on-line processing data pattern (card) message traffic	b	b	b		b	b	b	
Reports usages listings off-line operation	b	b	b		b	b	b	
Worldwide index/task organization daily updates	b	b	b		b	b	b	
Computer center cleaning/ maintenance	b	b	b		b	b	b	
Maintains disk units and unloads disk packs, resets and allocates disk storage units as required								
70/590	10	15	10		10	10	10	
70/568	1	1	1		1	1	1	
1600	2	2	2		2	2	2	

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand Honolulu	Guam	Norfolk	Italy	(3) Number per work station Honolulu	Guam	Norfolk	Italy
14. Computer operator and comm equip operator (cont'd)								
Checks/replaces magazines, locates and replaces damaged cards and formats new ones. Interprets and distinguishes between read/write status and operational status of equipment (mass storage duties)	b	b	b		b	b	b	
Loads and unloads cards; clears jams; resets for error conditions. Takes equip. off-line for 1600 AUTODIN Mode operators. (70/237)								
70/237	1	2	1		1	1	1	
70/668	2		3		2		3	
Operator resets CCM before processing each load (70/668)	b		b		b		b	
Operator loads and unloads mag tapes, labels, tape reels, maintains library. Maintain 3 tape units on-line for normal ops. (Journal tape, history tape, and data in tape for incoming data traffic) up to 6 tape units on-line under degraded or unusual common conditions. Closes out journal								

[b]Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
14. Computer operator and comm equip operator (cont'd)								
tape daily and history tape when end is reached. Physically marks tapes to use for journal and history tapes. When mass storage unit is down, marks and loads MSU intercept tape. Takes tape units off-line for AUTODIN Mode operation of 1600 processor.	b	b	b		b	b	b	
Prepares and loads printer control loop tapes. Changes and adjusts ribbons. Makes test prints. Reprograms memory unit. Must know location of all interlocks. Switches 70-242 off-line for use in AUTODIN.	b	b	b		b	b	b	
Operates and controls UNIVAC 70/75 computer								
UNIVAC spectra 70/45 computer				2				2
15. OCR operator								
Receives outgoing OCR typed messages for entry into NAVCOMPARS via OCR scanner and readout screen								
OCR scanner		1				1		
OCR readout screen		1				1		
OCR terminal				1				1

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
15. OCR operator (cont'd)								
Programs OCR scanner via input 8 level teletype and built-in computer								
OCR program input teletype		1				1		
16. GABN/TACAMO BCST operator								
Operates manual GABN/TACAMO BCST								
AN/UGR-10		12				1		
AN/UGR-11		3				1		
TT-333A		11				1		
Maintains accurate and complete logs and files								
TT-253		1				1		
17. Broadcast quality control/GSPG operator								
Monitors off-the-air GMUL/JMUL and GSPG BCSTs for quality and continuity								
AN/UGR-10		12				3		
AN/FGC-100		8				1		
AN/UGR-11		3				1		
TT-333A		11				1		
Initiates EAM BCST delivery logs								
TT-332A		2				1		

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand Honolulu	Guam	Norfolk	Italy	(3) Number per work station Honolulu	Guam	Norfolk	Italy
17. Broadcast quality control/GSPG operator (cont'd)								
Operates manual BCST when activated		b				b		
18. C-Sub operator								
Monitors submarine BCST								
AN/FGC-100		8				1		
TT-187		10				2		
CV-2015		4				2		
Maintains direct liaison with commander submarine forces PAC fleet								
TT-332A		2				1		
AN/FGC-79		4				1		
AM-413B/G		1				1		
AN/UGC-48		2				1		
TT-47		8				1		
19. Service center supervisor								
Oversee service VDT operations VDT		10				1		
Oversee router and inrouter VDT operations		b				b		
Drafts services and replies to services on message traffic		b				b		
Maintains accurate logs ensuring all computer rejected msgs are protected for		b				b		

[b] Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
19. Service center supervisor (cont'd)								
Assigns action on rejected msgs				b				b
20. Service clerk								
Fix message								
VDT	10				1			
Draft service messages								
AN/UGC-6	4				1			
UNIVAC 70/227	1				1			
File traffic not requiring action	b				b			
Performs service action				b				b
21. Inrouter VDT operator								
Assigns proper internal routing to incoming msgs not automatically processed by NAVCOMPARS								
VDT		10		10		1		1
Makes changes to internal routing on computer processed msgs, when required		b				b		
22. Router VDT operator								
Routes msgs not automatically routed by the computer								
VDT		10				1		
Corrects format lines necessary and re-enters msg to computer for coordination by automatic processing								
VDT				10				1

[b]Job listed but no equipment given.

TABLE III-1 (Cont'd)

(1) Work station/ operation name	(2) Total no. on hand				(3) Number per work station			
	Honolulu	Guam	Norfolk	Italy	Honolulu	Guam	Norfolk	Italy
23. Service VDT operator								
Processes replies to service msgs.								
VDT		10				5		
Answers BCST screen requests								
Corrects rejected msgs and re-ent[illegible] them for automatic processing								
24. Rome circuit								
Send message								
TT-331/403/404				13				1
TT-333/405				9				1
AN/UGC-61/79				10				1

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF FULL-PERIOD TERMINATION, RECEIVE

Data describing this job was submitted by all 4 sites and appears in tables III-2 and -3.

The first step in correlating this data was to compare the operational description and flow diagram submitted by each site with that contained in the original questionnaire (see reference A-3). The process followed by each site in doing this job is basically the same as that shown in the reference. Figure A-1 was therefore constructed as a flow diagram for use as a standard.

Derivation of Nontime Planning Factors

Figure A-2 shows, and table III-2 lists, the set of data submitted by each site and used to derive those planning factors that are unique to each site's environment. The next step was to derive the proportion of times it takes each site to do each activity. To simplify these calculations, all the activities were clustered into a set of major work functions, as shown in the figure. The flow of messages through these major functions is described here as part of the derivation of nontime planning factors, using the figure for illustration and the data in the table.

The first section of table III-2 contains the message flow characteristics for a job, as submitted by each site, using the designations shown in figure A-2. The second part of the table consists of the planning factor proportions associated with the job and derived from (or associated with) the data in the first part. The calculations used in deriving these planning factors are also included with each line.

The sites submitted this data in one or two acceptable ways. Certain sites submitted data from part one (total number of messages passing through each function), from which we estimated the proportions of messages with respect to the input number of messages. Honolulu invariably submitted the proportions directly on its flow diagram (presumably based on work samples taken), from which we derived the number of messages involved. When both types of data were missing, we derived the required data by using the mean of the pertinent data submitted by the other sites.

In all cases, the data we derived is explained in the text and is shown in parentheses in the table. Obviously, we prefer that each site reexamine its operations and submit the data it omitted so that the most accurate planning factors can be derived. But the analysis that follows shows how "average" planning factors can be derived, based on the entire set of data now available.

In originally establishing a satisfactory communications link between ship and shore before any messages can be processed, T connections per week need to be made for the number of circuits operated; see figure A-2. Line 1 of table III-2 indicates that no site submitted the appropriate data.

The most important planning factor is the number of messages received per week (A),[1] listed in line 2 of the table, since many of the other planning factors and the basic manpower calculation are derived from this number. Honolulu omitted this important data. We estimated the number of messages as 694, based on the percentages supplied with their flow diagram.[2]

Unfortunately, the estimated total is not consistent with the other data Honolulu submitted, and the set of data and the percentages should be reexamined.

Norfolk submitted its data on a per work-station basis. This must be converted to a total to allow calculating billets properly.

All A messages undergo the transmission activities, which is the set of operations done only once (that is, the first transmission) as a message is originally received by the full-period termination operator.

Of these A messages, B are received in acceptable form on the first transmission (line 3 of table III-2). The proportion of acceptable messages is thus B/A (line 9). The value of B was not submitted by Guam and Italy. Its calculation was based on the combined proportion of line 3 to line 1 for Honolulu and Norfolk:

$$P = \frac{538 + 392}{694 + 489} = \frac{930}{1,183} = 0.79 \quad .$$

For Guam,

$$B = (0.79)\ (2,794) = 2,207 \text{ messages per week acceptable on the first transmission;}$$

and for Italy,

$$B = (0.79)\ (604) = 477.$$

---

[1] All units labeled as "messages" in this volume imply a quantity of messages in one week.

[2] This estimate was based on the following data they supplied:

- There were 1,070 transmissions per week, of which 67 percent were acceptable.
- There were 13 pieced messages per week.
- Of the acceptable transmissions, 20 percent were transmitted before.
- Of the unacceptable transmissions, 5 percent can be acceptably pieced together.

The remaining C = A - B messages are received in unacceptable form on the first transmission. Not only do the C messages have to be retransmitted (at least once), but so do N messages (listed in line 4), which have been returned to the operator by the data speed-reader (DSR) operator.[1] The proportion of unacceptable messages requiring transmission is $(C+N)/A = [1-(B-N)]/A$, listed in line 10. Because of C + N unacceptable messages, a total of D messages are retransmitted.

The total number of transmissions therefore will be A + D, which is how the sites presented their data (line 5). The proportion of retransmissions (D/A) as derived is listed in line 11 of table III-2. Guam did not submit either set of data. So the proportion of transmissions Guam received per week (line 11) was derived as the weighted mean (the ratio of line 5 minus line 2 to line 1 for the other 3 sites):

$$P = \frac{(1070-694) + (588-489) + (785-604)}{694 + 489 + 604} = \frac{656}{1787} = 0.37 \ .$$

For Guam, (A+D) = (1.37) (2,794) = 3,828 transmissions per week.

Of the C total of unacceptable messages, a fraction E requires piecing, which is the set of activities combining the information on several messages into one acceptable message.

Guam and Italy did not report the number of messages pieced per week (line 6). The proportion of piecings required by the other 2 sites (line 12 of Honolulu and Norfolk) shows that they had a large difference between them (1:5) but the proportion of retransmissions required (line 10) was in the other direction much lower (4:1). These differences might be explained by different site policies concerning piecing, as opposed to retransmitting.

For example, Honolulu's data, compared with Norfolk's, indicates that Honolulu pieces fewer of its messages, relying instead on more retransmissions. Furthermore, it seems that Guam and Italy are more like Norfolk than Honolulu with respect to proportions of unacceptable messages and retransmissions (lines 2 and 5). Italy noted further that it requests a retransmission only twice. If these are still unacceptable, the message is "logged out to control," resulting in a small number of piecings by the full-period termination operator (but a higher work load for control). We therefore decided to use Honolulu's lower piecing proportion (0.02) for Italy and Norfolk's proportion (0.12) as the standard for Guam. The number of messages requiring piecing (E in line 6) was then calculated this way: Italy's piecings (E) = (0.02) (604) = 12; Guam's piecings (E) = (0.12) (931) = 112.

[1] See the next section for the analysis of this job.

After the C number of original unacceptable messages are received in, or pieced into, acceptable form, the incomplete copies are disposed of. The planning factor derived as a proportion (C/A) is listed on line 10.

Once an acceptable message is obtained, the administrative activities are done. These are done only once following message processing. It is assumed here that all A messages are completed and that they all go through this step.

The average lengths of original and retransmitted messages are listed in lines 7 and 8; the ratios of their deviations in length relative to a 1,200-character message are listed in lines 13 and 14.

Neither Guam nor Italy submitted the average length of a retransmitted message. But they did indicate that when a retransmission is required, the entire message is retransmitted. Because a Honolulu retransmitted message is shorter than the average message, it implies that Honolulu only retransmits that portion of a message that is unacceptable. Since longer messages are apt to require retransmission more often than short ones, we can infer from Norfolk's data that Norfolk also retransmits the entire message. We then decided to use only the Norfolk data (lines 7 and 8) as the basis for estimating line 14:

$$P = \frac{1,400}{1,200} = 1.17 \quad .$$

Thus, Guam's retransmitted message length = (1.17) (1,400) = 1,638 characters per retransmission (line 8), and Italy's = (1.17) (1,261) = 1,475.

There is another inconsistency in the Honolulu data. That station's shorter message length on retransmissions and its small proportion of piecing seem inconsistent. But the extrapolation is the best that can be done with the available data.

Derivation of Time Standards

Data describing each activity shown in figure A-1 was then listed in column 1 of table III-3 so that the data submitted by each site could be readily compared and a standard time for each activity calculated:

- The activity title and designation, as given in figure A-1, is listed in columns 1 and 2. Underlining this designation in column 2 indicates that the operator is completely occupied during this time. The designations submitted by the 4 sites are listed in columns 3, 6, 9, and 12.

- The times required to do each activity, as submitted by each site, are in columns 4, 7, 10, and 13.

While we wished to obtain a standard time for each activity as the mean of the times submitted, this could not be done when:

- An apparent arithmetic error was made in the time submitted by a site.

- When certain conditions peculiar to a site made the activity somewhat different from its counterpart at another site. One example of this: the time required for punching tape is a function of average message length, which varies from site to site.

In both cases, the time submitted was translated into a "standardized" time (that is, appropriate to the same standard set of conditions assumed); this, standardized time was used in calculating the mean. The reason for making these changes is described in this analysis.

The standard time recommended by the command for each activity is listed in column 15. Each value is derived as the mean (weighted by the number of messages per year at each site) for the 4 sites. (Throughout this analysis, the word "mean" indicates the weighted mean.) If a site did not include a time estimate, the mean was derived as the weighted mean of the data submitted by the other sites.

Description of Activities

This section describes each activity, using the designations in figure A-1. Operator activities are again indicated by underlining the designation.

Network Control Activities

No activity associated with setting up a full-period termination, receive, circuit was mentioned by any site. It seems that some fleet-center operator man-hours are required for this function. The sites are asked to describe these activities, estimate the times required and the frequency with which they are done -- according to procedures described in this handbook -- so that appropriate planning factors can be developed.

Transmission and Administrative Activities

- Activity a. Punch tape and print copy. The message is received from the ship in page copy and paper tape (via UGC-25 and TT-331 equipment). Honolulu submitted an initial machine time of 95 seconds, compared with 144 to 168 seconds, as submitted by the other sites. Since all the machine rates are the same (500 characters per minute), the time difference is reflected in all calculations involving message length. The standardized time, 144 seconds, was calculated on the basis of a standard message length of 1,200 characters.

- Activity b. Tear message off machine. The operator tears both page copy and tape off the machines. Honolulu submitted one time of 5 seconds for the operator to tear a message off the printer and inspect it (activities b and c). To conform with the standard structure, the 5 seconds was subdivided into two times -- 2 seconds for b and 3 seconds for c.

- Activity c. Inspect message. The operator scans the message to determine whether it is acceptable or whether it requires retransmission.[1] For simplicity, it was assumed that the time required for message inspection in activity c also includes the time required for decision making in activities d, f, i, and k. Thus, node d is treated as a no-time-loss decision node, allowing us to separate the flow of activities for received messages that are acceptable vs. those that are unacceptable. If a message is acceptable on first transmission, proceed down path d_1 to activity e.

Honolulu also included two times not reported by the other sites; these seem to be part of activity c. These activities are labeled g and r on Honolulu's flow chart. Activity g consists of 10 seconds to determine that a retransmission is required. The other sites presumably included their times in activity c. Activity r requires 10 seconds for the full-period termination operator to request the command's video display terminal (VDT) operator to hold the outgoing line to the ship so that a retransmission request may be made. The need for this function is not clear and should be reexamined. However, these 20 seconds were added to the 3 seconds carried over from activity b to yield a total of 23 seconds for Honolulu. It is assumed that the times listed are the average working times for both original messages as well as those returned by the data speed-reader operator.

- Activity e. Receipt for message. The operator receipts for an acceptable message on the TT-176. Italy indicates a requirement of 1 minute to receipt for a message, compared with 20 to 30 seconds for the other sites. Since this outlier may result from a "round-off error" in the time unit used, it was decided not to consider Italy's estimate in calculating the mean.

- Activity g. Log-in message. The operator logs the required information on the log card, then delivers the message for further processing.

- Activity h. Carry message to data speed-reader. The operator carries the acceptable message to the data speed-reader operator, who continues subsequent operations at his station. (See the next section for a description of this job.) Honolulu included 10 seconds to carry the message and add the Format Line 1 (FL/1) header. The time was divided into two parts -- 5 seconds for carrying, 5 seconds for adding the header. At decision node e, if the acceptable message was transmitted before the flow of activities, follow path e_1 to activity f.

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[1] As described, messages judged unacceptable by the data speed-reader operator and cannot be corrected by him are returned to the full-period termination operator at point R of figure A-1.

Retransmission Activities

- Activity j. Request retransmission. Given that a message has been received in unacceptable form, the operator must complete two decision nodes (whose times were included previously) before he requests a retransmission. The first, node h, is a decision node enabling him to separate the unacceptable messages into two subsets. When this transmission was the first unacceptable transmission of a message received, the operator proceeds directly through path i to activity j and requests a retransmission. But when this is not the first unacceptable transmission of a message, he proceeds through path i_2 to node k to determine whether the set containing the current, retransmitted message and all past transmissions of the same message permits the operator to piece together an acceptable message on his UGC-6. If not, he proceeds through path k_1 back to activity j, requesting another retransmission. When he can piece together an acceptable message, he proceeds through path k_2 to activity 1. In activity j, the operator requests retransmission of message on the TT-176. The process continues with repeated activities a, b, and c.

- Activity m. Disposal of old copies. After an acceptable copy is obtained (through retransmissions or piecing -- see the next function), the operator discards all old, imperfect copies of the message, then proceeds to activity e. Italy did not include a time estimate for discarding old messages, but it is assumed that the job must be done. Therefore, the mean time of the other 3 sites was calculated as the standard.

Piecing Activity (Activity 1)

When the operator has enough copies to piece together an acceptable message, he does so using the UGC-6. After he completes the job, he disposes of all the used and incomplete copies (activity m). Guam included disposal time of 20 seconds as part of its piecing activity 1. Thus, its time, 192 seconds, was reduced to 172 seconds to conform to the standard flow diagram.

Full-Period Termination, Receive, Manpower Requirements

Using figure A-2 and tables III-2 and -3, the manpower requirements for this job at Guam was calculated (table III-4) as described here.

Calculating Average Times Required Per Message

List the major work functions in column 1 and the standard operator and total times they require (in seconds) in columns 2 and 3, as obtained from tables III-2 and -3.

Also list, in column 1, any relative deviations from the standard times listed. The only deviations that occur relate to message length for a transmitted or retransmitted message. These relative deviations are listed in lines 13 and 14 of table III-2 as +.17 and +.36, respectively. Next, convert these relative deviations to time deviations by multiplying by 144 seconds (the machine time required for a 1,200-character message); list the value obtained in column 3 of table III-4.

List in column 4, the proportion that indicates how often each function is done for one message. This data, and the formula used, are obtained from the bottom half of table III-2.

Since no data concerning the network control function was provided by any of the sites, the calculation of the total time required for this job was made without considering this function. But the calculation for this function can be illustrated in algebraic form. Let M equal the number of man-minutes required each time a full-period termination circuit is to be terminated. Let N equal the number of such terminations per year. Thus, the actual working man-hours per year required for network control is:

$$MH = \frac{MN}{60} \text{ man-hours} .$$

Calculate the average operator time required for each function as the product of columns 2 and 4, and list this in column 5. Calculate the average total time required for the function as the product of columns 3 and 4, and list in column 6. Find the average operator time required as the sum of column 5; find the average total time required as the sum of column 6.

Calculating the Operator Time Ratio

Calculate the operator time ratio (OTR) as the ratio of the average operator time to the average total time required per message. Thus, for this job:

$$OTR = \frac{101 \text{ sec.}}{341 \text{ sec.}} = 0.30 .$$

See table III-4, line 8. Use of this factor is explained under Calculating Billet Requirements in the section on planning logic.

Calculating the Working Man-hours Required

Once the average operator time per message has been calculated, the man-hours required for actual operator work time can be calculated as the product of the average operator time per message year and the number of messages per year, converted to man-hours (table III-4, second part). As discussed in the section on planning logic, there may be some unavoidable operator idle time that must be added to these man-hours to determine the total man-hours per year required.

Piecing vs. Retransmission

Further analysis of the proportions listed in table III-2 (line 12) indicated that Norfolk pieced about 12 percent of its messages; Honolulu pieced only 6 percent. On the other hand, Norfolk required only 20 percent retransmissions (line 11), while Honolulu required 54 percent. This seemed to be a difference in policy regarding piecing, since the more retransmissions obtained (at a cost of extra time for the ship operator and the circuit), the fewer piecings required by the fleet center operator. Therefore, an analysis was made to see which policy is better (based on the least time required).

To make this analysis, the average times required per message (table III-4) was reconstructed using Honolulu and Norfolk data (table III-5). The first half of the table shows the times (operator and total) and the proportions associated with the two main functions being analyzed (retransmission and piecing). The table shows that the average operator time required per message for the two functions are about the same -- 26 and 29 seconds. However, Norfolk's total time is much less than Honolulu's -- 58 vs. 104 seconds. The times for the other two functions were also calculated (under standard conditions) and added to the first two so that the relative figures could be shown.

The conclusions drawn from this analysis are:

- There is only a 2-percent gain in operator time by doing less piecing, at the cost of more retransmissions.
- The total time required by more retransmissions is 58 seconds per message (or 17 percent more). This becomes a problem only when the operator does not have access to enough circuits to keep busy, and the layout should be constructed so this will not happen.
- The major waste is in the extra ship operator and circuit time required for the extra retransmissions required by Honolulu. No calculation of this was made because the two policies gave roughly the same results in operator time without this additional factor.
- Honolulu's policy of higher retransmissions and less piecing seems inferior to Norfolk's.

Work Samples Taken

To obtain some validation of the time estimates provided by the sites, work samples of the full-period terminations send and receive and the data-speed reader jobs were taken at Norfolk; the results appear in tables III-6 and -7. Eight sets of measurements (columns 1 through 9) were taken for this operation, showing:

- The ship circuits that each operator serviced during his test (lines 1 and 2),

- The total number of send-and-receive messages serviced by the operator during his test (lines 3 and 4).

- The operator working time (in minutes) required for the send messages (line 5), receive messages (line 6), idle time when no messages were being serviced (line 7), and total time elapsed -- that is, the sum of these three times (line 8).

Column 10 shows:

- The number of send-and-receive messages serviced during the 8 tests (lines 3 and 4).

- The working times devoted to send (line 5) and receive (line 6) messages.

Before conducting the actual sampling, all supervisors and participating operators were briefed as to why the exercise was being conducted, and the operators were asked to go about their work as usual. Cooperation was excellent.

There was some inconsistency in the procedure in that different operators usually followed several distinct sequences of activities, and they often varied their sequences. However, this may be viewed as a good thing, since the measurements obtained could be considered a good average of different operators and different procedures. Certainly the results represent an average of what actually takes place at a fleet center.

There was also some inconsistency in circuit layout. In some cases, the existing layout or work-station configuration was such that, for one terminated ship, the send set of equipment was not adjacent to the receiver -- in fact, relatively far away. Different operators were handling the different ends of the same termination in different and separated work stations. This arrangement was considered impractical in HF transmission; when send messages are received garbled by the ship, requests for retransmission come to the fleet center via the receive-message end of the termination. This means one operator is distracted from normal procedures, and either walks to the send side or shouts the necessary information to the send operator for the message to be retransmitted. The same problem arises when received messages are garbled. Thus, the time measurements calculated should be higher than those that could be obtained if a proper layout were available.

While a "normal" operator assignment might consist of a maximum of 3 send and 3 receive channels per work station, aircraft carriers were sometimes generating so much traffic that 2 operators were assigned to one work station. One operator handled send and the other receive, adjacent to one another. Again, the measurement could be viewed as representative of a mix of various conditions.

Since the basic objective of the work samples was to estimate the amount of time per message unit, times for individual activities were sacrificed. Total times were obtained by letting the clock run continuously and by identifying busy interval-send, busy interval-receive, and idle time, while counting the number of messages sent, received, and retransmitted. This data yielded average time per message for both send and receive, as well as utilization, or occupancy, as a function of message arrival rates and number of channels terminated.

From this data, the average full-period termination operator time required for a send or receive message was calculated; this is listed in column 2 of table III-7. The average data speed-reader time was obtained by similar measurements of 65 samples. The standard deviations, M, for these measurements are also calculated for the sample sizes (column 3) and used to calculate confidence intervals at the 90-percent level (column 2).

The times measured can be compared with the average times calculated in table III-4 this way:

- Since none of the 88 receive messages required either retransmission or piecing, the measured time of 65 $\pm$ 4 seconds compares favorably with the standard operator time of 66 seconds for transmission and administrative activities only. Obviously, we have no check on the time required for other functions.

- The work sample results for the data speed-reader operator are described in the next section.

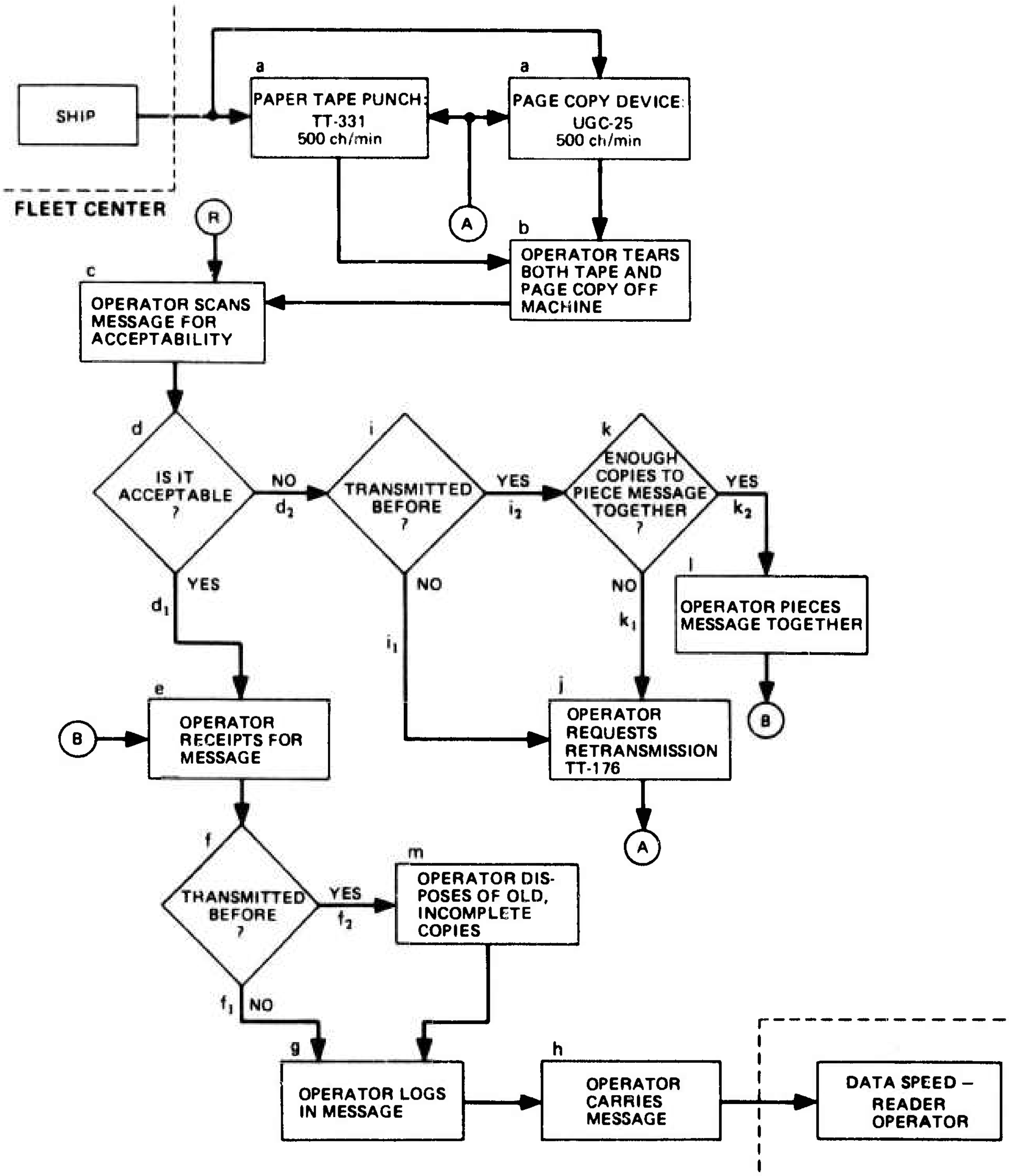

FIG. A-1: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF FULL-PERIOD TERMINATIONS, RECEIVE

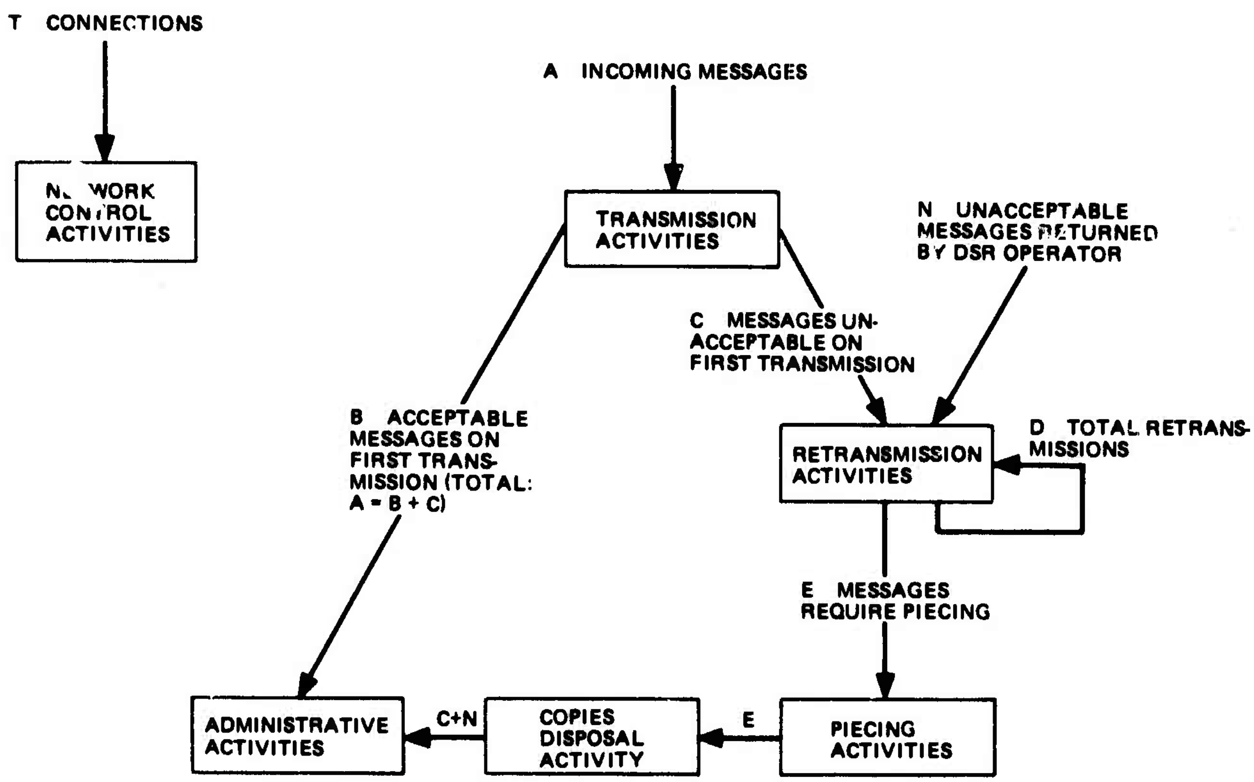

FIG. A-2: WORK FUNCTIONS ASSOCIATED WITH FULL-PERIOD TERMINATION, RECEIVE, JOB

TABLE III-2

NONTIME PLANNING FACTORS FOR FULL-PERIOD TERMINATION, RECEIVE, JOB

	Honolulu	Guam	Norfolk[a]	Italy
Flow characteristics submitted by sites				
1. Number of network connections per week (T)	-	-	-	-
2. Number of messages received per week (A)	(694)	2794	489	604
3. Number of messages acceptable on first transmission (B)	538	(2207)	392	(477)
4. Number of messages returned as unacceptable from the DSR operator (N)	-	-	-	-
5. Number of transmissions received (A+D)	1070	(3828)	588	785
6. Number of messages requiring piecing (E)	13	(335)	60	(72)
7. Average length of message	650	1400	1200	1261
8. Average length of retransmitted message	450	(1638)	1400	(1475)
Derived characteristics				
9. Proportion of messages acceptable on first transmission (B/A)	0.77	(0.79)	0.80	(0.79)
10. Proportion of messages requiring transmission (C+N)/A = (A-B+N)/A = (B-N)/A	0.23	(0.21)	0.20	(0.21)
11. Proportion of retransmissions required (D/A) = (A+D)/A -1	0.54	(0.37)	0.20	0.30
12. Proportion of piecings required (E/A)	(0.02)	(0.12)	0.12	(0.02)
13. Message length deviation relative to 1200 characters standard (line 7 - 1200)/1200	-0.46	+0.17	0	+0.05
14. Retransmission message length deviation relative to 1200 characters standard (line 8 - 1200)/1200	-0.63	+0.36	+0.17	+0.23

TABLE III-3

ACTIVITY TIME FOR FULL-PERIOD TERMINATION, RECEIVE

(1) Activity	(2) Std. activity designation	Honolulu (824) (3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	Guam (2,734) (6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	Norfolk (489) (9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	Italy (604) (12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Network control														
Total operator time	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total time	—	—	—	—	—	—	—	—	—	—	—	—	—	—
II Transmission														
Punch tape and print copy	a	a	95	144	a	168	144	a	144	144	a	150	144	144
Tear message off machine	b	b	5	2	b	2	2	b	3	3	b		5	3
Inspect message	c	b+g+r	20	23	c	10	10	c	5	5	c	15	15	12
Total operator time				25			12			8			20	15
Total time				189			156			152			184	159
III Administrative														
Receipt for message	e	c	30	30	g	25	25	g	20	20	e	80[a]	80[a]	25
Log-in message	g	e	10	10	k	5	5	k	20	20	f	10	10	8
Carry message	h	f	5	5	ℓ	14	14	m	5	5	g	15	15	12
Total operator time				45			44			45			85	45
Total time				45			44			45			85	45
Total time if no retransmission is required														
Total operator time[a]				70			56			53			105	80
Total time[a]				214			200			197			249	204
IV Retransmission														
Request retransmission	i	i	20	20	i	30	30	i	20	20	d	80[a]	80[a]	27
Total operator time (j+b+c)				45			42			28			80	42
Total time (i+a+b+c)				189			186			172			224	186
V Copies disposal	m	m	5		f	20		j	20			—		
Total operator time				5			20			20			—	17
Total time				5			20			20			—	17
VI Piecing	ℓ	c	180		j	172		k	180			—		
Piece message				180			172			180			—	174
Total operator time				180			172			180			—	174
Total time				180			172			180			—	174

[a]Unexplained "outlier" and not used in calculating standard time (weighted mean) of column 15.

TABLE III-4

MAN-HOURS REQUIRED AT GUAM FOR FULL-PERIOD TERMINATION, RECEIVE, JOB

I. Calculating Average Operator and total time per message

(1) Work functions	(2) Operator time	(3) Total time	(4) Proportions Designation	(4) Proportions Value	(5) Average operator time	(6) Average total time
(1) Transmission	15	159	A/A	1.0	15	159
Message-length deviation (0.17) x 144		+24	A/A	1.0		+24
(2) Administrative	45	45	A/A	1.0	45	45
(3) Retransmission	42	186	D/A	0.37	16	69
Message-length deviation (0.36) x 144		+52	D/A	0.37		+19
(4) Copies disposal	17	17	(C+N)/A	0.21	4	4
(5) Piecing	174	174	E/A	0.12	21	21
(6) Network control	-	-	-	-		
(7) Average time required per message	293	581	-	-	101	341
(8) Operator time ratio					0.30	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) required per message (column 5)	101
(2) Number of messages per year (supply)	145,288
(3) Operator time (in seconds) per year (lines 1 x 2)	14,674,088
(4) Convert time from seconds to hours per year (line 3/3,600)	4,076

TABLE III-5

AVERAGE TIMES REQUIRED PER MESSAGE FOR DIFFERENT REWORK POLICIES -- FPT RECEIVE

Work function	Oper. time	Total time	Honolulu proportions	Norfolk proportions	Average oper. time Honolulu	Average oper. time Norfolk	Average total time Honolulu	Average total time Norfolk
Retransmission	42	186	0.54	0.20	23	8	100	37
Piecing	174	174	0.02	0.12	4	21	4	21
				Subtotal	27	29	104	58
Transmission and administrative	60	204	1.00	1.00	60	60	204	204
Copies disposal	17	17	0.20	0.20	3	3	3	3
				Subtotal	63	63	207	207
				Total	90	92	311	265

TABLE III-6

SUMMARY OF DATA COLLECTED ON FULL PERIOD TERMINATION OPERATION
(all times in minutes)

(1) Sample Characteristics	(2) 1	(3) 2	(4) 3	(5) 4	(6) 5	(7) 6	(8) 7	(9) 8	(10) Total
(1) Send Term. (No.)	Forrestal (1) JFK (2)	Independence (1)	Autec (1) Mitscher (1) Forrestal (1)	Autec (1) Mitscher (1) Forrestal (1)	Shenandoah (1) Independence (1) Nimitz (1)	Inchon (1) Shenandoah (1) Iwo Jima (1)	Shenandoah (1) Nimitz (1) Independence (1)	Forrestal (1) JFK (2)	
(2) Rec. Term. (No.)	Forrestal (1) JFK (2)	Independence (2)	Autec (1) Forrestal (1) Mitscher (1)	Autec (1) Mitscher (1) Forrestal (1)	Independence (2) Nimitz (1)	Inchon (1) Shenandoah (1) Iwo Jima (1)	Independence (2) Nimitz (1)	Forrestal (1) JFK (2)	
(3) No. of send msgs.	23	15	5	6	7	5	26	24	111
(4) No. of rec. msgs.	23	5	14	10	7	4	6	19	88
(5) Send time (min.)	15.18	22.78	4.35	5.28	12.06	6.48	33.81	37.50	137.34
(6) Receive time (min.)	18.88	7.89	14.25	14.40	8.74	4.63	6.63	20.62	96.04
(7) Idle time (min.)	20.11	11.88	10.80	5.64	11.70	22.89	7.96	15.23	106.21
(8) Total time elapsed	54.29	42.55	30.52[1]	25.32	32.50	34.00	48.40	73.35	340.93
(9) Retransmitted messages (send only)	0	0	0	0	1	0	2	3	6
(10) Occupancy (U)	.63	.72	.65	.78	.64	.33	.84	.79	5.38

[1] The operator spent 1.12 minutes placing new tape on monitor machine.

TABLE III-7

SUMMARY OF WORK SAMPLE DATA

(1) Operation[1]	(2) Time per message[2] (seconds)	(3) Standard deviation (seconds)
FPT send	74 ± 5	29
FPT receive	65 ± 4	17
DSR operation	72 ± 2	72

[1] The respective sample sizes and standard deviations are from top to bottom $n_s = 111$, $n_r = 88$, $n_d = 65 + 2$ rejects, $s_s = .4816$, $s_r = .290$, $s_d = 1.206$

[2] Confidence intervals have been obtained at the 90% confidence level ($Z_{.05} = 1.96$)

OPERATIONAL MANPOWER REQUIREMENTS:

ANALYSIS OF DATA SPEED-READER

The data speed-reader (DSR) job was analyzed the same as the full-period termination, receive, job. Figure A-3 is the flow diagram to be used as a comparison standard among sites. Figure A-4 illustrates the major functions done and the message flow through these functions.

Data describing the DSR job was submitted by Honolulu, Guam, and Norfolk, as shown in this section and listed in tables III-8 and 9. Italy stated only that its DSR job is done by the full-period termination or ship-to-shore operator. No flow chart, activity description, or quantitative data was provided by Italy.

The DSR job begins as the message is given by the FPT (or other) operator to the DSR operator, who feeds it to the computer via the DSR.

Derivation of Nontime Planning Factors

Figure A-4 shows and table III-8 lists the data submitted by each site and used to derive those planning factors that are unique to each site's environment and operation. Again, the first section of the table contains the message flow characteristics for this job as submitted by each site, using the designations shown in figure A-4. The second part of table III-8 consists of the proportion planning factors associated with this job, derived from the data in the first part. Again, these planning factors are of three basic types:

- Incoming work load (number of messages).
- The proportion of time that some rework activity must be done.
- Message length: this factor may be used to adjust the standard times, as needed.

It is important that each site review table III-8 and resubmit the data required. Since the data is defined in one of several possible ways, each site should make certain it reviews the definition of each factor before collecting the data. These definitions should be clearly understood by the site so that data is submitted correctly.

The most important factor is the total number of messages received per week by the DSR operator for entry into the DSR. As figure A-4 shows, there are three types of messages: A message comes to the DSR operator from the FPT (or other) operator for the first time. E of the incoming A messages are judged to be unacceptable and uncorrectable by the DSR operator, who returns them to the FPT operator for correction. Of all the messages transmitted to NavComPARs, F messages (as described elsewhere in this volume) are rejected and are returned to the original checking activity; therefore, these messages essentially are treated as additional input messages.

The total input messages are the A original messages plus E and F repeat messages. Since at least one site (Honolulu) submitted its data as proportions based on work samples, it is easier to have the base used for these proportions as A' = A + E + F messages, rather than A.

Thus, the first factor listed in table III-8 (A in line 1) is the number of messages received per week for the first time by the DSR operator. Since no site provided this (or most of the other) data, we are listing an illustrative set of data in column 2 to illustrate how the planning factors and other characteristics are calculated. Assume A equals 1,000 messages per week, as shown in column 2. Honolulu's entry of 694 messages is the same as its FPT-received messages.

All A messages undergo initial checking for acceptability, based on a number of criteria (see below), resulting in B of these messages being found totally acceptable. In addition:

- C of the A' messages (listed in line 2) are found to have their Format Line 1 (FL/1) header missing, requiring the operator to supply this header to the message. Line 8 lists the proportion of messages requiring an FL/1 header, and is equal to C/A'.

- D of the A' messages checked (line3) were found unacceptable--for reasons other than a missing FL/1 header--but can be corrected by the DSR operator. Line 9 lists the proportion of unacceptable messages that the DSR operator can correct himself, and is equal to D/A'.

- E of the A' messages checked (line 4) were found unacceptable for reasons other than a missing FL/1 header. These E messages are then returned to the original operator for his correction. This results in an increased work load for the FPT operator, and it can be assumed to result in N extra messages requiring retransmissions, as shown in figure A-2. The A messages coming to the DSR operator include not only the original messages coming to him for the first time, but all messages previously returned by him to the FPT operator for correction, and subsequently returned. Line 10 lists the proportion of unacceptable messages that the DSR cannot correct himself, but returns to the original operator; this equals E/A'. It is assumed that this planning factor will be used in calculating the work done by the original (FPT) operator.

- Of the original A messages transmitted to NavComPARs, after any necessary corrections, a total of F messages (line 5) are rejected by NavComPARs and are returned to the operator for his inspection (at M in figure A-3), continuing the entire process that follows the original inspection activity. Thus, the proportion of messages transmitted to NavComPARs is (A + F)/A (line 12) and the proportion of messages rejected by NavComPARs, which must be reinserted into the total process, is F/A' (line 11).

- The total number of messages handled administratively is A (line 1); the proportion of these messages (A/A') is listed in line 13.

Finally, the average message length is listed in line 7 and the ratio of its derivation in length relative to a 1, 200-character message is listed in line 14.

Derivation of Time Standards

Data describing each activity in figure A-3 was next listed in table III-9 so that the data submitted by all the sites could be compared and a standard time for each activity calculated, as already described.

Description of Activities

Initial Checking Activity

- Activity a. Check message. The DSR operator checks the message for acceptability this way:

  - Is the FL/1 header included? This decision-making process is shown as decision node b in figure A-3, and it includes the time for this decision as part of the time of activity a. If the header is not present, it is added as part of the rework process (described elsewhere).

  - Is the message acceptable in other respects? This decision-making process is shown as decision node c with its time also included as part of activity a. If the message is not acceptable, the operator must decide whether he can correct the message or whether it must be returned for correction to the operator who originally brought it to the DSR. This decision is represented by decision node i. (All rework activities are discussed under that function.)

Honolulu makes no mention of this inspection activity, probably because the FPT ship-shore operator also operates the DSR, and the message-checking function was done earlier. Thus, in calculating the command standard for this activity, we consider only the data submitted by the other 2 sites; we always follow this rule for missing data.

Transmission and Administrative Activities

- Activity d. Place tape on DSR.

- Activity e. Feed message to NavComPARs. The operator places message tape on DSR and sets up the machine for reading. The DSR machine reads the paper-tape message and enters it into the computer, which sends the operator and acceptance feedback signal and the Processing Sequence Number (PSN) assigned to the message.

These two activities are treated together, since Honolulu and Guam did so. Since we wished to develop standard times for each activity, we divided Honolulu's 12 seconds into 9 seconds of machine-running time for activity e (based on an average message length of 650 characters for FPT messages and a DSR speed of 850 words per minute or 4,250 characters per minute) and 3 seconds set-up time for activity d. Similarly, Guam's time of 20 seconds was divided into 20 seconds running time, leaving 0 seconds for set-up (Guam's average message length was 1,400 characters).

Obviously, Guam's data is inconsistent, and it was standardized by:

- During set-up time using the mean of the times submitted by the other sites.

- Standardizing the machine running time (for all sites) based on an average message length of 1200 characters and the DSR speed, giving a standard time of 17 seconds.

Since the machine running time for activity e is so short, it seems that the operator cannot efficiently go to another activity. We therefore consider activity e as operator time.

- Activity f. Check channel log. The operator checks the channel log to see whether the NavComPARs computer has accepted the message. This activity includes decision node g. If the computer rejects the message, rework activities (described elsewhere) take place. Only Honolulu mentioned this activity. But since the other sites must also do the work, they probably included the time as parts of activities d and e. But if this activity were omitted, Honolulu's time (5 seconds) would be added to the total times.

- Activity h. Log in PSN and file message. After the message is accepted by the computer, the operator annotates the page copy of message with the PSN assigned by the computer and files the message. Large differences in time were observed in the sites' time submissions for this activity. Honolulu submitted 5 seconds, with no mention of logging in the PSN. We assume that the latter activity was considered to be part of the former. One reason why Honolulu's time may be so much lower is that the FPT operator also operates the DSR, and he may log the message in only once rather than twice.

On the other hand, Guam not only requires 24 seconds for the activity, but also indicated an additional requirement of 17 seconds for activity f, "logs message in." These 41 seconds must be considered as an outlier until further explanation of what tasks are done during this time is provided.

Rework Activities

This function consists of additional activities that may take place in modifying a message to put it into proper form to be acceptable by NavComPARs.

- Activity i. Add FL/1 header. This is done when the header is not already on the message. Norfolk indicated it adds precut FL/1 headers to all its messages before putting it on the DSR; Honolulu adds the header only "if necessary." Guam omitted any discussion of FL/1 headers, and Honolulu was the only site to submit a time. However, this time--10 seconds--was for both carrying the message to the DSR and adding the FL/1 header tape when necessary. Since carrying of the message was included in the FPT job, the time for each of the two activities had to be separated; it was assumed that 5 seconds was required for each.

- Activity j. Return the message to the original operator. This is done only when the original operator can correct the message, and it basically consists of travel time. Only Guam submitted a time. It could be assumed that if the FPT operator also operates the DSR, he also works with acceptable messages and therefore, never (or rarely) does this activity.

- Activity k. DSR operator corrects message.

- Activity g_1. Operator checks the message rejected by NavComPARs. Honolulu included the possibility of the computer's rejecting the message, thus requiring some rework. If the computer does not accept the message, the operator must determine why. The rejection may be caused by a formatting error, a hole in the tape, or some other reason easily corrected by the operator. However, it is unclear whether the operator merely resubmits the tape, or if he attempts to correct it before replacing it on the DSR. No additional time was included for correcting a message that had been rejected.

Norfolk did not include this rework function, perhaps because it rarely happened. Only Guam indicated that, occasionally, the rejection is caused by something of a more serious nature, and the message must be returned to the source operator for a retransmission.

Calculating Working Man-Hours Required

Once the standard activity times have been derived for table III-9, the operator and total time per message, operator time ratio, and the working man-hours required for this job may be calculated in exactly the same way as for the FPT receive job. Table III-10 shows the method of making this calculation, using the standard times and hypothesized data of table III-9.

Work Samples Taken

As mentioned, work samples of the DSR job were taken at Norfolk, and these observations made.

The DSR operator and the orderwire operator were found to be the same person. This operator monitors the orderwire until enough messages are gathered on an adjacent table, he then switches attention to the DSR operation. This operation is divided into three major activities:

- The operator leaves his orderwire monitoring job; he picks up the messages and places them in a basket underneath the machine, after separating them from the page copies. One-by-one, he runs them through the machine as the computer acknowledges acceptance via an adjacent teletype (reruns might be necessary).
- After all the messages have been run, the operator writes again one-by-one, the PSN assigned each message by the computer.
- After all PSNs have been written, the operator logs and files each message, also one-by-one.
- The operator then returns to his orderwire monitoring function.

Five samples were taken on different days and shifts. The 5 samples included a total of 65 messages. As the operator abandoned his orderwire job, the clock was allowed to run continuously. The analyst marked the end time of each phase of the operation.

As table III-7 shows, the work samples taken indicate that each message required an average DSR time of 72 $\pm$ 2 seconds, including a rerun proportion of 0.03 (2 messages out of 65 reruns). This compares with a calculated average time of 33 seconds per message using the standard times of table III-9 and a rerun proportion of 0.03 . This standard times appear to be conservative estimates in this case.

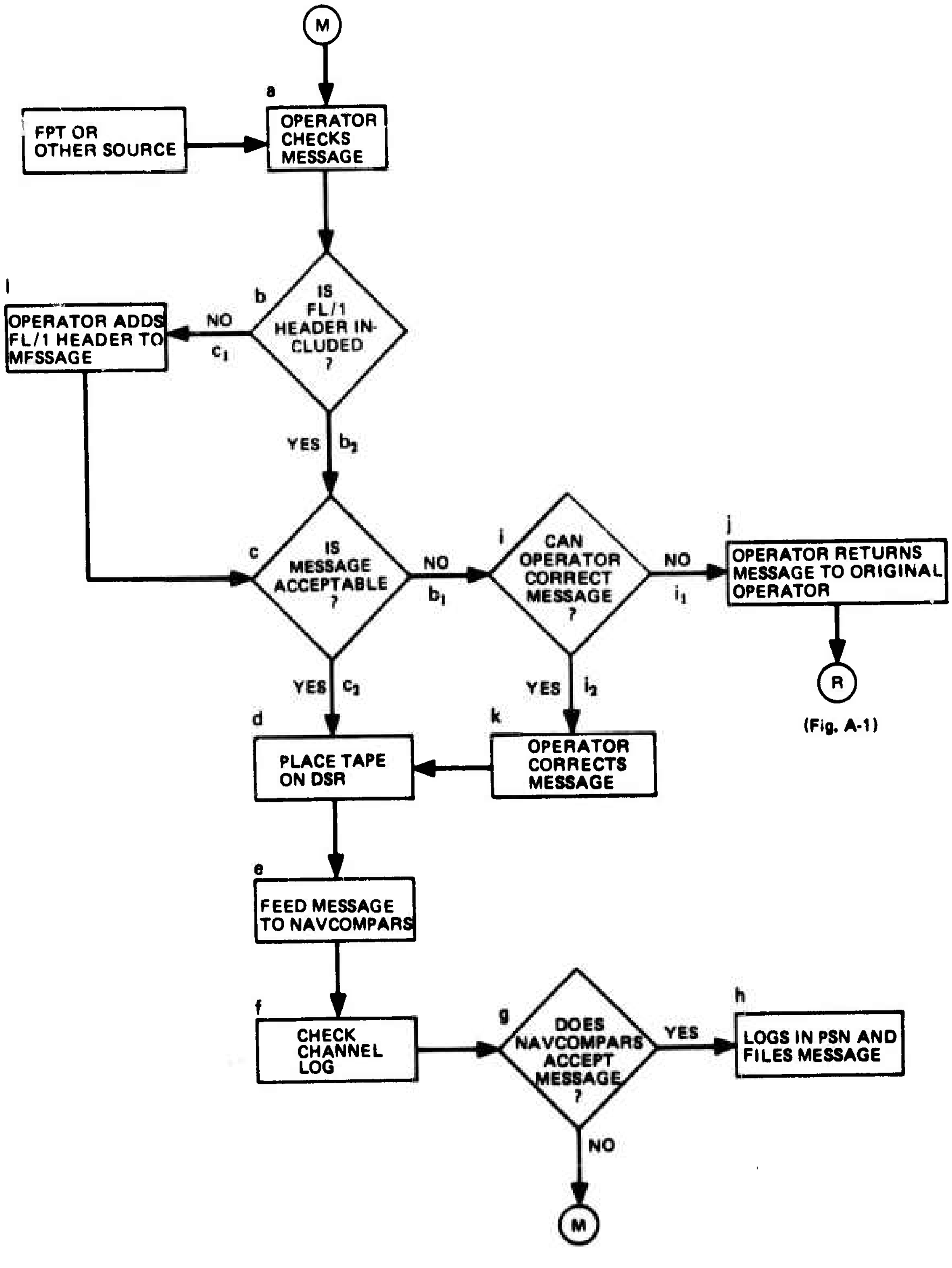

FIG. A-3: ACTIVITIES INVOLVED IN DATA SPEED READER JOB

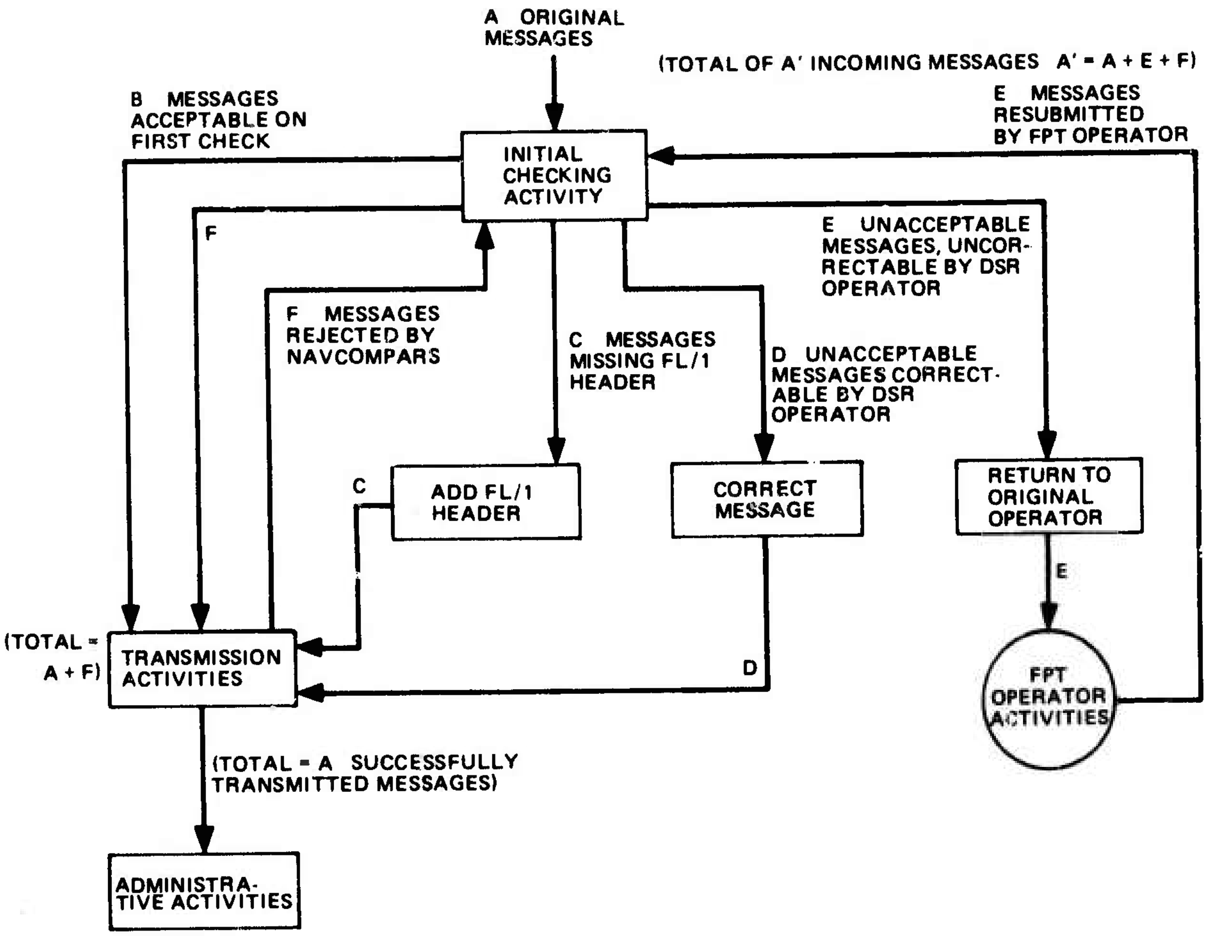

FIG. A-4: WORK FUNCTIONS ASSOCIATED WITH THE DATA SPEED READER

TABLE III-8

ADDITIONAL PLANNING FACTORS FOR DSR JOB

(1)	(2) Illustration	(3) Honolulu	(4) Guam	(5) Norfolk	(6) Italy
Flow characteristics submitted by sites					
1. Number of messages per week received the first time by the DSR (A)	1,000	(694)		1,404	686
2. Number of messages requiring FL/1 header (C)	200				
3. Number of messages found unacceptable but corrected by DSR operator (D)	100				
4. Number of messages found unacceptable by DSR operator and returned to original operator (E)	300				
5. Number of messages rejected by NavComPARs (F)	50				
6. Total number of incoming messages (A' = A + E + F)	1,350				
7. Average length of message	1,400	650	1,400	1,200	1,261
Derived characteristics					
8. Proportion of messages per week requiring FL/1 header (C/A)	0.15			1.0	
9. Proportion of unacceptable messages per week correctable by DSR operator (D/A')	0.07				
10. Proportion of unacceptable messages per week returned to original operator (E/A')	0.22				
11. Proportion of messages rejected by NavComPARs (F/A')	0.04	0.05			
12. Proportion of messages transmitted (A + F)/A'	0.78				
13. Proportion of messages handled administratively (A/A')	0.74				
14. Message length deviation relative to 1,200 character standard (line 7 - 1,200)/1,200	+0.17				

TABLE III-9

ACTIVITY TIME FOR DATA SPEED READER

(1) Activity	(2) Std. activity designation	Honolulu (694) (3) Activity designation	Honolulu (4) Required time (sec)	Honolulu (5) Standardized time (sec)	Guam (2,794) (6) Activity designation	Guam (7) Required time (sec)	Guam (8) Standardized time (sec)	Norfolk (1,404) (9) Activity designation	Norfolk (10) Required time (sec)	Norfolk (11) Standardized time (sec)	Italy (886)[b] (12) Activity designation	Italy (13) Required time (sec)	Italy (14) Standardized time (sec)	(15) Standard time (sec)
I Initial checking			–	–	a	5	5	a	2	2				4
Check message	a													
Total operator time				–			5			2				4
Total time				–			5			2				4
II Transmission		h	12	3	g	20[a]	20[a]	d	5	5				4
Place tape on DSR and set it up	d			17			17	e	17	17				17
Feed message to NavComPARS	e		5	5										5
Check channel log	f													
Total operator time				25			37			22				26
Total time				25			37			22				26
III Administrative		t	5	5	i	24[a]	24[a]	f	15	15				12
Log-in PSN and file message	h				f	17[a]	17[a]							
Total operator time				5			41			15				12
Total time				5			41			15				12
IV Format Line 1 header		g	5	5	b	–	–	b	–	–				5
Add FL/1 header	g													
Total operator time				5			–			–				5
Total time				5			–			–				5
V Correct message					a	42	42							42
Operator corrects message	k													
Total operator time							42							42
Total time							42							42
VI Return message					[illegible]	12	12							12
Operator returns message to original operator	l													
Total operator time							12							12
Total time							12							12

[a]Outlier; do not use in calculation of mean.
[b]No data.

TABLE III-10

MAN-HOURS REQUIRED FOR DSR
(Example)

(1) Work Function	(2) Operator Time	(3) Total Time	(4) Proportion		(5) Average Operator Time	(6) Average Total Time
I Calculating average operator and total time per message						
(1) Initial checking	4	4	(A+E+F)/A'	1.0	4	4
(2) Transmission	26	26	(A+F)/A'	.78	20	20
Message length deviation (+ 0.17 x 144)		24	(A+F)/A'	.78		19
(3) Administrative	12	12	A/A'	.74	9	9
(4) Add FL/1 Header	5	5	C/A'	.15	1	1
(5) Correct Me-sage	42	42	D/A'	.07	3	3
(6) Return to original operator	12	12	E/A'	.22	3	3
(7) Average total time required	101	101			40	59
(8) Operator time ratio					.68	
II Calculating working man-hours required per year						
(1) Total operator time (in seconds) required per message (col. 5)					40	
(2) Total number of messages per year (supply) (A' = A+E+F)					70,200	
(3) Operator time (in seconds) per year (1) x (2)					2,808,000	
(4) Convert time from seconds to hours (3) ÷ 3600 (man-hours per year)					780	

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF FULL-PERIOD TERMINATION, SEND

This job is done manually by the FPT operators at Norfolk and Italy, and semiautomatically by Honolulu and Guam (using NavComPARs to automatically transmit the message and the FPT and VDT operators' handling of retransmission requests). The first part of this section describes the analysis of the manual operation, using the data submitted by Norfolk and Italy. The remainder of the section describes the semiautomated operation. Figure A-5 is the flow diagram to be used as the standard of comparison.

Derivation of Nontime Planning Factors

Figure A-6 illustrates and table III-11 lists the set of data submitted by all 4 sites and used to derive those planning factors that are unique to each site's environment and operation. This data shows that:

- The FPT operator receives A messages per week (line 1) from NavComPARs to be transmitted to the ships; these are transmitted.
- Fraction B of the A messages are received by the ships in acceptable form, but the C = A - B messages (line 2) remaining are requested to be retransmitted, resulting in D retransmissions (line 3). The proportion of retransmissions (D/A) is listed on line 6.
- After the ship confirms that an acceptable copy was obtained, the FPT operator performs the necessary administrative activities. There are A such activities, since it is assumed that all A messages are eventually sent. Honolulu did not include the number of A messages sent per week, but did say that 30 percent of the messages must be retransmitted. In other words, 70 percent are perfect on the first transmission. But they also said that 814 messages are perfect on the first transmission, so A must equal 1,163.
- Italy stated that its Rome circuit is exceptionally good, with only one in 1,000 messages needing retransmitting.
- The average message lengths transmitted and retransmitted are listed on lines 4 and 5 of table III-11, and the ratios of their deviations relative to a 1,200-character message are listed on lines 7 and 8.
- There is no need to determine the number of transmissions sent acceptably on the first transmission.

Derivation of Time Standards

Data describing each of the activities shown in figure A-5 is listed in table III-12; the data i compared and a standard time for each activity calculated.

Description of Activities

Transmission Activities

- Activity a. Punch tape copy. The teletype device receives the message from the computer and punches a paper message. Standard machine time is 144 seconds, as calculated from machine speed of 100 words per minute and average message length of 1,200 characters.

- Activity b. Tear message off machine.

- Activity c. Log-in message. The operator records the required information on the send log. Logged information consists of identification data and message origin.

- Activity d. Place tape on transmission device. Operator places tape on the transmitting device and sets it up for transmission.

- Activity e. Transmit message. Standard machine time is 144 seconds as calculated previously.

Administrative Activities

- Activity f. Teletype for response. Operator uses keyboard of TT-176 teletype to obtain a receipt for message, or to determine whether the ship wants retransmission. Node g is a no-time loss decision, since it is done by the ship's operator. The node is given here to indicate the two possible paths (g_1 and g_2) that exist depending on the ship's response. If a receipt is obtained from the ship, indicating that the transmission was received in acceptable form, path g_1 is followed to activity h. If not, path g_2 is followed, returning to activity d. This path will be described further under rework activities.

- Activity h. Log-out message. The operator records, on the log card, the time the ship receipts for the message. Italy did not indicate any tasks that are necessary after the ship's receipt has been obtained. It is assumed that activity h must also be done, so this activity (as well as activity i) is included as part of the job.

- Activity i. Check monitor. The operator ensures the teletype monitoring device is operating--that is, that all send transmissions are being recorded.

Rework Activities

As indicated already, if the message was not properly received by the ship's operator, path g_2 is followed and activities d, e, and f are repeated.

Calculating Working Man-Hours per Year Required

Table III-13 illustrates the calculation of the man-hours per year required by Norfolk. This was calculated as described before.

An analysis of the semiautomatic operation of the full-period termination, send, job could not be made because of a lack of data from Honolulu and Guam. The only data submitted describing their semiautomatic operation was Honolulu's statement that "NavComPARs automatically queues up and transmits traffic according to precedence, and has the capability for resending any message upon demand.... It is suggested that 10 percent of the computed workload for the receive portion of the FPT operator's duties be used as a working figure for the amount of man-hours required for the operation of the send side of full-period terminations."

The automatic process is interrupted by the command VDT operator, (at the request of the FPT operator) when:

- It is necessary to communicate with the ship to determine the quality of the transmitted signal or to obtain a QSL[1] for traffic sent.
- The ship requests a retransmission of a message already sent.

Guam reported only that all its send channels except for a few are on-line with the computer. It is unclear what "a few" means, or what the operator must do for these channels. The site also said, in its table 4A, that the operator uses a keyboard device to obtain a receipt for the messages or to determine whether the ship desires a retransmission. No estimate of the time required by the FPT operator for this task was given.

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[1] QSL is an operating signal used to acknowledge the receipt in acceptable form of a particular message.

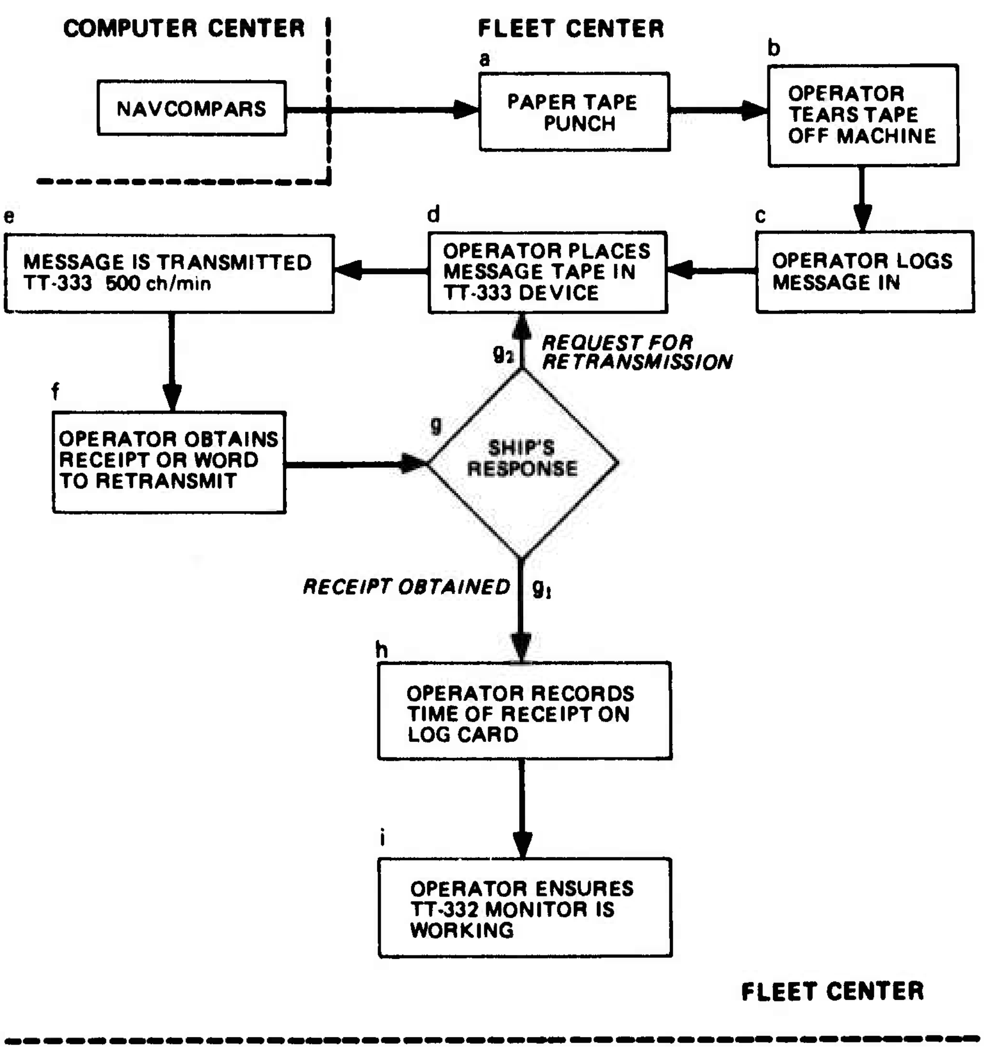

FIG. A-5: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF FULL-PERIOD TERMINATIONS, SEND

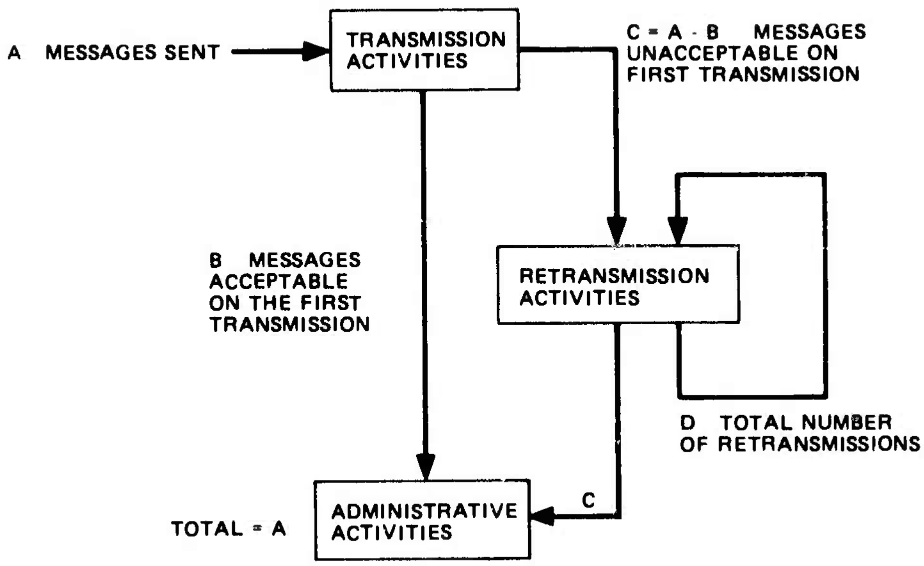

FIG. A-6: WORK FUNCTIONS ASSOCIATED WITH THE FULL-PERIOD TERMINATION, SEND, JOB (MANUAL OPERATION)

TABLE III-11

NON-TIME PLANNING FACTORS FOR FULL-PERIOD TERMINATION, SEND (MANUAL)

	Honolulu	Guam	Norfolk	Italy	Italy (Rome circuit)
I. Flow characteristics (submitted by sites)					
1. Number of messages sent (A)	(1,163)	13,212	1,056	1,807	381
2. Number of messages unacceptable on first transmission (C)	349		206		0
3. Number of retransmissions sent (D)			211	542	0
4. Average message length	930		1,200	1,261	1,261
5. Average length of retransmitted message	930		1,400	1,261	1,261
II. Derived characteristics					
6. Proportion of retransmitted messages (D/A)			0.20	0.30	0
7. Message length deviation (line 4-1,200/1,200)	-0.23		0	+0.05	+0.05
8. Retransmission message length deviation (line 5-1,200/1,200)	-0.23		+0.17	+0.05	+0.05

TABLE III-12

ACTIVITY TIME FOR FULL-PERIOD TERMINATION, SEND (MANUAL)

	(1) Activity	(2) Std activity designation	Honolulu (3) Activity designation	Honolulu (4) Required time (sec)	Honolulu (5) Standardized time (sec)	Guam (6) Activity designation	Guam (7) Required time (sec)	Guam (8) Standardized time (sec)	Norfolk (1,056) (9) Activity designation	Norfolk (1,056) (10) Required time (sec)	Norfolk (1,056) (11) Standardized time (sec)	Italy (1,607) (12) Activity designation	Italy (1,607) (13) Required time (sec)	Italy (1,607) (14) Standardized time (sec)	Italy - Rome Circuit (381) (15) Activity designation	Italy - Rome Circuit (381) (16) Required time (sec)	Italy - Rome Circuit (381) (17) Standardized time (sec)	(18) Standard time (sec)
I	Transmission																	
	Punch tape copy	a							a	144	144	a	150	144	a	150	144	144
	Tear message off machine	b							b	2	2	b	5	5	b	5	5	4
	Log-in message	c							c	15	15	c	10	10	c	10	10	12
	Place tape on machine	d							d	15	15	d	5	5	d	5	5	8
	Transmit message	e							e	144	144	e	150	144	e	150	144	144
	Total operator time										32			20			20	24
	Total time										320			308			308	312
II	Administrative																	
	Teletype for response	f							f	20	20	f	60	60	f	60	60	47
	Log-out message	h							h	3	3							3
	Check monitor	i							i	0	0							0
	Total operator time										23			60			60	50
	Total time										23			60			60	50
III	Retransmission																	
	Total operator time (d+f)										35			65			65	55
	Total time (d+e+f)										179			209			209	199

[a]Data does not apply – send channel is semiautomatic at Honolulu and Guam.

TABLE III-13

MANPOWER REQUIRED FOR FULL-PERIOD TERMINATION, SEND (MANUAL)
(NORFOLK)

I. Calculating average operator and total time per message

(1) Work function	(2) Operator time	(3) Total time	(4) Proportions designation	(4) Proportions value	(5) Average operation time (2) x (4)	(6) Average total time (3) x (4)
(1) Transmission Activities	24	312	A/A	1.0	24	312
Message length deviation (0x288)	—	0	A/A	1.0	—	0
(2) Administrative Activities	50	50	A/A	1.0	50	50
(3) Retransmission Activities	55	199	D/A	0.20	11	40
Message length deviation (+0.17x144)		24		—	—	—
(4) Average total time per message	129	561			85	402
(5) Operator time ratio					0.23	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) required per message (col. 5)	85
(2) Number of messages per year (supply)	54,912
(3) Operator time (in seconds) per year ((1) x (2))	4,667,520
(4) Convert time from seconds to hours ((3) ÷ 3,600)	1,296

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS
OF PRIMARY SHIP/SHORE, RECEIVE

This job was analyzed the same as the full-period termination, receive, and DSR jobs. And since many of the same activities in this job also occur as part of the other two jobs, a comparison of the standard times derived for all the similar activities of different jobs was made, as shown later. The data comparison should be considered when reviewing the proposed standards. Figure A-7 is the flow diagram to be used as a standard of comparison among sites. Data describing this job was received from Honolulu, Norfolk, (Sugar Grove), and Italy. Guam did not include a description of its activities or times.

Derivation of Nontime Planning Factors

Figure A-8 illustrates, and table III-14 lists, the set of data submitted by each site and used to derive those planning factors that are unique to each site's environment and operation. The data shows that:

- A messages per week (line 1) are originally transmitted from ship to shore. Generally, this will be the base for the planning factor proportions derived.

- B of A messages (line 2) are received by the shore in acceptable form on the first transmission; therefore, no further retransmission is required. C = A - B messages were initially received as unacceptable, and at least one retransmission was required. Line 20 lists the proportion of initially unacceptable messages C/A = (A - B)/A.

- Because of the C unacceptable messages received on the first transmission, a total of D sets of retransmission activities is made. The sites reported the total number of message transmissions received per week (A + D in line 4). Thus, the number of retransmissions required (A + D - A) is listed in line 5, and the proportion of retransmissions required (D/A) is listed in line 18.

- Of C unacceptable messages, a number E (line 6) require piecing. This proportion (E/A) is listed in line 19.

- After the C unacceptable messages are received or pieced into acceptable form, the old, incomplete copies are disposed of. This planning factor, derived as a portion (C/A), is described elsewhere and appears in line 20.

Once an acceptable message is obtained, the initial administrative activities are completed. It is assumed all A messages are completed, and therefore undergo this function. Part of this function is an inspection of the message to see whether the FL/1 header is missing. F such messages (line 7) require the addition of a header, and the proportion of such messages (F/A) is listed in line 21. Honolulu implied in its discussion of node Q that headers must be added to all its messages.

All A messages are then transmitted to NavComPARs and the results are checked to determine the success of this transmission function. Of the A messages transmitted:

- G messages (line 8) are rejected by NavComPARs, but can be (and are) corrected by the operator. The proportion (G/A) is listed in line 22.

- H messages (line 9) are rejected by NavComPARs but require message retransmission by the ship to make the correction. The additional message retransmission work load caused by these messages is already accounted for in the D total retransmissions (line 5).

- The remaining messages (A-G-H) are accepted by NavComPARs.

The G messages requiring retransmission result in a total of I retransmissions to NavComPARs (line 10), where it is assumed that:

- I is equal to or greater than G, since any message may require more than one retransmission.

- I operator corrections are also made, since each retransmission requires an operator correction.

The proportion (I/A) is listed in line 23.

All A messages then undergo final administrative activities. The average lengths of a message and a retransmitted message are listed in lines 14 and 15, and the ratio of their deviations in length relative to a 1,200-character message are listed in lines 26 and 27. (Italy reported that when a retransmission is required, the entire message is retransmitted).

Additional net control activity is required when the primary ship-to-shore operator needs a retransmission of one or more messages. L requests (line 13) are made to the ship, resulting in D retransmissions.

Three proportion planning factors are derived from this data:

- The transmission request proportion, K/J (line 24).

- The ratio of the number of original transmission requests to the number of messages handled, J/A (line 17).

- The ratio of the total number of transmission requests to the number of messages handled, K/A (line 16). Note that K/A can be derived as (K/J) (J/A).

- The ratio of retransmission requests to the ship, L/A.

The only data submitted by the sites was the number of initially unacceptable net control signals that were received. The remaining data should be submitted when the network control work load is to be calculated in accordance with each site's particular environment. While the preceding discussion concerned the work load related to a group of messages, there is an additional primary ship-to-shore operator work load caused by the ship/shore network control. This work must be done before the activities pertaining to net control and processing of messages are done. This is analogous to the net control activities of full-period termination operations. For the total of A messages handled per week, there are J requests per week (line 11) from ships for transmission of a set of messages that are received by the primary ship-to-shore operator.

However, a series of requests for transmission also emanate from the ship for two main reasons:

- Because of unacceptable signal quality; these are in response to the primary ship-to-shore operator's instructions to try again either on the same or different frequency.

- Because all of the ship's messages could not be handled at one time and a later request to complete the job is required.

The total number of requests received per week, for transmission K -- which equals the original requests (J) and all subsequent requests -- is listed on line 12.

Derivation of Time Standards

Data describing each of the activities shown in figure A-7 is listed in table III-15, compared, and a standard time for each activity calculated.

Description of Activities

Network Control Activities

This function consists of all net control activities before message transmission. Some of the activity designations are in capital letters; others are in lower-case letters. The latter correspond exactly to activities with the same designations on the full-period termination, receive, diagram (figure A-1); the capital letters are activities different from that flow. The diagrams have been lettered this way to ease comparisons.

- Activity A. Read ship's request for transmission.

- Activity C. Instruct ship.

These activities are taken together since they are related. The ship makes an initial call up to the NavCommSta, indicating how many messages are to be sent, by priority. The ship-to-shore operator reads this call, then decides in decision node B (whose time is included as part of activity A) whether the signal is acceptable. If so, the ship is instructed (activity C_2) what turn was assigned and which messages to send. If the signal was not acceptable, the operator's instruction (activity C_1) is to try again on the same frequency or different frequency.

In Italy, the primary ship-to-shore facility is located in the fleet center. Hence, the connectivity activities necessary for the other sites to establish communications with the ships are not part of the Italy operation, but are presumably performed at the receiver site.

Transmission Activities (Receive Message)

This function consists of all the activities involved in receiving the message from the ship (with no rework activities involved).

- Activity a. Punch tape and print copy.

- Activity b. Tear message off machine.

- Activity f. Place frequency on page copy.

- Activity c. Inspect message.

These activities are analyzed together because of the relationship between activities a and c. The message is received from the ship in page and paper tape form. Machine speed is 100 words per minute. This results in message length of 144 seconds for the standard message. After the operator tears the page off the machine (activity b) and places the send/receive frequencies on the copy of the message, he scans the message and decides whether it is acceptable, or whether it requires retransmission by the ship's operator. This decision process is accomplished in the no-time loss decision nodes d and i. If the message is acceptable, the process continues with activity e. If not, rework activity e is performed, as described elsewhere.

Sugar Grove estimated the time to inspect the message to be "half a minute," which is longer than the other sites' estimates, which are given in seconds. The difference in time may be attributed to round-off error.

There is a question regarding how much time is required to inspect a message. Sugar Grove reported that, in addition to the time required for activity i (5 to 30 seconds for the g sites), its operators also monitor the page copy for acceptability as it comes in, unless the message flow is very heavy. The site stated that, ideally, one person will handle 2 circuits at the same time and that, during peak traffic conditions, one person can handle 3 circuits simultaneously by not monitoring the page copy as it comes in. This "on-line" monitoring is considered important, and it is done whenever possible because periodically scanning of messages allows more efficient detection of errors, so that corrections may be made more rapidly. As a result, communications circuits can be used more efficiently.

Sugar Grove also reported that an experienced operator can pick up some kinds of garble (such as skipping entire lines in an address or list) by listening to the keyboard operation; garbling cannot be caught by only reading the finished copy.

The basic question is: How much time should be allowed for the entire message-checking function. No site indicated how much of the 144 seconds of machine time should be used by the operator. Such a recommendation needs to be made by the site and the command.

Sugar Grove's time for its activity E includes the times for standard activities C, D, and E. The activity designations for Italy were added by us for convenience in discussing the various tasks.

Initial Administrative Activities

The first set of administrative activities occurs after the message is satisfactorily received. After the message is read into NavComPARs, a set of final administrative activities is done, as described elsewhere in this volume.

- Activity E. Receipt for message. The operator receipts for the message and places time of receipt (TOR) on the page copy.

- Activity G. Prepare tape. The operator removes and rolls the tape and staples it to the page copy.

- Activity H. Carry message. At Sugar Grove, the operator carries the message to the supervisor's desk and places it in the basket. In Honolulu and Italy, the operator carries it directly to the DSR. In Honolulu, the supervisor scans the message at the end of the operation (that NavCommSta's step o); the time is included as part of this activity.

- Activity I. Log-in message. In Sugar Grove, the supervisor logs the message in the master log and assigns the station serial number. In Honolulu, it is done by the operator. However, they did not include a time for this activity.

- Activity J. Inspect message and place it in basket. The message is inspected to see whether the FL/1 header must be added. If not, the process continues to activity L. If it must, activity K must be done. The supervisor places the message in the appropriate outgoing basket. This activity is not done at Honolulu or Italy, since the operator performs the steps before and after this one.

Transmission to NavComPARs Activities

This function consists of the activities associated with transmitting the message to NavComPARs, and is analogous to the DSR job. In Italy, the primary ship/shore operator's duties include sending the message to NavComPARs, but the activities and times were not described. We therefore used the standard times for all activities.

- Activity L. Place tape on reader and set it up. The operator carries the tape, unrolls it, and places it on the NavComPARs input device. Sugar Grove and Honolulu both combine this activity with the one following. Sugar Grove included two times, Honolulu one combined time.

- Activity M. Feed message to NavComPARs. The message is fed to NavComPARs at a rate of 100 words per minute, resulting in a standard time of 144 seconds.

- Activity N. Check channel log. The operator checks to see whether the NavComPARs computer has accepted the message. This activity includes the no-time-loss decision node O. When the message is rejected, a rework activity of correcting the message takes place.

- Activity P. Remove message from machine. Once NavComPARs has accepted the message, the operator removes the tape and page copy from machine. In Sugar Grove, this activity includes rolling the tape and storing it (storage is for 24 hours). In Honolulu, this node includes stapling the tape to the page copy.

- Activity Q. Add time of day (TOD) to original copy. The operator adds TOD to the original copy and places it in the supervisor's basket.

- Activity R. Log-in message. The required information is logged into the Pony Loop, a master log by the supervisor (at Sugar Grove) or the operator (at Honolulu).

- Activity S. File message. The message is filed. In Sugar Grove, the rolled copy is retained for 30 days.

Rework Activities

While the previous activities were done for all messages handled (except for the connectivity activities, which occurred each time a particular ship wanted to transmit one or a set of messages at a time), there are a number of rework activities; each of these must be done for some proportion of the total messages handled. The rework activities include:

- Additional connectivity work (when the ship needs to change frequency).

- Retransmission activities (when an unacceptable message occurs and an additional transmission is necessary).

- Piecing activity (when an unacceptable message occurs and enough transmissions are available for piecing together an acceptable message).

- Adding FL/1 header when it is missing from the message.

- Rework message after NavComPARs rejection.

- Activity j. Operator requests retransmission. When a retransmission is required, the operator does so. The activity then returns to X and continues with activity c_2.

- Activity l. Operator pieces the message together. This activity involves making an acceptable message from several past transmissions of the same message. Sugar Grove explained that a message is retransmitted 2 or 3 times before piecing. It is unlikely that the propagation conditions causing the garbling the first time will occur at exactly the same place in a message the next time, so 2 copies are usually enough for piecing. Since piecing is time consuming, a third copy is sometimes requested in hopes of receiving a clean copy and thus avoid piecing. At times, only the heading or only one page of a long message is asked to be repeated. When a message is 2 pages or less, the entire message is usually retransmitted. Messages that include data such as supply lists and social security numbers may have to be transmitted more than three times. It is impossible for the operator to deduce from the context of such a message what the required information is if it is garbled. Message piecing-time is separated from the time required to add the FL/1 header (activity k_1).

- Activity m. Copies disposal activity. After receipting for a message, the operator disposes of all old, unacceptable copies.

- Activity k_1. Operator adds FL/1 header. After the message is inspected (activities j and k), the FL/1 header, if needed is added at this time. Honolulu reports that when a message needs to be pieced, the header is added then, requiring only an additional 15 seconds. If piecing is not required but the header must be added, it takes 160 seconds to do so.

- Activity u. Operator corrects message. When the NavComPARs computer rejects the message (activity n) and the operator determines he can correct it (activity t), he does so.

Calculating Working Man-hours Required

Table III-16 shows the calculation of the man-hours per year required by Norfolk (Sugar Grove), using the standard times derived.

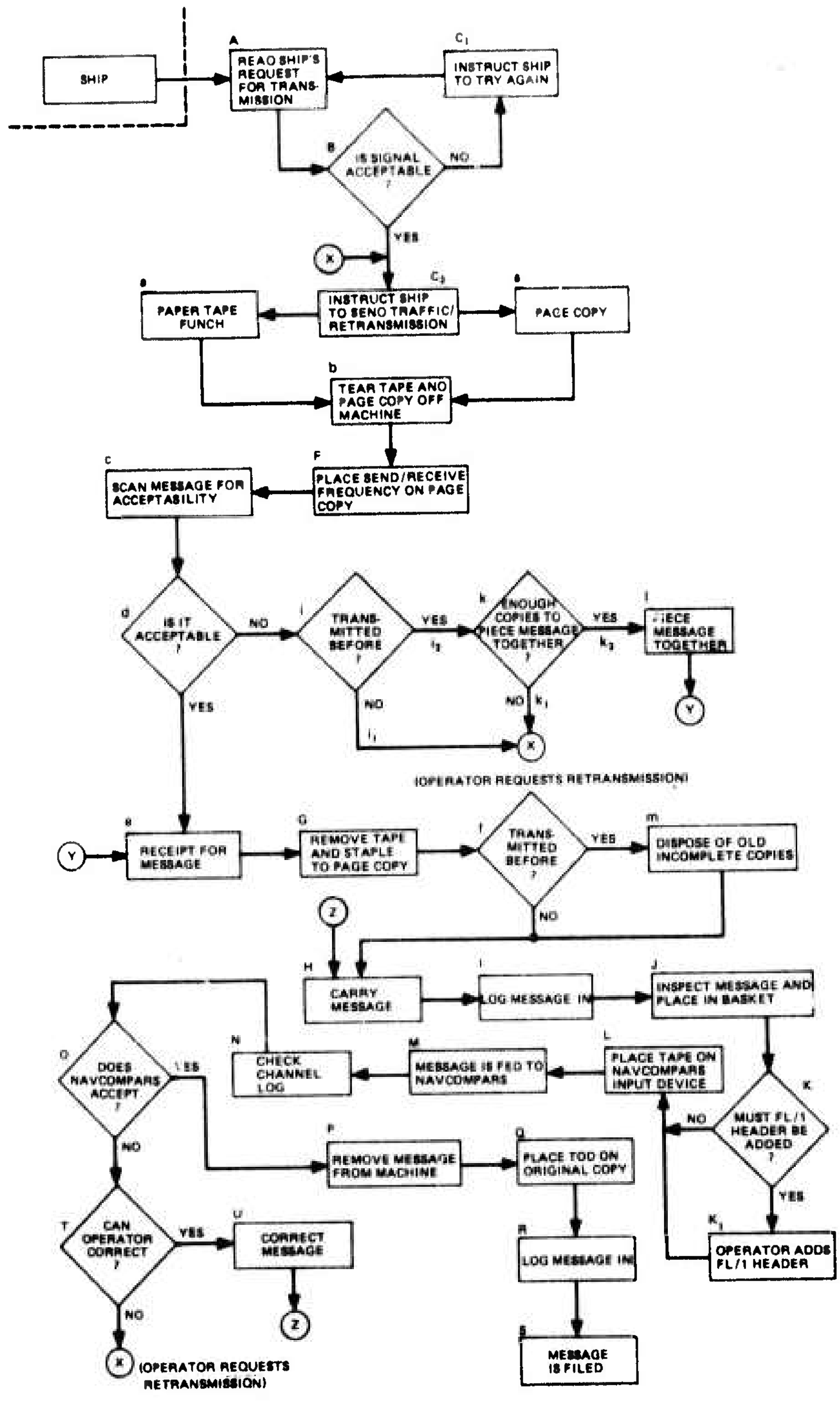

FIG. A-7: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF PRIMARY SHIP-TO-SHORE JOB

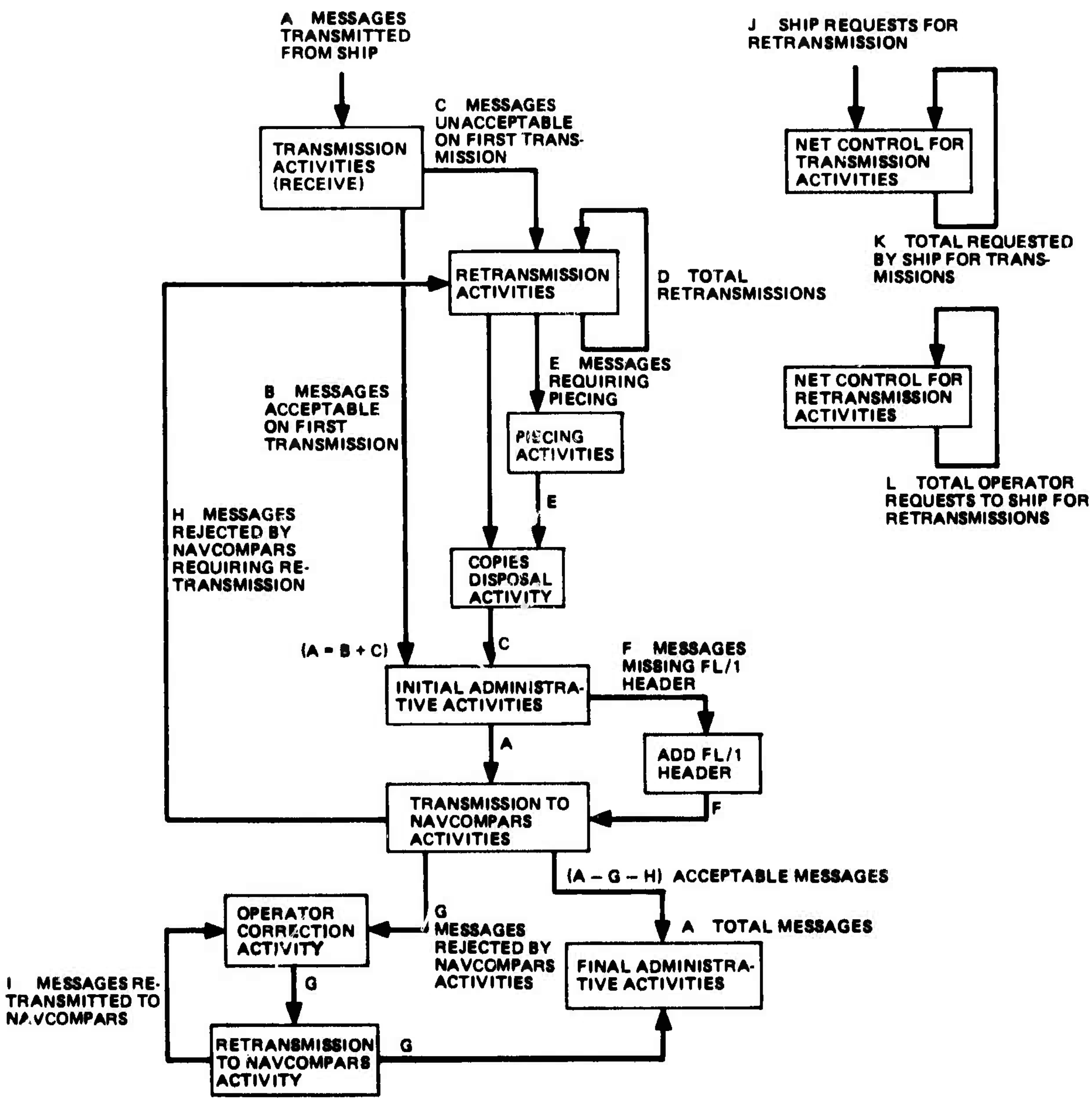

FIG. A-8: WORK FUNCTIONS ASSOCIATED WITH PRIMARY SHIP/SHORE

TABLE III-14

NONTIME PLANNING FACTORS FOR PRIMARY SHIP/SHORE, RECEIVE

	Sugar Grove	Honolulu	Italy	Guam
I. Flow characteristics submitted by sites				
1. Number of messages received per week (A)	884	416	82	1,535
2. Number of messages acceptable on first transmission (B)	750	354		1,460
3. Number of messages unacceptable on first transmission (C)	133	62		75
4. Number of message transmissions received per week (A+D)	999	541	175	1,688
5. Number of message retransmissions (D=(A+D) -A)	115	125	93	153
6. Number of messages requiring piecing (E)	134	62		75
7. Number of messages missing FL/1 Header (F)	0	416		
8. Number of messages rejected by NavComPARS but correctable by operator (G)	(18)			
9. Number of messages rejected by NavComPARS requiring retransmission (H)	(2)			
10. Number of retransmissions to NavComPARS (I)	a			
11. Number of ship initial requests for transmissions (J)	a			
12. Total number of ship requests for transmissions (K)	a			
13. Total requests to ship for retransmission (L)	a			
14. Average message length	990	1,200	1,261	1,200
15. Average length retransmission	850	1,200	1,261	1,400
II. Derived characteristics				
16. Proportion of total ship requests for transmission (K/A)	a			
17. Proportion of ship requests for transmissions (J/A)	a			
18. Proportion of retransmissions required (D/A)	0.13	0.30	1.13	0.10

TABLE III-14 (cont'd)

	Sugar Grove	Honolulu	Italy	Guam
19. Proportion of placing required (E/A)	0.15	0.15		0.05
20. Proportion of unacceptable messages (C/A)	0.15	0.15		0.05
21. Proportion of PL/1 header additions required (F/A)	0	1.0		
22. Proportion of messages rejected by NavComPARS, but correctable by operator (G/A)	0.02			
23. Proportion of retransmissions by NavComPARS (I/A)	a			
24. Transmission request proportion (K/J)	a			
25. Proportion of retransmission network control (L/A)	a			
26. Deviation of message length relative to 1, 200-character standard ((line 14-1, 200)/1, 200)	-0.18	1.0	1.05	1.0
27. Deviation of retransmission length relative to 1, 200-character standard ((line 15-1, 200)/1, 200)	0.30	1.0	1.05	1.2

[a]No data.

TABLE III-15

ACTIVITY TIME FOR PRIMARY SHIP/SHORE, RECEIVE

		Sugar Grove (884)			Honolulu (416)			Italy (82)			Guam (1,536)[a]			
(1) Activity	(2) Std. time designation	(3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	(6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	(9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	(12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Network control														
Read request for transmission	A	A	30	30	A	10	10	b						24
Instruct ship to send	C1	D	30	30	B	15	15	b						25
Total operator time				60			25							49
Total time				60			25							49
II Transmission														
Punch and print copy	a	E }	120	144	E	144	144	A	151	144				144
Tear message off machine	b	E }			F	2	2	B	10	10				5
Place frequency on page copy	F	E }			–	–	–							–
Inspect message	c	F	30	30	G	5	5	C	15	15				22
Total operator time				30			7			25				27
Total time				174			151			169				171
III Initial administration														
Receipt for message	g	I	60	60	J	20	20	E	60	60				49
Prepare tape	G	O	30	30	–	–	–	F	5	5				28
Carry message	H	Q	30	30	R,V	5+10	15	G	15	15				25
Log-in message	I	R	60	60	O b	–	–	b						60
Place message in basket	J	S	5	5										5
Total operator time				185			35			60				166
Total time				185			35			60				166
IV Transmission to NavComPARS														
Place tape on reader and set it up	L	T	30	20	S }	180	6							22
Feed message to NavComPARs	M	T	144	144	S }		144							144
Check channel log	N	V	30	30	–	–	–							30
Total operator time				60			6							52
Total time				204			150							196
V Final administrative														
Remove tape and page copy	P	W	30	30	–	–	–							30
Place TDD on original copy	Q	X	15	15	T	4	4							12
Log-out message	R	Y	10	10	U	10	10							10
File message	S	Z	10	10	W	3	3							8
Total operator time				65			17							60
Total time				65			17							60
REWORK														
VI Additional net control	C1	B	–	–	B	20	20							20
Total operator time							20							20
Total time							20							20
VII Net control for retransmission														
Total operator time (C)				30			5			15				22
Total time (C)				30			5			15				22
VIII Retransmission														
Total operator time (C_1+b+F+c)				60			22			25				47
Total time (C_1+a+b+F+c)				204			171			169				192
IX Piecing	l	P	–	–	P	185	185							185
Total operator time							185							185
Total time							185							185
X Copies disposal	m	J	–	–	K	20	20							20
Total operator time							20							20
Total time							20							20
XI Add FL/1 header	K1				Q		15							15
							180							180
Total operator time							175							175
Total time							175							175
XII Correct message	u	P	30	30										30
Total operator time				30										30
Total time				30										30
XIII Retransmit to NavComPARS														
Total operator time (H+I+J+L+M+N)				298			186							258
Total time (H+I+J+L+M+N)				298			186							258

[a]No data for Guam.
[b]Activity not done.

TABLE III-16

MANPOWER REQUIRED FOR PRIMARY SHIP/SHORE
(Sugar Grove)

I. Calculating average operator and total time per message

(1) Time factors	(2) Operator time	(3) Total time	(4) Proportion		(5) Average operator time	(6) Average total time
(1) Network control	49	49	K/A	a	a	a
(2) Transmission	27	171	A/A	1.0	27	171
Message-length deviation (-0.18) x 144		-26	A/A	1.0		-26
(3) Initial administrative	166	166	A/A	1.0	166	166
(4) Transmission to NavComPARS	52	196	A/A	1.0	52	196
(5) Final administration	60	60	A/A	1.0	60	60
(6) Additional net control	20	20	K-J/A=K/A-J/A	-	-	-
(7) Net control for retransmission	22	22	L/A	a	a	a
(8) Retransmission	47	192	D/A	0.13	6	25
Message-length deviation (-0.30) x 144		-43	D/A	0.13		-6
(9) Piecing activity	185	185	E/A	0.15	28	28
(10) Copies disposal	20	20	C/A	0.15	3	3
(11) Add FL/1 header	175	175	F/A	0	0	0
(12) Correct message	30	30	G/A	0.02	1	1
(13) Retransmit to NavComPARS	256	256	I/A	a	a	a
(14) Total time required per message	1,109	1,473			343	618
(15) Operator time ratio					.56	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) required per message (col. 5)	343
(2) Number of messages per year (supply)	45,968
(3) Operator time (in seconds) per year ((1) x (2))	15,767,024
(4) Correct time from seconds to hours ((3) ÷ 3,600)	4,380

[a] No data.

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF ALLIED/NATO/SEATO/ RECEIVE JOB

The purpose of the Allied/NATO/SEATO circuit is to provide Allied ship-shore service. Data describing the work involved in operating these circuits was submitted by Honolulu, Norfolk, and Italy. Honolulu divided the total work into two jobs (as with the FPT operator):

- Allied receive, in which messages are received from Allied subscribers for entry into Autodin V.
- Allied send, in which messages are received from Autodin V and sent to Allied subscribers.

This section describes the analysis of the Allied receive job (the send job is covered in the next section).

Norfolk reported that its NATO job is similar to the full-period termination job but included no further comparison as to tasks or times required. Italy included a flow diagram for receive from Autodin V, it included the "NATO A&B" flow diagram, the function of which is not clear.

Unfortunately, the data received from Italy (table 4b) consists of one set of data covering both send and receive. Also included were these message totals per week:

	Send	Receive
Mode V	1,003	1,653
NATO A	1,060	1,804
NATO B	997	670

Since these two sets of numbers could not be correlated in a way that would give send-and-receive totals that we could be certain of, the data was not used. Guam included no information concerning Allied message traffic.

The 2 flow diagrams submitted by Honolulu (figures A-9 and A-11) were used as the standards of comparison among sites. All other data submitted by the sites is used in conjunction with these flow diagrams.

Because many of the activities in these two jobs are related to those of other jobs (particularly the FPT operation), a comparison of the derived standard times of the related activities was made.

Derivation of Nontime Planning Factors

Figure A-10 illustrates, and table III-17 lists, the set of data submitted by each site and used to derive those planning factors that are unique to each site's environment and operation. The first part of the table contains message flow characteristics for this job as submitted by each site (figure A-9). The second part contains the proportion planning factors associated with the job; these factors were derived from the data in the first part of the table. The data shows that:

- The Allied operator receives A original messages per week from Allied subscribers for entry into Autodin V (line 1). This number does not include R retransmissions of messages originally received in an unacceptable form, and, as described elsewhere, a total of A' = A + R messages are processed through this first function.

- B of the total A messages are received in acceptable form; no further retransmission of them is required. But C = A - B messages (line 2) are found to be unacceptable in the first transmission. Line 9 lists the proportion of unacceptable messages (C/A). Honolulu reported that 4 percent of its 3,250 messages are unacceptable on the first transmission. This means that 130 messages are received in an unacceptable form.

- Because of the C unacceptable messages, a total of D service requests are drafted or redrafted (line 3). D does not equal C for three reasons. More than one C message may be serviced on the same service request. Also, some messages need to be serviced more than once, since the retransmission may not be acceptable. Finally, some of the service requests drafted are not acceptable to the supervisor and must be redrafted by the operator before they can be sent.

Honolulu indicated that 65 service messages were sent; of these, 5 percent had to be redrafted. A total of 68 service messages was drafted. Line 10 lists the proportion of these service messages (D/A).

The result of this process is that a total of E acceptable service drafts are sent (line 4). Its proportion (E/A) is listed in line 11. After these E requests are transmitted on the dedicated circuit, a new copy of each originally unacceptable message is later received in as a retransmission. The A messages require R retransmissions (listed in line 5, with its proportion, R/A, listed in line 12). Therefore, a total of A' = A + R messeges are processed through the transmission activities (receive) function. Honolulu also reported that it received a total of 3,380 transmissions (A + R), which means that F = 3380 - 3250 = 130 retransmissions.

After an acceptable copy is received, administrative activities can then be completed for all A messages; and they are then transmitted on Autodin V. Lines 6 and 7 list the average length of a message and of a service request. Honolulu listed two different lengths for each message and service message length. Both are included in the table.

Norfolk indicated it does its rework activities differently from the flow diagram of figure A-9. Although Norfolk did not describe its NATO work characteristics as a flow diagram, the station did say that the work involved is similar to that of the full-period termination operator. In that case, the rework described under the FPT operator would replace the rework as described here for the NATO operator, and the FPT planning characteristics must be used rather than these. Thus, line 8 lists the number of Norfolk messages pieced together (G), and line 13 lists the proportion of messages (G/A).

Derivation of Time Standards

Data describing each of the activities shown in figure A-9 is listed in table III-18, compared, and a standard time for each activity calculated.

Description of Activities

Incoming Transmission and Inspection Activities

These activities include all those tasks involved in receiving the incoming message from an Allied subscriber and in determining whether it is acceptable for input to the Autodin V or whether rework is needed.

- Activity a. Page and tape copy received. The message is received from Allied subscribers at an average machine speed of 500 characters per minute. The standard machine time was calculated as before, using a message length of 1,200 characters. Honolulu included two estimates of message length. Its table 4b gives message length as 840 characters, whereas its figure 4 showed 1,590 characters. This data should be clarified.

- Activity b. Tear off message. The operator tears the page and tape copies off the machines.

- Activity c. Inspect message. The operator inspects the message for acceptability (decision mode d). If the message is acceptable, he continues to e. If not, he goes to i.

Outgoing Transmission Activities

These include all administrative activities done after a message has been received in an acceptable form, as well as the activities associated with sending a message on Autodin V.

• Activity g. Log-in message. The operator logs in the message on the incoming log.

• Activity h. Carry message. The operator carries the message to the Autodin V terminal. Honolulu includes this activity, but gives no time.

• Activity i. Log message in Autodin V log.

• Activity j. Place message on terminal. The operator places the message on the outgoing terminal. Honolulu did not include this as a separate activity. But since its calculated machine time for mode 1 does not include this operator time, this activity should be included.

• Activity k. Enter message. The message is entered into the Autodin V at 100 words per minute. See explanation of Honolulu's machine time (activity a).

Draft Service Request Activities

The service draft activities include all those tasks necessary when an unsatisfactory message is received. In Norfolk's case, since its flow diagram is the same as its FPT diagram, the rework involved makes up the retransmission activities, rather than service draft activities. Although individual tasks are different, the total rework times can be compared.

• Activity l. Draft service message. When the message is not acceptable (at node d), the operator drafts a service message.

• Activity m. Review service message. The chief of watch reviews the message for acceptablility. The decision is indicated in node N. If the service message is acceptable, continue to activity o; if not, return to activity l.

Transmit Service Request Activities

• Activity o. Place message on terminal. The operator places the service message on the dedicated circuit terminal in preparation for transmitting.

• Activity p. Send service message. The service message is sent on the dedicated circuit at a machine speed of 100 words per minute. Honolulu reported a service message length of 280 characters (table 4b) but 345 characters in its description (figure 4). This discrepancy should be clarified.

Calculating Working Man-Hours Required

Table III-19 shows the calculation of the working man-hours per year required by Honolulu, using the standard activity times derived. This calculation is described in a preceding section.

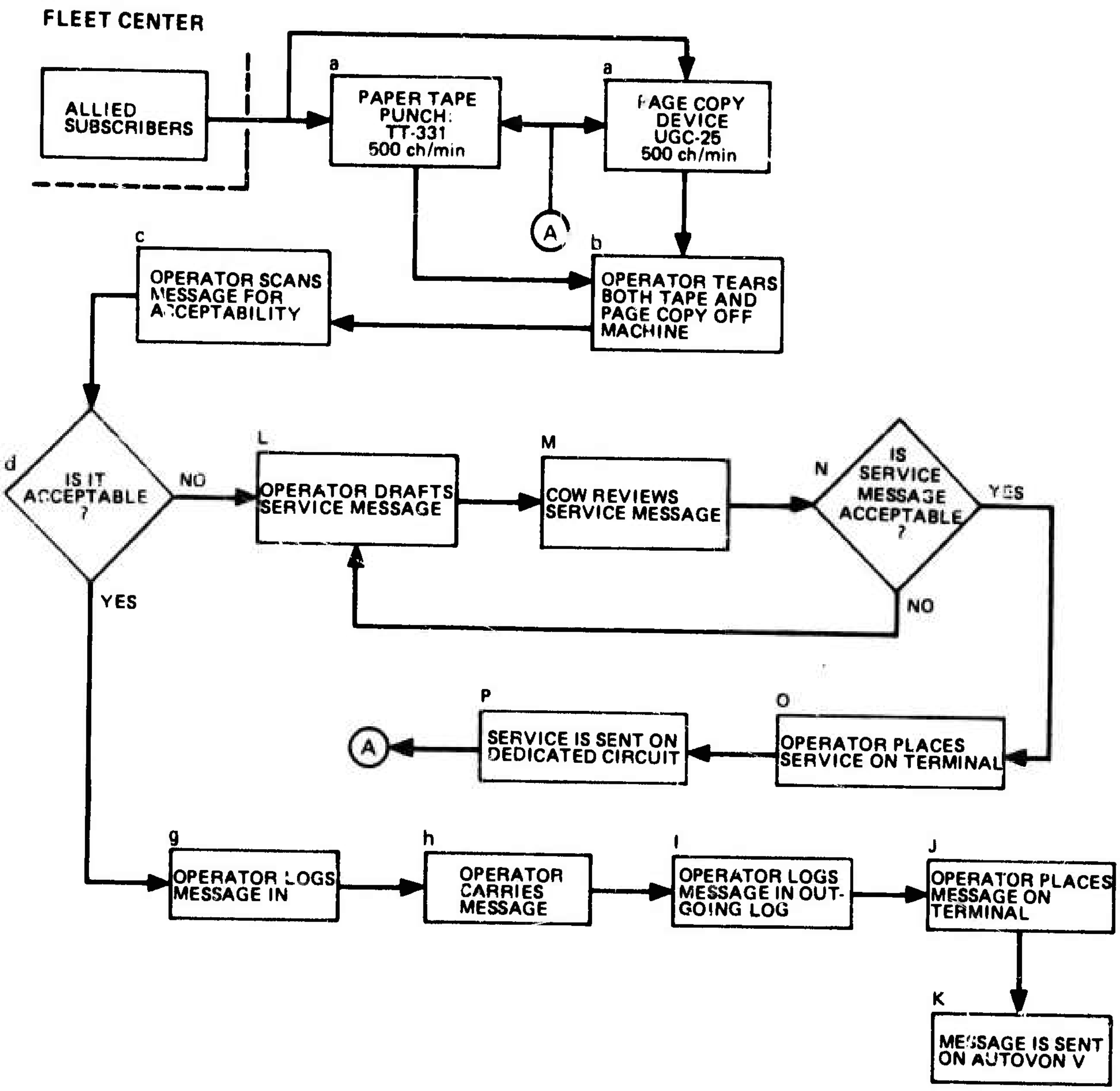

FIG. A-9: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF ALLIED/NATO/SEATO, RECEIVE

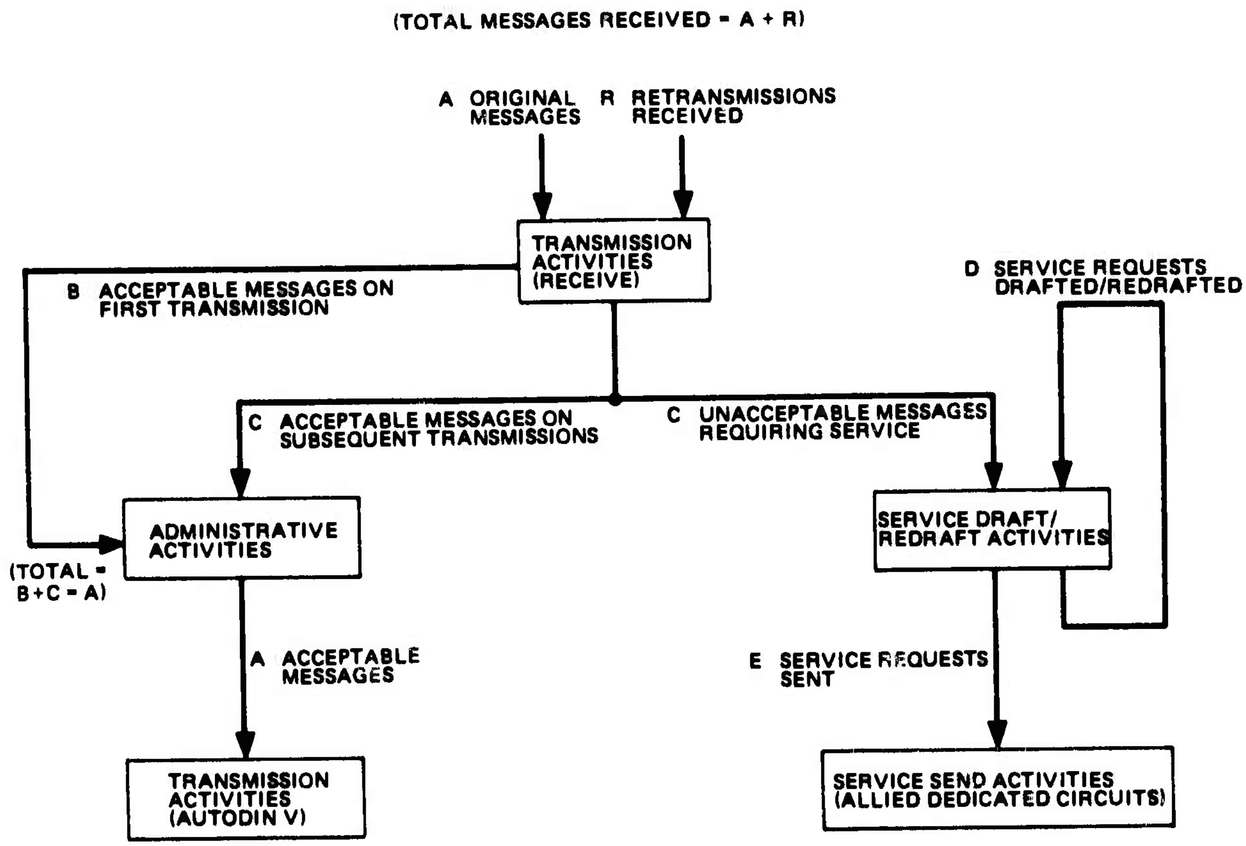

FIG. A-10: WORK FUNCTIONS ASSOCIATED WITH ALLIED/NATO/SEATO, RECEIVE

TABLE III-17

NONTIME PLANNING FACTORS FOR ALLIED/NATO/SEATO, RECEIVE

	Honolulu	Guam[a]	Norfolk	Italy[a]
I. Flow Characteristics (submitted by sites)				
1. Number of messages per week (A)	3,250		1,484	
2. Number of unacceptable messages received (C)	130		44	
3. Number of service messages drafted or redrafted (D)	68			
4. Number of service messages sent (E)	65			
5. Number of retransmissions received (R)	130			
6. Average message length	840/1,590		1,200	
7. Average service length	280/345			
8. Number of messages pieced (Norfolk) (G)			371	
II. Derived Characteristics				
9. Proportion of unacceptable messages received (C/A)	0.04		0.03	
10. Proportion of service drafts/redrafts required (D/A)	0.02			
11. Proportion of service messages sent (E/A)	0.02			
12. Proportion of retransmissions received (R/A)	0.04			
13. Proportion of messages pieced (Norfolk) (G/A) Message length deviation (line 6-1,200)/1,200 Service message length deviation (line 7-1,200)/1,200			0.25	

[a]No data

TABLE III-18

ACTIVITY TIMES FOR ALLIED/NATO/SEATO RECEIVE MESSAGE FLOW (FOR ENTRY INTO AUTODIN)

(1) Activity	(2) Std. activity designation	Honolulu (3,250) (3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	Guam[a] (6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	Norfolk (1,484)[b] (9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	Italy (1,833)[c] (12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Transmission (receive)														
Tape punch and printer	a	a	[d]	144				a	144	144	a	150	144	144
Tear message off machine	b	b	5	5				b	3	3	b	5	5	5
Inspect message	c	c	10	10				c	5	5				8
Total operator time				15						8			5	13
Total time				159						152			149	157
II Administrative														
Log-in message	g	d	10	10										10
Carry message	h	—	—	—										—
Total operator time				10										10
Total time				10										10
III Transmission (Autodin)														
Log-out message	i	e	10	10							c	5	5	10
Place on Autodin V terminal	j	—	—	—							d	150	144	5
Send message on Autodin V	k	f	[d]	144										144
Total operator time				10									5	15
Total time				154									149	169
IV Service draft														
Draft service message	l	g	180	180										180
Supervisor review service message	m	h	20	20										20
Total operator time				180										180
Total supervisor time				20										20
Total time				200										200
V Service send activities														
Place service message on terminal	o	—	—	—										—
Send service message	p	h_1	37	144										144
Total operator time				—										—
Total time				144										144

Norfolk (bracketed)	(9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)
Retransmission[b]			
Request retransmission	i	20	20
Total operator time (i+b+c)[d]			28
Total time (i+a+b+c)[d]			172
Copies disposal			
Total operator time	j	20	20
Total time			20
Placing			
Place message	k	180	180
Total operator time[d]			180
Total time[d]			180

[a]No data.
[b]These activity designations refer to Norfolk's full-period termination receive diagram.
[c]No message count was given, so it was derived using the proportion of Norfolk to Italy in FPT, receive.
[d]Unexplained "outlier" and not used in calculating standard time (weighted mean) of column.

TABLE III-19

MANPOWER REQUIRED FOR ALLIED /NATO/SEATO, RECEIVE
(Honolulu)

I. Calculating average time per message

(1) Work function	(2) Operator time	(3) Supervisor time	(4) Total time	(5) Proportion designation	(5) value	(6) Average operator time (2) x (5)	(7) Average supervisor time (3) x (5)	(8) Average total time (4) x (5)
(1) Transmission	13	0	157	A+R/A	1.04	14	0	163
Message length deviation (0.33x144)[a]	—	—	48	A+R/A	1.04	—	—	50
(2) Administrative Activities	10	0	10	A/A	1.0	10	0	10
(3) Transmission Activities (Autodin)	15	0	169	A/A	1.0	15	0	169
Message length deviation (0.33x144)[a]	—	—	48	A/A	1.0	—	—	48
(4) Service Draft Activities	180	20	200	D/A	0.02	4	0.4	4
(5) Service Send Activities	—	0	144	E/A	0.02	—	0	3
Service message length deviation (-0.71x144)	—	—	-102	E/A	0.02	—	—	-2
(6) Average time required per message					—	43	0.4	445
(7) Operator time ratio (col. 6/col. 7)					—	0.10		

II. Calculating working man-hours required per year

	Operator	Supervisor
(1) Total operator time (in seconds) required per message (col. 6 and 7)	43	0.4
(2) Number of messages per year (supply)	169,000	169,000
(3) Operator time (in seconds) per year ((1) x (2))	7,267,000	67,600
(4) Convert time from seconds ((3) ÷ 3600)	2,019	19

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF ALLIED/NATO/SEATO SEND JOBS

This section describes the analysis of the Allied/NATO/SEATO send job in which messages are received from Autodin V and sent to Allied subscribers over a dedicated circuit.

The data obtained from the sites is discussed in the section dealing with the Allied receive job. Figure A-11 is the operational flow diagram.

Derivation of Nontime Planning Factors

Figure A-12 illustrates, and table III-20 lists, the set of data submitted by each site and used to derive those planning factors that are unique to each site's environment and operation. This data shows that:

- A total of A original messages per week are received from Autodin V to be sent to Allied subscribers. This total (line 1) does not include retransmissions but only those messages coming into the process for the first time.
- R retransmitted messages (line 2) are also received. These retransmissions result from previously transmitted service requests and are discussed under that function. The total number of messages (T) for the incoming transmission and inspection activities is A + R.
- The base taken for calculating all proportion planning factors is A. The proportion of retransmitted messages received (R/A) is listed on line 10. If the proportions are obtained through work sampling, they should be derived using A original messages as a base.
- All incoming messages are inspected by the operator for acceptability.

Of the A messages, B messages are acceptable to the operator and can be transmitted immediately to the subscribers. Thus, C messages (line 3, C = A - B) are unacceptable because:

- D messages have both security designations missing.
- E messages have only one security designation missing.
- F messages are unacceptable for some reason other than security, and cannot be fixed by the operator.
- G messages are unacceptable for some reason other than security, but can be fixed by the operator. The proportion (G/A) is listed on line 11.

Because of the C unacceptable messages, additional work functions must also be done:

- Service requests must be drafted for a total of I messages; I = D + E + F.

Unfortunately, some of these I draft service requests are unacceptable to the supervisor, and a total of H service requests (line 5) is drafted. The proportion (H/A) is given on line 12.

Note that Honolulu's submitted data showing that of its 280 service messages, 5 percent (14 messages) must be redrafted. Thus, the number of service drafts totalled 294, resulting in a proportion of 294/4,000 = 0.07. A total of I service requests (line 6) is transmitted. This proportion (I/A) is listed on line 13. Assuming that a service request is for only one message, I = D + E + F.

Of the original A incoming messages, a total of B + E + G can be transmitted immediately to Allied subscribers. All of the remaining messages eventually arrive in acceptable form following the service requests. Thus, all A messages complete the outgoing transmission function.

The average message and service message lengths are listed on lines 7 and 8 of table III-20. The average length of a retransmission may differ from the average message length when, for example, only security designations are retransmitted; when longer messages contain more errors and need to be retransmitted more often; or when service messages precede the retransmission. Line 7 should be the average of all original messages plus all retransmissions.

Honolulu reported its average message length as 1,400 on its table 4b, but as 1,590 in the description of the flow chart. This discrepancy should be clarified by Honolulu.

Derivation of Time Standards

Data describing each activity shown in figure A-11 is listed in table III-21 compared, and a standard time for each activity calculated.

Description of Activities

Receive Activities

These include all activities involved in receiving an incoming message from Autodin V and determining whether the message is acceptable for transmission to Allied subscribers, or whether rework is needed.

• Activity a. Tape punch and printer. The message is received from Autodin V as paper tape and page copy. Machine time in the standard column is calculated using the standard machine speed of 500 characters per minute, and message length of 1,200 characters, rather than the average message length at each site. Because Honolulu gave two different message lengths, only the standard time was calculated. The correct value should be determined.

• Activity b. Tear off and log message. The operator tears off the message and logs it into the Autodin terminal receive log.

• Activity c. Inspect message. The operator inspects the message to determine whether it is acceptable as received, or what needs to be done with it if unacceptable. This activity includes the time for the appropriate decision-making nodes. Decision node d determines whether there are security errors. In any event, the messages also must be checked for other errors. For those messages containing no security errors, decision node e determines whether there are other errors. If so, decision node u determines whether the message can be repaired by the operator or whether a service request must be generated. (These activities are discussed under rework activities.)

If no other errors are found at node e, the messages continue to activity f.

From decision node d, node j determines, for those messages with security errors, whether there are other errors. These messages are also discussed further under rework activities.

Transmission Activities

This group includes all activities done in transmitting an acceptable message and keeping proper records of the events.

• Activity f. Log message. When the message is acceptable, the operator logs the message into the outgoing log for the appropriate circuit.

• Activity g. Place message on machine for transmission.

• Activity h. Send message. The message is sent to Allied subscribers at 100 words per minute. For explanations of Honolulu's machine times, see activity a.

• Activity i. File message. The operator files the message. Honolulu included this activity, but not the time required to complete it.

Rework Activities

These are the activities involved in processing a message originally received in unacceptable form and includes fixing those that can be fixed by the operator and transmitting a service request for all unacceptable messages that he cannot fix.

The first step is to determine whether a service request must be made, or whether the operator can fix the message himself. A service message must be drafted when there are errors the operator cannot fix or when there are security errors.

The original message is unacceptable when either the ZMN[1] or the "releasable to appropriate nation" is missing. When one of these elements is missing, the message is transmitted as received, and the originator's attention is directed to the format error. When both are missing, the message is filed without transmitting and the originator is serviced.

Activities involved in generating a service request are given here.

- Activity l. Draft service message. From decision node k, if the message cannot be fixed, the operator drafts a service message to the originator.

- Activity m. Review service message. The chief of watch (COW) reviews the service message for acceptability. Node n indicates the decision made in activity m. If the message is acceptable, activity o follows; if it is not, activity l is next.

- Activity o. File message. The operator files a copy of the service request and the original message.

- Activity p. Send service message. The operator sends the service message on the Autodin V terminal.

- Activity r. COW returns service request for further action. Following decision node n, the chief of watch returns an unsatisfactory serviced draft to the operator for correction.

- Activity t. Prepare to send message. From node k, if only one of the security designations is missing, the operator carries the message to transmission service in preparation for sending, and flow resumes at step f. (Honolulu included this activity, but not the required time.) If the message error involved something other than security (as determined in decision node e or j), the activities proceed to node u or s, as appropriate. The operator checks to see whether the message can be fixed. If so, he continues to activity v or t. If not, activity l is continued, requiring the generation of a service request.

- Activities v and t. Fix message. From step v, there are no other errors, so the message is transmitted and the flow resumes at step f. From step t, since there was one security error, the message is both transmitted (go to step f) and serviced (go to step l). Honolulu did not include a time for fixing a message.

---

[1] ZNM is an operating signal indicating that the originator authorizes transfer of the message into secure networks of all authorities addressed, providing these networks are approved for the security classifications involved.

Calculating Working Man-Hours Required

Table III-22 shows the calculation of the average times required per message by a typical site (Honolulu), using the standard activity times derived. The total working man-hours required is the product of this average time and the total messages serviced per year.

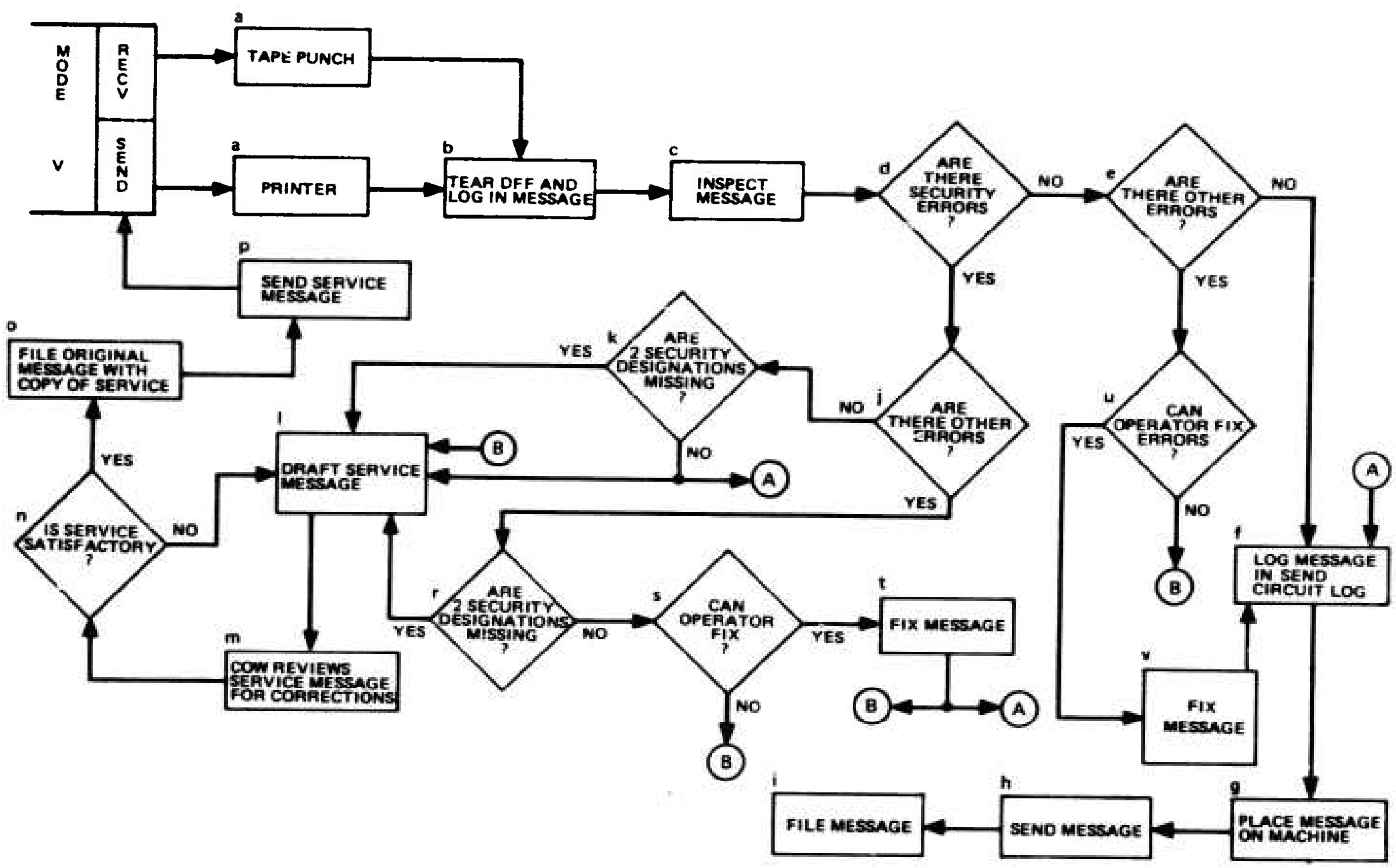

FIG. A-11: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF ALLIED/NATO/SEATO SEND

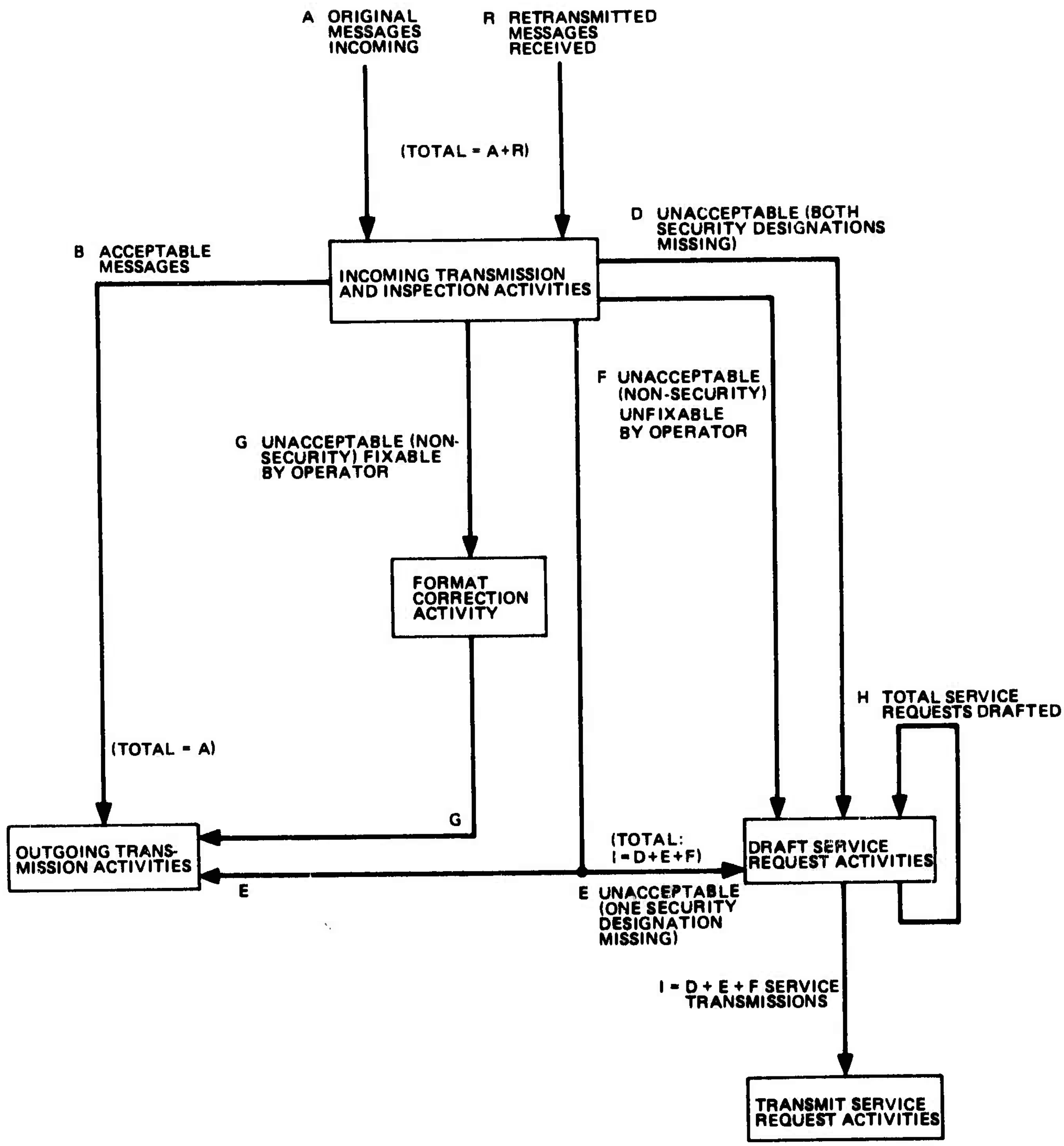

FIG. A-12: WORK FUNCTIONS ASSOCIATED WITH ALLIED/NATO/SEATO SEND

TABLE III-20

NONTIME PLANNING FACTORS FOR ALLIED/NATO/SEATO - SEND

	Honolulu	Guam[a]	Norfolk	Italy[a]
I. Flow characteristics				
1. Number of messages received from Autodin V (A)	4,000		1,439	
2. Number of retransmissions received (R)	200		30	
3. Number of messages unacceptable on first transmission (C)	200		39	
4. Number of messages unacceptable but fixable (G)	0			
5. Total number of service requests drafted (H)	(294)			
6. Total number of service requests sent (I)	280			
7. Average message length	1,400/1,590		1,200	
8. Average service request length	420			
II. Derived characteristics				
9. Proportion of unacceptable messages (C/A)	0.05		0.03	
10. Proportion of retransmissions (R/A)	0.05			
11. Proportion of messages fixable by operator (G/A)	0			
12. Proportion of service drafts made (H/A)	0.07		0.02	
13. Proportion of sent service messages (I/A)	0.07			
14. Deviation from standard message length ((line 7-1,200)/1,200)			0	
15. Deviation from standard service length ((line 8-1,200)/1,200)	-0.65		+0.17	

[a]No data.

TABLE III-21

ACTIVITY TIMES FOR ALLIED/NATO/SEATO, SEND

		Honolulu (4,000)			Guam[a]			Norfolk (1,439)			Italy[a]			
(1) Activity	(2) Std. time designation	(3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	(6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	(9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	(12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Incoming transmission														
Receive message on Autodin V	a	a		144				a	150	144				144
Tear off and log-in message	b	b	10	10				b	5	5				9
Inspect message	c	c	5	5										5
Total operator time				15						5				14
Total time				159						144				158
II Outgoing transmission														
Log-in message	f	ℓ	5	5				c	5	5				5
Place message on machine	g	m		144				d	150	144				5
Send message	h	n	—	—										144
File message	i													—
Total operator time				5						5				10
Total time				149						144				154
III Format error correction		d	10	10										10
Fix message	v,t	d_2												
Total operator time				10										10
Total time				10										10
IV Draft service														
Draft service message	ℓ	e	180	180										180
COW review service message	(m)	f	10	10										10
Total operator time				180										180
Total COW time				10										10
Total time				190										180
V Transmit service														
File message	o	s	5	5										5
Send service message	p	q	20	144										144
Total operator time				5										5
Total time				149										149

[a]No data for Guam and Italy.

TABLE III-22

MANPOWER REQUIRED FOR ALLIED/NATO/SEATO, SEND
(Honolulu)

I. Calculating average operator and total time per message

(1) Time factors	(2) Operator time	(3) COW time	(4) Total time	(5) Proportion designation	(5) value	(6) Average operator time	(7) Average COW time	(8) Average total time
(1) Incoming transmission and inspection activities	14	0	158	$\frac{A+R}{A}$ = 1+R/A	1.05	15.0	0	166
Message-length deviation([a] x 144)	—	—	[a]	1+R/A	1.05		0	
(2) Outgoing transmission activities	10	0	154	A/A	1.0	10	0	154
Message-length deviation ([a] x 144)	—	—	[a]	A/A	1.0		0	
(3) Format error correction activities	10	0	10	G/A	0	0	0	0
(4) Draft service activities	180	10	190	H/A	0.07	12.6	0.7	13.3
(5) Transmit service request activity	5	0	149	I/A	0.07	0.4	0	10.4
Service message length deviation (-0.65x144)	—	—	-94	I/A	0.07		0	-6.6
(6) Average total time required per message						38.0	0.7	337.1
(7) Operator time ratio						0.11	.002	

II. Calculating working man-hours required per year

	Operator	COW
(1) Total operator time (in seconds) required per message (col. 6 + 7)	38.0	.7
(2) Number of messages per year (supply)	208,000	208,000
(3) Operator time (in seconds) per year ((1) x (2))	7,904,000	145,600
(4) Convert time from seconds to hours ((3) / 3,600)	2,195.6	40.4

[a]Since Honolulu's message lengths were ambiguous, the message length deviation could not be calculated, and so omitted (treated as "0") in these calculations.

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF CW BROADCAST JOB

The objective of this job is to convert teletype messages that are to be transmitted at a scheduled time on the CW broadcast circuit into proper format, including CW code, and transmit such messages. Data describing this job was submitted by Honolulu, Guam, and Norfolk. No data was submitted by Italy. Figure A-13 is the operational flow diagram to be used for this job.

Derivation of Nontime Planning Factors

Figure A-14 illustrates, and table III-23 lists, the set of data submitted by the sites and used to derive those planning factors that are unique to each site's environment and operation. This data shows:

- The CW operator receives an average of A messages per week (line 1) for inclusion in the CW broadcast.
- The messages are then clustered to meet a CW broadcast schedule, consisting of an average of B broadcasts per week (line 2). No data was submitted for the value of B; but we believe it to be once per watch, or 21 per week. Therefore, there is an average of C messages per CW broadcast (line 4), where C = A/B.

All planning factors are derived on the basis of a single broadcast. The C messages are converted into CW format and code. The operator then performs a set of CW set-up activities for each batch of C messages to be transmitted on the CW broadcast.

These activities include arranging the CW transmission schedule for the batch and preparing the equipment used for transmission. Unlike the other functional activities, this function is not done for each message but, instead, for a batch of messages, B times per week.

The C messages are then transmitted at the scheduled time and are logged-in and filed (administrative activities). The average length of a message is listed on line 3. Since no rework activities were listed by any site, it is assumed that the time required for any necessary retransmission activities is negligible.

Derivation of Time Standards

Data describing each activity shown in figure A-13 is also listed in table III-24, compared, and a standard time for each activity calculated. All times listed are the times per CW message, except the time for setting up the CW keyer. This time is the total time per broadcast.

Description of Activities

Transmission (Receive) and Conversion Activities

This group consists of all the activities necessary for each original message to be received, including conversion into CW format.

- Activity a. Punch tape and print copy. Message is received in both tape and page copy forms.

- Activity b. Tear off message. The operator tears both tape and page copy off the machines.

- Activity c. Edit message. The operator edits the message and converts it to CW format.

CW Set Up Activity

- Activity e. Set up CW keyer. Guam included as its activity f, "operator sets up and checks CV-2015A transmitter keying equipment," requiring 92 seconds of operator time. Apparently, this job is done every time a batch of messages is to be sent. No other site mentioned this activity.

Transmission (Send CW) Activities

- Activity d. Schedule message. Operator places the message on the schedule to await transmission at proper time.

- Activity f. Transmit message. The message is transmitted at the proper time, and the operator listens to the message tones during transmission. The machine operates at 80 or 145 characters per minute; average operator machine time is 640 seconds (based on an average machine speed of 112.5 characters per minute). The times given assume that the operator must be involved with the broadcast to the extent that he cannot perform other jobs while the message is being transmitted, unlike the situation with full-period termination operations; such involvement is not efficient. Activity g is an exception.

Administrative Activities

Administrative activities include those tasks necessary after the message has been broadcast.

- Activity g. Log in message. The operator enters the message on the station log. While all 3 sites included this activity, Guam reported an additional message logging activity (shown as activity b_1 "operator logs required information on broadcast schedule log") requiring an additional 12 seconds. Norfolk states that logging-in a message is done at the same time a message is being transmitted. Therefore, the 10 seconds required for this activity can be assumed to be included. Thus, if the 640 seconds were counted as operator time for all 3 sites, it would include the 10 seconds.

- Activity h. File message. The operator files the transmitted messages in station files.

Calculating Working Man-Hours Required

Table III-25 shows how to calculate the average time required by Honolulu per CW broadcast, as well as the man-hours per year required using the standard activity times and site planning factors derived. The procedure described in a preceding section is used here, except that the proportion to be used for each message-handling function is A/B = C rather than 1. In addition, in the absence of data, it is assumed that there are 21 broadcasts per week.

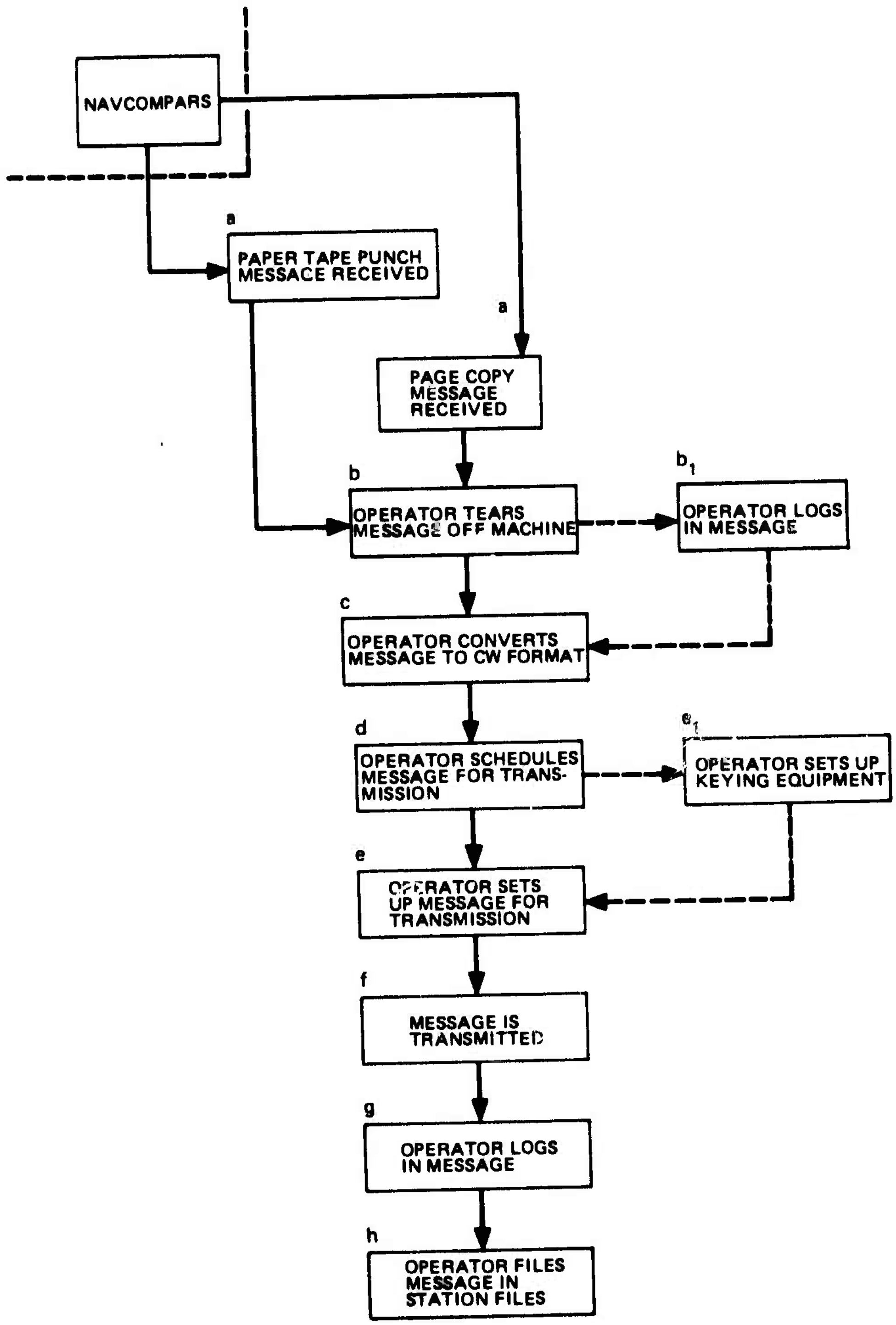

FIG. A-13: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF CW MESSAGE TRANSMISSION

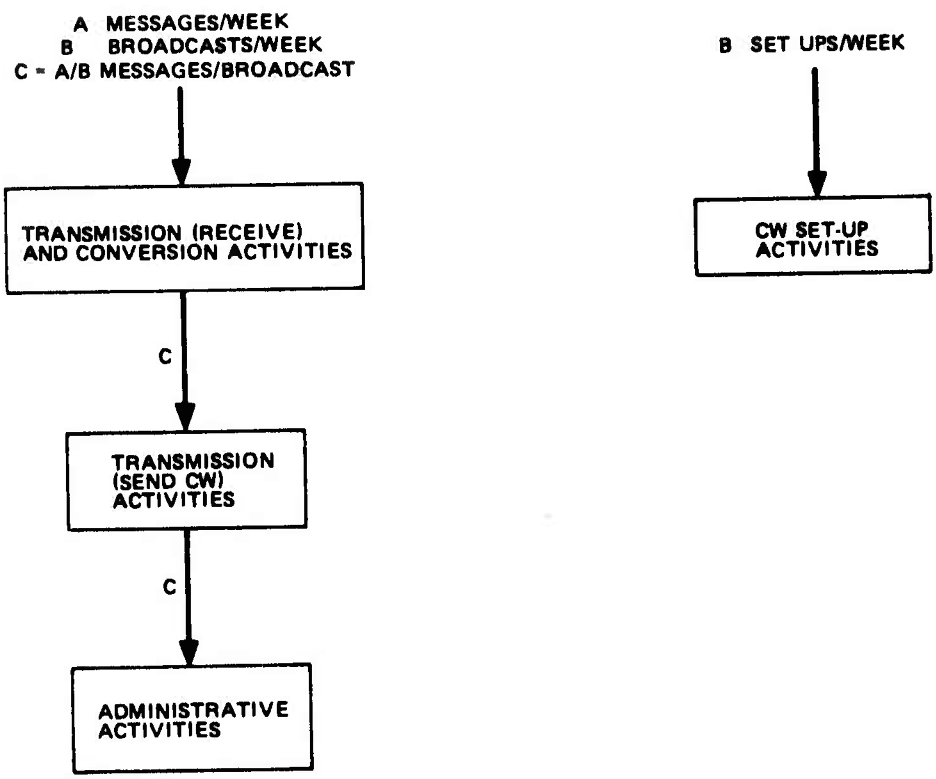

FIG. A-14: WORK FUNCTIONS ASSOCIATED WITH CW BROADCAST

TABLE III-23

NONTIME PLANNING FACTORS FOR CW MESSAGE TRANSMISSION[a]

	Honolulu	Guam	Norfolk
I. Flow characteristics submitted			
1. Average number of messages per week (A)	300		630
2. Average number of CW broadcasts per week (B)	21[b]	21[b]	21[b]
3. Average message length	965		
II. Derived characteristics			
4. Average number of messages per broadcast (A/B = C)	14.3		30
5. Message-length deviation ((line 3-1, 200)/1, 200)	-0.20		

[a]No data for Italy.

[b]Assumed.

TABLE III-24

ACTIVITY TIMES FOR CW MESSAGE TRANSMISSION

		Honolulu (300)			Guam (600)[b]			Norfolk (630)			Italy[a]			
(1) Activity	(2) Std. activity designation	(3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	(6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	(9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	(12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Transmission (receive) and conversion														
Punch tape and page copy	a	a	116	144	a	108	144	a	144	144				144
Tear off machine	b	b	5	5	b	2	2	b	4	4				3
Convert to CW format	c	c	180	180	d	85	85	c	180	180				143
Total operator time				185			87			184				146
Total time				329			231			328				290
II CW set-up														
Set-up CW keyer[d]	e_1				f	92	92							92
Total operator time per broadcast							92							92
Total time per broadcast							92							92
III Transmission (send) CW														
Schedule message for transmission	d	d	10	10	e	23	23	d	10	10				15
Set-up message for transmission	e	e	5	5	g	3	3	e	10	10				6
Transmit message	f	f	515	640	h	636	640	f	640	640				640
Total operator time				655			666			660				661
Total time				655			666			660				661
IV Administration														
Log-in message	g	g	10	10[c]	c,j	12,14	26[c]	g	10	10[c]				16
File message	h	h	10	10	j	7	7	h	10	10				9
Total operator time				20			33			20				25
Total time				20			33			20				25

[a]No data for Italy.
[b]Number of messages derived by multiplying Honolulu by 2.
[c]Done together with activity f.
[d]Total time per broadcast; all other times are per message.

TABLE III-25

MANPOWER REQUIRED FOR CW MESSAGE TRANSMISSION
(Honolulu)

I. Calculating average time per broadcast

(1) Work functions	(2) Total/Average operator time	(3) Total/Average time	(4) Proportion designation	(4) Proportion value	(5) Average operator time	(6) Average total time
(1) Transmission (receive) and conversion activities	146	290	A/B = C	14.3	2088	4147
Message-length deviation (-0.20 x 144)	—	-29	C	14.3		-415
(2) Transmission (send)	661	661	C	14.3	9452	9452
Message-length deviation (-0.20 x 144)	—	-29	C	14.3		-415
(3) Administrative	25	25	C	14.3	358	358
(4) CW set-up time	92	92	B/B	1.0	92	92
(5) Average time per broadcast					11,990	13,219
(6) Operator time ratio					0.91	

II. Calculating working man-hours required per year

(1) Average time (in seconds) required per broadcast (col. 5)	11,990
(2) Average number of broadcasts per year (B x 52)	1,092
(3) Average time (in seconds) required per year ((1) x (2))	13,093,080
(4) Convert from seconds to hours ((3) ÷ 3600)	3,637

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF PG BROADCAST JOB

Data describing this job was received from Norfolk (Sugar Grove), Guam, and Italy. Neither Honolulu nor Norfolk included a description of its broadcast. Italy's descriptions of this and its U.S. Navy Ship (USNS) broadcasts are identical and are therefore combined. Figure A-15 is the flow diagram to be used as a standard of comparison among the sites.

Derivation of Nontime Planning Factors

Figure A-16 illustrates, and table III-26 lists, the set of data submitted by the sites and used to derive those planning factors that are unique to each site's environment and operation. The data shows:

- The operator receives an average of A messages per week (line 1) for inclusion in the PG broadcast.
- The messages are then clustered to meet a PG broadcast schedule, consisting of an average of B broadcasts per week (line 2). There are an average of C messages per broadcast listed in line 8, where C= A/B.

All planning factors are derived on a single broadcast basis. The C messages are processed into one master tape (including a header) that is then transmitted at the scheduled time. Retransmission is done immediately after the original transmission.

Sugar Grove estimated it averages 25 to 30 messages per broadcast, although the written figure submitted was 136.2 messages per week. With 3 broadcasts per day, or 21 per week, 136 messages per week result in 6.5 messages per broadcast. The total was taken to be more accurate, and is used as the value of C for Sugar Grove.

Some ships do not receive all their messages in acceptable form (even after two transmissions) and request a further retransmission of at least some messages. An average of E retransmission requests (line 4) is received by the operator, resulting in a total of D messages (line 3) being retransmitted. These requests are then serviced by the operator.

From the above data, three other planning factors are derived:

- The proportion of retransmission requests per broadcast, E/B (line 9).
- The proportion of messages retransmitted following the rerun, D/B (line 10).

- The number of messages per retransmission request, E/D (line 11).

- The average lengths of message, retransmission request, and service message appear in lines 6, 7, and 8. The message-length deviations are listed in lines 11, 12, and 13.

Derivation of Time Standards

Data describing each activity shown in figure A-15 is also listed in table III-27, compared, and a standard time for each activity calculated.

Description of Activities

Transmission (Receive) Activities

These activities involve receiving the message into the fleet center.

- Activity a. Tape and printer. A tape and page copy of the message is received. While Sugar Grove estimated a time of 5 minutes for a message to be received, this time was standardized to 144 seconds for each standard length message.

- Activity b. Log-in message. At Sugar Grove, the operator logs-in the message while it is being received during activity a above, thus reducing the total time required for both activities but not affecting the total operator time required. Guam logs-in the message after transmission, but the time is comparable.

- Activity c. Tear off message. The operator tears the tape and page copy of the message off the machine, staples them together, and places it in a box, where they await the next scheduled broadcast.

Transmission (Broadcast) Activities

These activities are concerned with preparation for, and transmission of, the regular broadcast.

- Activity d. Make master tape; add header to message tape. The operator makes a master tape of all the messages received for this broadcast. Sugar Grove gave its total time as 1-½ hours (5,400 seconds). Included in making the master tape is the addition of a precut header tape to the one containing the messages. Guam reported that this activity takes 15 seconds. Sugar Grove did not give a comparable time. But since its time to make the entire master tape was 1-½ hours, it is assumed the 15 seconds is included. For this reason, Sugar Grove's time was standardized to 5,385 seconds.

Another estimate by Sugar Grove of the average time to make the master tape was "1-½ hours." If 6.5 is the correct value for C, 1-½ hours gives 900 seconds per message, which seems too high. Therefore, we assumed that the 25 to 30 messages correlates with 1-½ hours, since it was given in the same estimate. This results in a requirement of 192 seconds per message (dividing an average of 28 messages into 5,385 seconds). The 192 seconds seems to be a much more realistic number; it is not too far from the 144 seconds required for each message, and additional time for some is probably required. The time of 192 seconds for each message is used on this table. Italy says the messages are "held/prepared" during down times, but does not discuss the activities or times involved. Guam gave the impression that it did not prepare a master tape but broadcast the individual messages in series.

- Activity e. Place tape on tape-reading device. The operator places the tape on the transmitting device in preparation for the broadcast. Sugar Grove requires 5 seconds for this activity. Guam requires 15 seconds to do so. But since all but the first can be accomplished during the time (144 seconds) the previous message is running, the only additional time required is 15 seconds to place the first message.

- Activity f_1. Send message.

- Activity f_2. Broadcast rephase. The messages are broadcast on schedule. Sugar Grove determined its time by multiplying the number of messages per broadcast by 5 minutes for each message. Instead, the time was standardized by 144 seconds (based on average message length) per message. Guam did not include a time for message broadcast, but it is assumed to be the same as the time it takes to receive the message (144 seconds). The operator must rephase the crypto between each message. Activity f_2 is done in parallel with activity f_1. Only the former is counted as operator time.

- Activity g_1. Rebroadcast. The entire broadcast is immediately retransmitted.

- Activity g_2. Rebroadcast rephase. Guam reported that the transmitted tapes are filed for the rerun schedule, but did not describe its rerun activities. Again, the crypto must be rephased throughout the broadcast, but this time only after every third message.

- Activity h. Tear off message. The operator separates each message, staples the page and tape copies together, and puts them on the board. The messages remain on the board for 30 days in case a retransmission request is sent from one of the ships; the messages are then destroyed.

<u>Retransmission Activities</u>

- Activity j. Receive retransmission request. A retransmission request is received from the ship. Italy states only that "retransmissions are received from the ships prepared on AN/UGC-6 and retransmitted." Neither Italy nor Guam discussed the activities involved when a retransmission is requested.

- Activity k. Retrieve message. The operator retrieves all requested messages from the board.

- Activity l. Draft service message. The operator drafts a service message to accompany each retransmission to ship.

- Activity m. Send message. The operator sends the requested messages along with the service message as a new broadcast number. No mention is made of logging-in the broadcast number. The flow then returns to step I. The time given by Sugar Grove, 7 minutes, includes 2 minutes for the service message plus 5 minutes for the retransmission. The standardized time uses 144 seconds for the service message and the standard 144 seconds for each of the D/E messages per service request.

Calculating Working Man-Hours Required

Table III-28 shows the calculation for the average time required for each PG broadcast using the standard activity times and illustrative data for the planning factors. The average times, operator time ratios, and total working man-hours required per year were calculated in the same way for the CW broadcast. Again, it is assumed that there are 21 PG broadcasts per week.

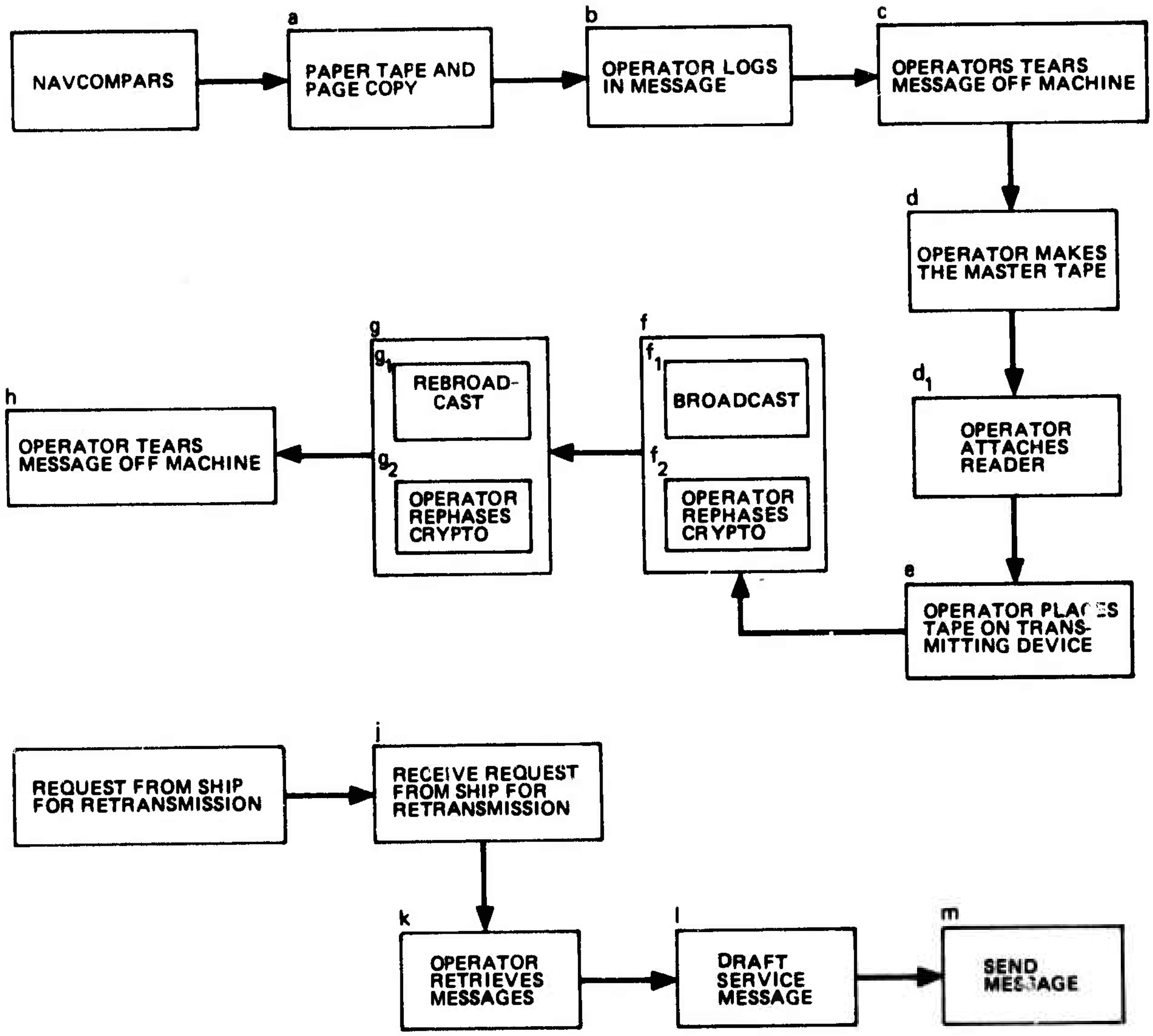

FIG. A-15: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF PG BROADCAST TRANSMISSION

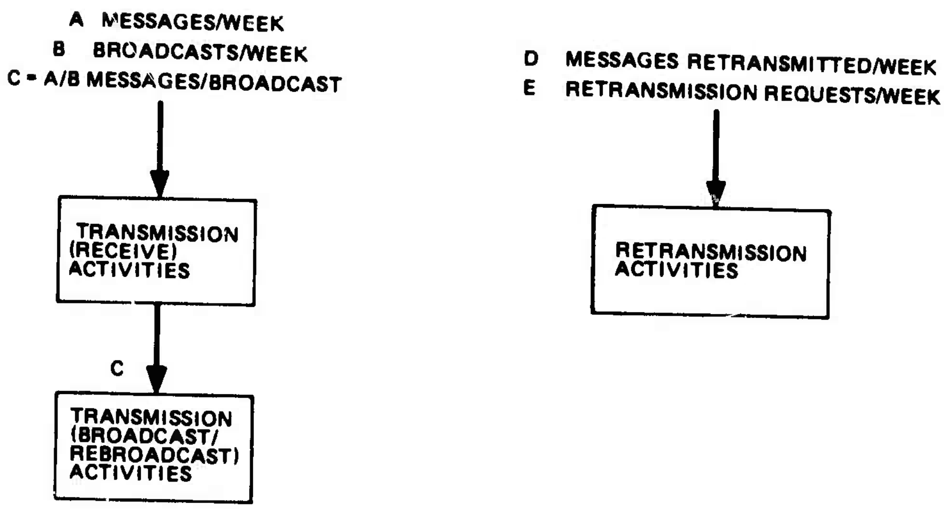

FIG. A-16: WORK FUNCTIONS ASSOCIATED WITH PG BROADCAST

TABLE III-26

NONTIME PLANNING FACTORS FOR PG BROADCAST[a]

	Sugar Grove	Guam[a]	Italy	Illustration
I. Flow characteristics submitted by sites				
1. Number of messages per week (A)	136.2		313	200
2. Number of broadcasts per week (B)	21		21	21
3. Number of messages retransmitted per week (D)				50
4. Number of retransmission requests per week (E)				10
5. Average message length	1,120		1,661	1,300
6. Average length of retransmission				1,300
7. Average length of service message				240
II. Derived characteristics				
8. Number of messages per broadcast (C = A/B)	6.5		14.9	9.5
9. Proportion of retransmission requests (E/B)				0.48
10. Proportion of retransmitted messages (D/B)				2.4
11. Number of messages per retransmission request (D/E)				5
12. Message-length deviation ((line 5-1,200)/1,200)	-.07		.34	0.08
13. Retransmitted message-length deviation ((line 6-1,200)/1,200)				0.08
14. Service-message-length deviation ((line 7-1,200)/1,200)				-0.20

[a]No data for Guam.

TABLE III-27

ACTIVITY TIMES FOR PG BROADCAST

(1) Activity	(2) Std. activity designation	Sugar Grove (136.2) (3) Activity designation	(4) Required time (sec)	(5) Standardized time (sec)	Guam (313)[b] (6) Activity designation	(7) Required time (sec)	(8) Standardized time (sec)	Italy (313) (9) Activity designation	(10) Required time (sec)	(11) Standardized time (sec)	Honolulu, Norfolk[a] (12) Activity designation	(13) Required time (sec)	(14) Standardized time (sec)	(15) Standard time (sec)
I Transmission (receive)														
Tape and page copy	a	a	300	144	a	144	144	a	150	144				144
Log-in message	b	c[c]	10	10	e	20	20	c	10	10				14
Tear off message	c	d	10	10	b	2	2	b	5	5				3
Total operator time per message				20			22			15				17
Total time per message				164			166			159				161
II Transmission (broadcast/rebroadcast)														
Make master tape	d	e	5,400	192										192
Attach header[d]	d_1			15[d]	c	–	15[d]							15[d]
Place tape on device[d]	e	f	5[d]	5[d]	d	15	15[d]	d	5[d]	5[d]				9[d]
Transmit broadcast	f_1	g	300	144			144	e	159	144				144
Re-hase broadcast	f_2	g_1	60	60										60
Retransmit broadcast	ℓ_1	h	300	144										144
Rephase broadcast	ℓ_2	h_1	20	20										20
Tear off and file	h	i	5	5	f	45	45							33
Total operator time per broadcast				20[d]+565			30[d]+169			5[d]+144				24[d]+593
Total time per broadcast				20[d]+585			30[d]+189			5[d]+144				24[d]+593
III Retransmission														
Request for retransmission received	j	k	90	90										90
Look up message	k	ℓ	80	80										80
Draft service message	ℓ	m	180	180										180
Send requested messages and service	m	n	420	144+144(D/E)[e]										144+144(D/E)[e]
Total operator time per request				330										330
Total time per request				618										474+144(D/E)[e]

[a]No data.

[b]No message count was given for Guam. This count was derived from Italy.

[c]Done during time of activity a, reducing total time required for both activities.

[d]These transmission activities are done only once per broadcast. The other transmission activities are done for each message.

[e]This time is actually 144 + an additional 144 for each of the D/E messages retransmitted in a group.

TABLE III-28

MANPOWER REQUIRED FOR PG BROADCAST
(Illustration)

I. Calculating average time per broadcast

(1) Work functions	(2) Total operator time	(3) Total time	(4) Proportions designation	(4) Proportions value	(5) Average operator time (2) x (4)	(6) Average total time (3) x (4)
(1) Transmission (Receive)	17	161	A/B = C	9.5	162	1,530
Message-length deviation (0.08 x 144)	—	11.5	A/B = C	9.5	—	109
(2) Transmission (broadcast/rebroadcast)	24 + 593[a]	24 + 593[a]	(1.0) (C)	(1.0[a]) (9.5)	5,658	5,658
Message-length deviation (broadcast) (0.08 x 144)	—	11.5	A/B = C	9.5	—	109
Message-length deviation (rebroadcast) (0.08 x 144)	—	11.5	A/B = C	9.5	—	109
(3) Retransmission	330	474 + 144 D/E	E/B	0.48	158	573[b]
Retransmitted message-length deviation (0.08 x 144)	—	11.5	D/B	2.4	—	27.6
Service-message-length deviation (-0.20 x 144)	—	-28.8	E/B	0.48	—	-13.8
(4) Average time per broadcast					5,978	8,102
(5) Operator Time Ratio					0.74	8,102

II. Calculating working man-hours required per year

(1) Average operator time (in seconds) per broadcast (col. 5)	5,978
(2) Number of broadcasts per year (B x 52)	1,092
(3) Average operator time (in seconds) per year ((1) x (2))	6,527,976
(4) Convert to hours ((3) / 3,600)	1,813

[a] Done only once per broadcast; the other transmission activities are done for each message. Multiply 593 by C (here, 9.5) and add 24 to this product.

[b] First multiply 144 by $\frac{D}{E}$ (in this illustration $\frac{50}{10} = 5$). Add 144 to this product and multiply the sum by E/B (here, 0.48).

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF ENCRYPTING JOB

Detailed data on this job was supplied by Guam and Norfolk. Honolulu did not provide activity times but reported that each message takes about 60 minutes to encrypt and 20 minutes to check decrypt. Italy supplied no data. Figure A-17 is the flow diagram to be used as a standard of comparison among sites.

Derivation of Nontime Planning Factors

Since all messages undergo the same activities, this constitutes only one work function. Hence, no separate figure showing the work functions associated with encryption is required. Table III-29 lists two nontime characteristics for this job. Line 1 lists the number of messages encrypted per week, and line 2 lists the average message length. The only derived characteristic, listed on line 3, is the deviation of the message length from 1,200 characters (although no site supplied this data).

Derivation of Time Standards

Data describing each activity shown in figure A-17 is listed in table III-30, compared, and a standard time calculated.

Description of Activities

- Activity a. Punch tape and print copy. A message requiring encryption is received. As before, the standard time is calculated from an average message length of 1,200 characters. Guam's time of 10 seconds to receive a message for encryption is much lower than the 144 seconds' standard time; the reason for this discrepancy is unclear.

- Activity b. Log-in message.

- Activity c. Encrypt message. The operator puts the message through the encrypting systems.

- Activity d. Obtain CWO signature. The operator seeks and obtains the CWO's signature before transmitting an encrypted message.

- Activity e. Feed message into DSR. The operator feeds the message to the computer via the DSR. In Guam, the message is fed into NavComPARs by the paper tape reader instead of the crypto/operator. Guam included no time for transporting the message. The time required to send a 1,200-character message across the SDR at 850 words per minute (17 seconds) is used as the standard time. It is considered too small for the operator to engage in another activity and, therefore, it is counted as operator as well as machine time.

• Activity f. Log-in message. The operator enters the TOD on the log and files the message.

Norfolk reported that its message-encryption activity consists of these subactivities:

1. Log-in message in TOR log.
2. Type in textual format needed for encryption.
3. Calculate the encryption system indicator (ESI).
4. Find out what system recipient holds.
5. Set up rotors for encryption.
6. Perform a 36- to 45-letter check to ensure rotors are set properly.
7. Encrypt rotor message indicator (RMI) to get the rotor message alignment (RMA).
8. Set rotors up according to RMA.
9. Run tape through machine to encrypt message.
10. Change banks, rotors, etc., to check decryption.
11. Re-encrypt RMI.
12. Count number of groups, put in proper format for transmission.
13. Log message in encrypt log and assign SSN (station serial number) from SSN log.
14. Find CWO (Communications Watch Officer) to have message released.
15. Transmit message via DSR.

Norfolk's decrypting procedure is similar and the time allotted is commensurate.

The time required to perform this series of subactivities is between 45 and 60 minutes, based on an average message length of 300 groups. Thus, we assumed an average time of 52.5 minutes (3,150 seconds) for the entire encrypting subactivities lists. This time does not include the time (undisclosed) needed by Norfolk to obtain routing indicators to address the message or call signs and to make the proper notation in a check-off list after each operation.

But Norfolk's subactivity 14 is really standard activity d at 180 seconds, its activity 15 is standard activity e at 17 seconds, and its activity 13 may be standard activity b at 10 seconds. We therefore subtracted 207 seconds from Norfolk's 3,150 seconds to obtain the equivalent of standard activity c at 2,943 seconds. Norfolk also reported that "message is checkdecrypted" as one of its encrypting tasks. It is assumed that this time is included in Norfolk's time for activity c; by contrast, Honolulu listed this time separately.

Guam seems to have divided the task "message is encrypted" into two parts -- breaking out 472 seconds for the "operator to put message in format for encryption"-- leaving 1,621 seconds for the rest of the task. The two times are combined for activity c. Unfortunately, Guam gave no breakdown of how its total encrypting time was spent.

Calculating Working Man-Hours Required

Once the standard activity times have been derived for table III-30, the working man-hours required for the job may be calculated. In this case, the average time per message is the same as the total time found in table III-30, unless the message length deviates from the standard. The total man-hours required may be obtained as the product of this average time and the total number of messages serviced per year, using Norfolk's data for the example in table III-31.

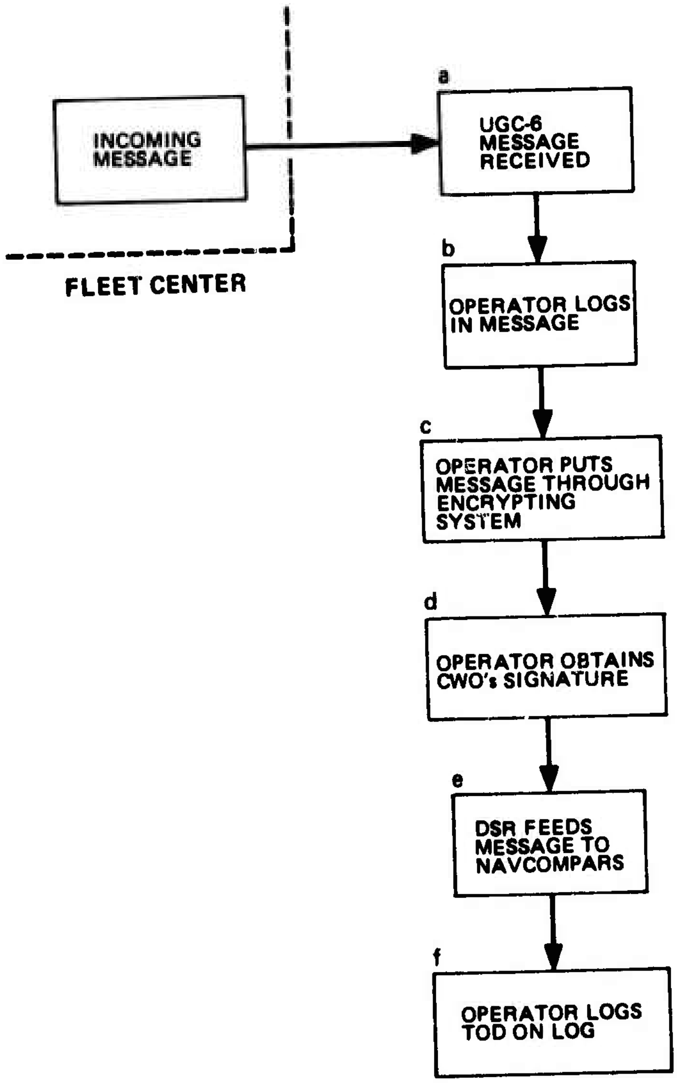

FIG. A-17: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF MESSAGE ENCRYPTION

TABLE III-29

NONTIME PLANNING FACTORS FOR MESSAGE ENCRYPTION[a]

	Honolulu	Guam	Norfolk
I. Flow characteristics submitted by sites			
(1) Number of messages per week (A)	10	—	19
(2) Average message length	—	—	—
II. Derived characteristics			
(3) Message length deviation ((line 2-1, 200)/1, 200)			

[a]No data for Italy

TABLE III-30

ACTIVITY TIMES FOR MESSAGE ENCRYPTION[a]

(1) Activity	(2) Standard activity designation	(3) Activity designation	Honolulu (4) Required time (sec)	(5) Standardized time (sec)	(6) Activity designation	Guam (10) (7) Required time (sec)	(8) Standardized time (sec)	(9) Activity designation	Norfolk (19) (10) Required time (sec)	(11) Standardized time (sec)	(12) Standard time (sec)
Message encryption											
Page copy	a				a	10	144	a	144	144	144
Log-in message	b				b	17	17	b	10	10	12
Encrypt message	c				c, d	2,093	2,093	c	2,943	2,943	2,650
CWO checks and releases message	(d)				e	180	180	d	180	180	180
Feed message to NavComPARs	e					—	—	e	17	17	17
Operator logs-in and files message	f				g	48	48	f	10	10	23
Total operator time to encrypt							2,158			2,980	2,702
Total CWO time to encrypt							180			180	180
Total time to encrypt		80 min (4,800 sec.)					2,482			3,304	3,026

[a]No data for Italy.

TABLE III-31

MANPOWER REQUIRED FOR MESSAGE ENCRYPTION
(Norfolk)

I. Calculating average time per message

(1) Time factors	(2) Operator time	(3) CWO time	(4) Total time	(5) Proportions designation	(5) Proportions value	(6) Average operator time (2) x (5)	(7) Average CWO time (3) x (5)	(8) Average total time (4) x (5)
(1) Message encryption time	2,702	180	3,026	A/A	1.0	2,702	180	3,026
Message-length deviation (0 x 144)[a]	—	—	0	A/A	1.0	—	—	0
(2) Average time per message						2,702	180	3,026
(3) Operator time ratio						.89	.06	

II. Calculating working man-hours required per year

	Operator	CWO
(1) Total time (in seconds) required per message (col. 6 and 7)	2,702	180
(2) Number of messages per year (supply)	991	991
(3) Operator time (in seconds) per year ((1) x (2))	2,677,682	178,380
(4) Convert time from seconds to hours ((3) / 3,600)	743	50

[a] Norfolk's time of 144 seconds to receive a message implies a standard message length of 1,200 characters, making the message length deviation equal to zero.

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF DECRYPTING JOB

Detailed data on this job was supplied by Guam and Norfolk. Honolulu did not provide activity times but reported that each message takes about 45 minutes to decrypt. Italy supplied no information. Figure A-18 is the flow diagram to be used as a standard of comparison among sites.

Derivation of Nontime Planning Factors

Figure A-19 illustrates, and table III-32 lists, the set of data submitted by each site and used to derive those planning factors that are unique to each site's environment and operation. The data shows that:

- A total of A messages (line 1) is received over the service printer for decryption. All A messages are decrypted.
- Of the A messages B messages (line 2) are delivered locally, and the remaining C = A - B (line 3) are carried to the DSR. The proportion of locally delivered messages (B/A) is listed on line 5, and the proportion of messages carried to the DSR operator (C/A) is listed on line 6.
- The average message length is listed on line 4, and the message-length deviation in relation to 1,200 characters is on line 7.

Derivation of Time Standards

Figure A-18 is the flow diagram used as a standard for the sites. Data describing each activity shown in figure A-18 is listed in table III-33, compared, and a standard time calculated.

Description of Activities

- Activity a. Receive message. A message requiring decryption is received. Again, the machine time listed for Guam's activity a is much less than the standard time of 144 seconds, for some unknown reason.
- Activity b. Log-in message.
- Activity c. Decrypt message. The operator puts the message through decrypting. Guam's estimate of the time (1,023 seconds) for an operator to put a message through the decrypting system is far different from Norfolk's (2,700 seconds); the reason for such a large difference is not clear. The standard time is the weighted mean of these two times.

• Activity d. Obtain CWO authorization. The operator obtains CWO authorization to deliver locally or to carry the decrypted message to the DSR for transmission. The time for activity d also includes the time for decision node e, the purpose of which is to decide whether the addressee is local or not. If so, path e_1 is taken to activity f.

• Activity f. Deliver message. The operator delivers the message locally.

• Activity g. Carry message. If the addressee is not local, path e_2 is taken to activity g, and the operator carries the message to the DSR operator. At Guam, all the approved messages are carried to the paper tape reader, (PTR), who then feeds the message to NavComPARs or delivers it to the local addressee.

Calculating Working Man-Hours Required

Table III-34 shows the working man-hours per year required by Norfolk, using the standard activity times derived. This calculation is described earlier.

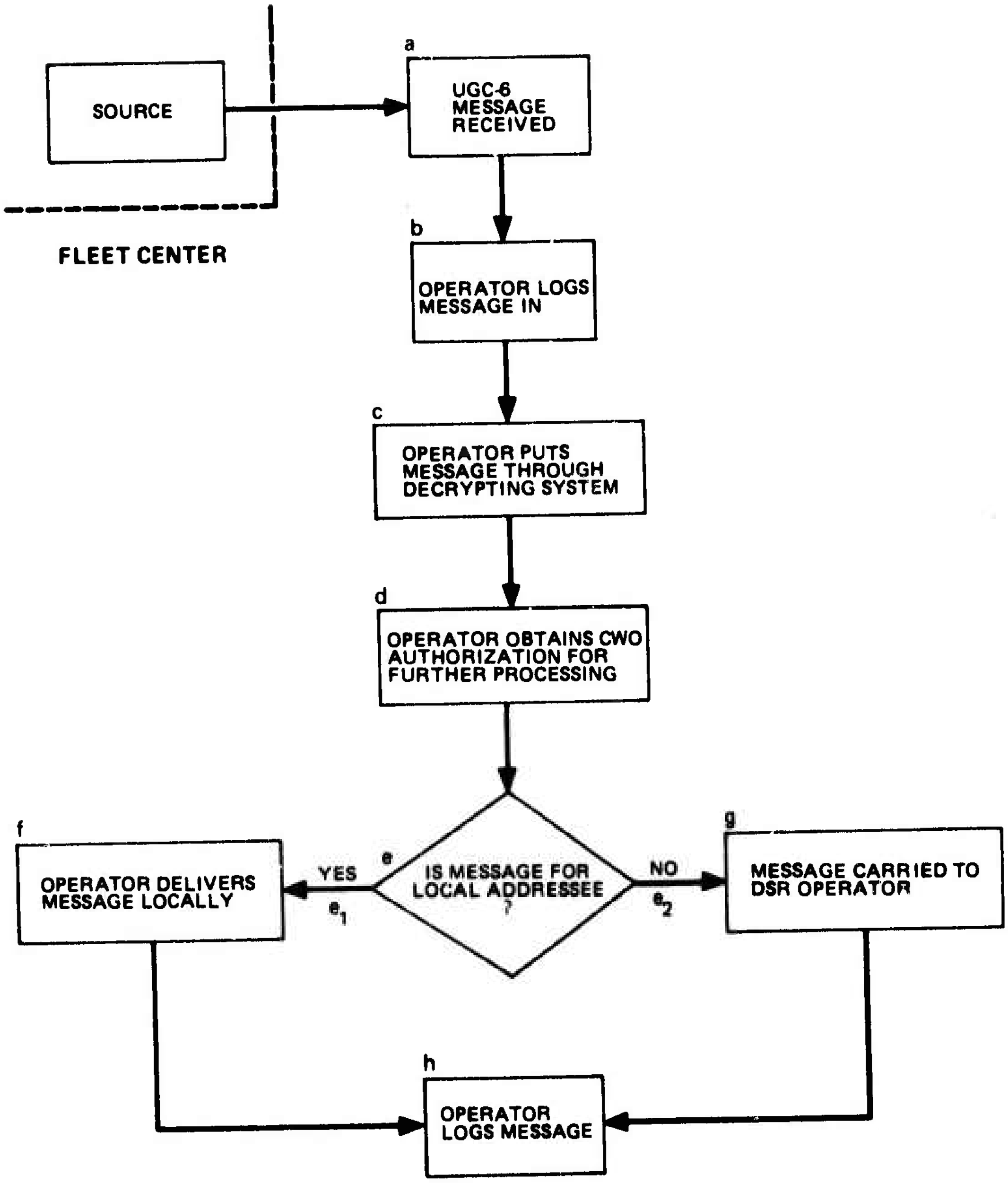

FIG. A-18: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF MESSAGE DECRYPTION

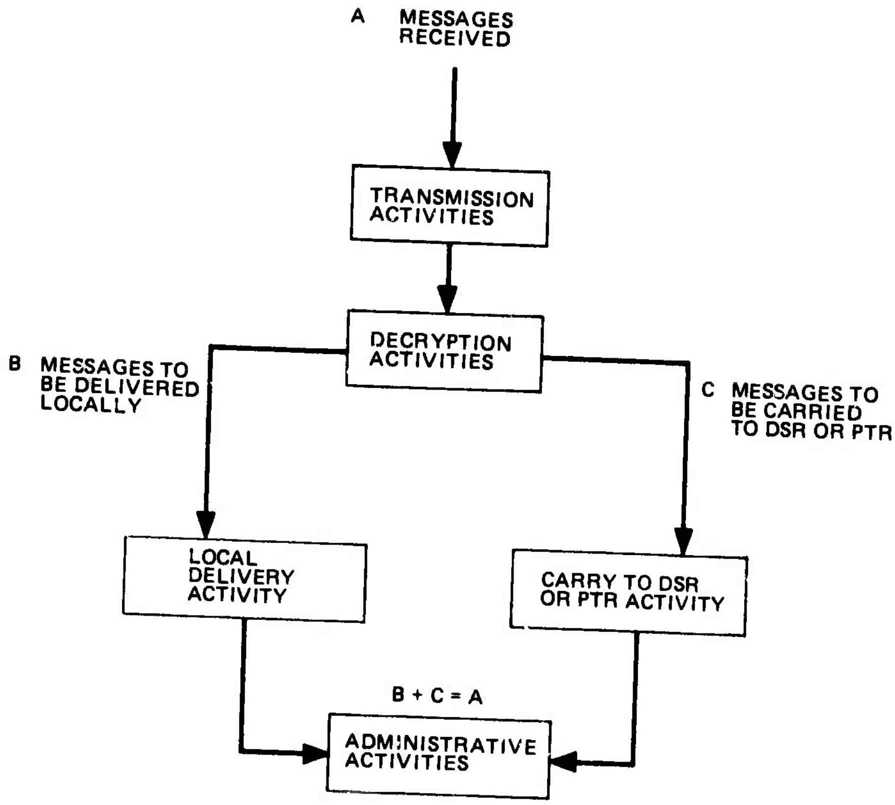

FIG. A-19: WORK FUNCTIONS ASSOCIATED WITH MESSAGE DECRYPTION

TABLE III-32

NONTIME PLANNING FACTORS FOR MESSAGE DECRYPTION[a]

	Honolulu	Guam	Norfolk
I. Flow characteristics			
(1) Number of messages received per week (A)	2	—	17
(2) Number of messages delivered locally (B)		—	2
(3) Number of messages carried to DSR or PTR operator (C = A - B)		—	15
(4) Message length			
II. Derived characteristics			
(5) Proportion of messages for local delivery (B/A)	0.20	0	0.12
(6) Proportion of messages carried (C/A)	0.80	1.00	0.88
(7) Message length deviation ((line 4-1200)/1200)	—	—	—

[a]No data for Italy.

TABLE III-33

ACTIVITY TIMES FOR MESSAGE DECRYPTION

(1) Activity	(2) Std. activity designation	Honolulu (2) (3) Activity designation	Honolulu (2) (4) Required time (sec)	Honolulu (2) (5) Standardized time (sec)	Guam (15)[b] (6) Activity designation	Guam (15)[b] (7) Required time (sec)	Guam (15)[b] (8) Standardized time (sec)	Norfolk (15) (9) Activity designation	Norfolk (15) (10) Required time (sec)	Norfolk (15) (11) Standardized time (sec)	Italy[a] (12) Activity designation	Italy[a] (13) Required time (sec)	Italy[a] (14) Standardized time (sec)	(15) Standard time (sec)
I Transmission														
Page copy	a				a	10	144	a	144	144				144
Log-in message	b				b	12	12	b	5	5				9
Total operator time							12			5				9
Total time							156			149				153
II Decryption														
Decrypt message	c				c	1,023	1,023	c	2,700	2,700				1,862
Obtain CWO authorization	(d)				d	194	194	d	180	180				187
Total operator time							1,023			2,700				1,862
Total CWO time							194			180				187
Total time							1,217			2,880				2,049
III Local delivery														
Deliver locally	f							f	180	180				180
Total operator time										180				180
Total time										180				180
IV Carry to DSR or PTR														
Carry message	g				e	25	25	g	17	17				21
Total operator time							25			17				21
Total time							25			17				21
V Administration														
Log-out message	h	(Total time to decrypt a message is 45 minutes)			f	37	37	h	10	10				24
Total operator time							37			10				24
Total time							37			10				24

[a]No data for Italy.

[b]Number not reported; therefore, this number equals Norfolk's.

TABLE III-34

MANPOWER REQUIRED FOR MESSAGE DECRYPTION
(Norfolk)

I. Calculating average times per message

(1) Time factor	(2) Operator time	(3) CWO time	(4) Total time	(5) Proportion designation	(5) Proportion value	(6) Average operator time (2) x (5)	(7) Average CWO time (3) x (5)	(8) Average total time (4) x (5)
(1) Transmission activities	9	0	153	A/A	1.0	9	0	153
Message length deviation	—	0	—	A/A	1.0	—	0	—
(2) Decryption activities	1,862	187	2,049	A/A	1.0	1,862	187	2,049
(3) Local delivery activity	180	0	180	B/A	0.12	22	0	22
(4) Carry to DSR or PTR activity	21	0	21	C/A	0.88	19	0	19
(5) Administrative activity	24	0	24	A/A	1.0	24	0	24
(6) Total average time per message						1,936	187	2,266
(7) Operator time ratio						.85	.08	

II. Calculating man-hours required per year

	Operator	CWO
(1) Total operator time (in seconds) required per message (col. 5)	1,936	187
(2) Number of messages per year (supply)	886	886
(3) Operator time (in seconds) per year ((1) x (2))	1,715,296	165,682
(4) Convert time from seconds to hours ((3) / 3600)	476	46

OPERATIONAL MANPOWER REQUIREMENTS: ANALYSIS OF SERVICE CENTER

Data describing the work of the service center was submitted by Honolulu only. Figure A-20 is that NavCommSta's operational flow diagram.

Derivation of Non-Time Planning Factors

Figure A-21 illustrates, and table III-35 lists, the data submitted by Honolulu and used to derive those planning factors that are unique to that site's environment and operation. As the figure shows:

- A total of A messages per week (line 1) are originally received through the service printer. Honolulu did not give a value for A, but we calculated (from the information received) that 2,660, or 45 percent, of the messages received are filed. These messages are then inspected by the service supervisor to see which ones require operator action. Of the A messages, B messages (line 2) require no operator action; these are filed.
- C messages (line 3) require operator actions (where C = A - B). These messages are handled by the service clerk, either by fixing D messages (line 4) or drafting E service requests (line 5), and returned to the supervisor for final check. (D + E may not equal C, since some of the D or E messages may have been returned by the supervisor for rework.)
- G of the C message actions are unacceptable by the supervisor and are returned to the service clerk for further action. Thus, the service supervisor handles a total of F = C + G action requests (line 6) for each A message received. Finally the C messages, having been corrected, are passed through the completion activity.

The various proportions of all the messages described (B through F) are listed in lines 8 through 12 of table III-35. The proportions in parentheses were calculated from the other proportions supplied by Honolulu on its flow chart. The numbers in parentheses in part one of the table were calculated from the proportions. Line 7 lists the average message length.

Derivation of Time Standards

Data describing each activity shown in figure A-35 is listed in table III-36. Since only one site presented data for this job, its activity times are used as standard times until additional data is obtained. (Two people are involved in this job. The supervisor's times are enclosed in parentheses, and the operator times are underlined.)

Description of Activities

• Activity a. Page copy received. Messages are rejected to the service printer automatically or manually by the router. The message prints out on a Univac 70/242 medium-speed printer at 850 line blocks per minute. Although Honolulu reported that the machine time is considered minimal, we calculated it as 3 seconds, based on: the stated printer speed of 850 lines per minute; an average printed line of 32 characters and an average message length of 1, 200 characters.

• Activity c. Tear off and scan message. The service supervisor tears off the message and scans it to decide whether action is required. This activity includes the time for decision node d, which determines whether action is required by the service clerk. If so, the process proceeds to activity e; if not, it proceeds to activity 1.

• Activity e. Assign to service clerk. If action is required, the message is assigned to the service clerk. Honolulu says it takes 120 seconds until the service clerk picks up message. Apparently, though, the supervisor merely places all messages assigned to a service clerk in a holding box, where they await pick-up by the clerk. Thus, no supervisor working time would be involved. This point should be validated by the sites.

• Activity f. Check message (this is the start of the service clerk activity): The service clerk checks the message to determine what action is necessary. This activity includes time for decision node g to determine whether the message can be fixed. If so, the process continues with activity h; if not, it begins with activity m.

• Activity h. Fix message.

• Activity m. Draft service message. When the message cannot be fixed by the service clerk, he drafts a service message.

• Activity i. Supervisor check. The corrected message (or service message) is returned to the service supervisor for approval. This activity includes time for decision node j to determine whether the message is satisfactory. If it is, the activities proceed with activity k; if not, the process returns to activity e.

• Activity k. Complete action. When the message is satisfactory, action is completed. Honolulu's description of activity k is not clear. It seems to be a "finishing off" activity, which varies with the nature of the action involved. The average time of 30 seconds is ascribed to the supervisor, since there is no indication that he returns the message to the clerk.

● Activity l. File message. When decision node d is that no action is required, the activities proceed to l, and the message is filed.

Calculating Working Man-Hours Required

Table III-37 shows the calculation of the working man-hours per year required by Honolulu, using the standard activity times derived.

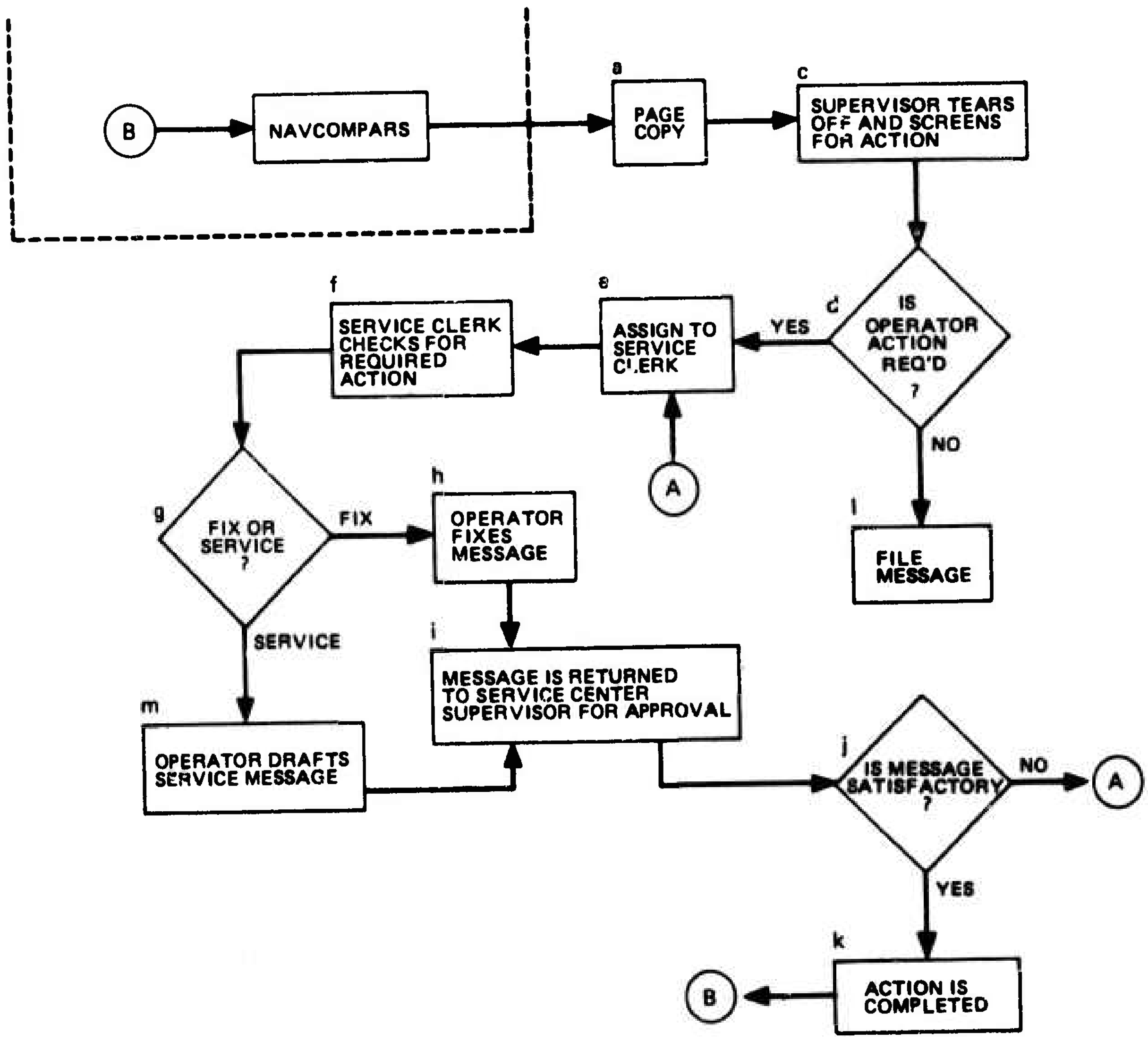

FIG. A-20: SERVICE CENTER

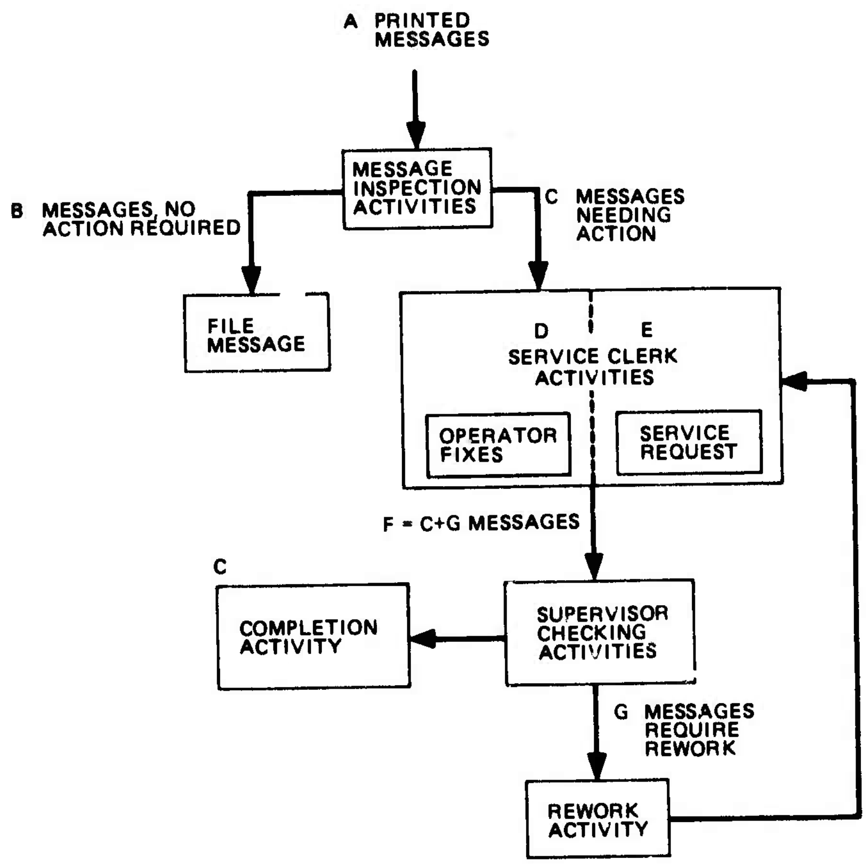

FIG. A-21: WORK FUNCTIONS ASSOCIATED WITH SERVICE CENTER

TABLE III-35

NONTIME PLANNING FACTORS FOR SERVICE CENTER
(Honolulu)

I.	Flow characteristics	
1.	Number of messages per week (A)	(5, 911)
2.	Number of messages filed (B)	2, 660
3.	Number of messages requiring action (C)	(3, 251)
4.	Number of messages fixed (D)	2, 560
5.	Number of messages serviced (E)	640
6.	Number of messages checked by supervisor (F = C + G)	(3, 428)
7.	Average message length	(1, 200)
II.	Derived characteristics	
8.	Proportion of messages filed (B/A)	0. 45
9.	Proportion of messages fixed (D/A)	(0. 43)
10.	Proportion of messages serviced (E/A)	(0. 11)
11.	Proportion of messages checked (F/A)	(0. 58)
12.	Proportion of messages requiring action (C/A)	0. 55

TABLE III-36

ACTIVITY TIMES FOR SERVICE CENTER
(Honolulu)

	(2) Standard activity designation	(3) Activity designation	(4) Required time	(5) Standard time (sec)
I. Message inspection activities				
Page copy received	a	d	3	3
Tear off and screen	(c)	c	20	20
Assign to service clerk	(e)	e_1	120	0
Total supervisor time				20
Total clerk time				0
Total time				23
II. File message activity				
File message	(e)	c_2	30	30
Total supervisor time				30
Total clerk time				0
Total time				30
III. Service clerk activity				
Fix message	h	g_1	210	210
Total supervisor time				0
Total clerk time				210
Total time				210
IV. Service clerk activity				
Draft service message	m	g_2	180	180
Total supervisor time				0
Total clerk time				180
Total time				180
V. Supervisor check activity				
Check message	i	h	60	60
Total supervisor time				60
Total clerk time				0
Total time				60
VI. Completion activity				
Action completed	(k)	h_1	30	30
Total supervisor time				30
Total clerk time				0
Total time				30

TABLE III-37

MANPOWER REQUIRED FOR SERVICE CENTER
(Honolulu)

I. Calculating average time per message

(1) Time factor	(2) Supervisor time	(3) Clerk time	(4) Total time	(5) Proportion designation	(5) Proportion value	(6) Average supervisor time (2) x (5)	(7) Average clerk time (3) x (5)	(8) Average total time (4) x (5)
(1) Message inspection	20	0	23	A/A	1.0	20	0	23
(2) File message	30	0	30	B/A	0.45	14	0	14
(3) Service clerk -- fix	0	210	210	D/A	(0.43)	0	90	90
(4) Service clerk -- draft	0	180	180	E/A	(0.11)	0	20	20
(5) Supervisor check	60	0	60	F/A	0.58	35	0	35
(6) Completion	30	0	30	C/A	0.55	17	0	17
(7) Average time per message						86	110	199
(8) Supervisor time ratio (col 6/col 8)						0.43		
(9) Clerk time ratio (col 7/col 8)							0.55	

II. Calculating man-hours required per year

	Supervisor	Clerk
(1) Total time (in seconds) required per message (col 6 and 7)	86	110
(2) Number of messages per year (supply, or A x 52.14)	308,200	308,200
(3) Operator time (in seconds) per year ((1) x (2))	26,505,200	33,902,000
(4) Convert time from seconds to hours ((3) / 3,600)	7,363	9,417

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF DATA BASE MAINTENANCE OPERATIONS

Figure A-22a illustrates the various activities (modified slightly) performed by the data base operator at Guam while making a daily change in the data base. A flow chart (figure A-22b) of Honolulu activities was provided by them. Unfortunately, no quantitative data was submitted by either Honolulu or any other site. Data describing the activities involved in making a data base update each day as submitted by Guam, however, and the analysis of that data is given here.

Derivation of Nontime Planning Factors

Figure A-23 illustrates, and table III-38 lists, the set of data submitted by the site and used to derive those planning factors that are unique to its environment and operation. The data shows that a total of A cards is received daily for the data base update. Honolulu reported it proofread 4, 200 update cards per week. The context implies these cards are for the update job covered in this section. Thus, Honolulu receives an average of 700 cards per day. Italy reported that its data base operator received 450 cards per day, and we assume that these cards are for the same update operation. Guam receives 500 cards per day; this total is used as a standard in calculating some of the computer times required. These times appear to be a function of the number of cards involved. Line 14 lists each site's deviation from this standard.

B of the cards (line 2) must be corrected by the operator each day before the required programs can be run. The proportion B/500 is listed in line 8.

Each day, the operator runs 3 programs -- the main program (UPDSORT, SFMR, SFTS, SFBU, and SFAS in series), SFRD, and FILELOD. Program SFAC is run on C days per year (line 4). Guam did not report the circumstances that determine whether SFAC is run.

Each program may also be rerun during the day because of errors. (Lines 4 through 7 list the number of times each program must be rerun each year.) The number of yearly program reruns are:

- D reruns per year for any part of the main program (line 4).
- E reruns per year for program SFAC (line 5).
- F reruns per year for program SFRD (line 6).
- G reruns per year for program FILELOD (line 7).

Lines 10 through 13 list the proportions D/365, E/365, F/365, and G/365, respectively. Before rerunning each program, the operator must make the necessary corrections as indicated by the diagnostic errors received. After all the programs are completed, the operator runs additional programs to list the required files, and files the update cards. This activity is also done once a day (365 times a year).

Figure A-24 is a flow diagram generalized enough to illustrate computer activities associated with each of the update programs. The program is loaded onto the computer by the operator and run for the first time. It may run the full time required, depending on whether there are errors in the program or data cards.

When the program run is finished, the operator must check the diagnostic printout to see whether the run was successful. If it was, he goes on to the next program. If not, the computer will have printed out a series of diagnostic statements pointing out the errors. The operator checks these statements to decide what must be corrected before the program will run successfully. This process is indicated by the node "check diagnostic errors." After the operator makes the necessary corrections, the program must be rerun. This series run is finally successful. Differences in the programs and the calculations of the times required for each of them are discussed elsewhere in this volume.

Derivation of Time Standards

Data describing each activity shown in figure A-22 is listed in table III-39. Since only Guam included time estimates for activities listed, its times are used as a guide until other data is obtained.

Description of Activities

Initial Processing Activities

These activities include those tasks involved in receiving and checking the day's update cards.

- Activity a_1. Load interpreter. The operator receives the update cards and places them in the card interpreter. Guam's activity a (interpret update cards) was converted into 2 activities to separate operator from computer times required.

- Activity a_2. Run interpreter. The interpreter reads each card and prints what has been read at the top of the card at a rate of 50 cards per minute. The average machine time required is a function of the average number of cards in a batch. We have assumed, as a baseline, Guam's average of 500 cards, resulting in a machine time of 600 seconds. The machine time for all other sites is calculated as a deviation from this baseline.

- Activity b. Separate cards. The operator separates the cards by the file that will be updated.

- Activity c. Check cards. The operator checks the cards against the local coding sheet to determine whether the cards are correct and whether any must be added or deleted. This time includes decision node d, which indicates the two possible paths (d_1 and d_2) that exist, depending on the operator's decision. If all cards are correct and no cards need to be added or deleted, path d_2 is followed to activity f. If corrections are needed d_1 is followed to activity e.

Program Processing Activities

These activities include all those tasks required to run the various programs used in the data base update.

- Activity f. Mount tapes. The operator mounts the 5 input and 4 output tapes required to update the data base. Estimated average operator time is 1 minute for each of the 9 tapes.

- Activity g_1. Load main program. The operator loads programs UPDSORT, SFMR, SFBU, SFTS, and SFAS. Estimated average operator time is 1 minute for each program. Again, Honolulu's activity g (load and execute programs) was divided into 2 activities to separate operator time from computer time.

- Activity g_2. Execute programs. Estimated average computer time for each program is:

UPDSORT:	5 minutes
SFMR:	15 minutes
SFBU:	7 minutes
SFTS:	12 minutes
SFAS:	2 minutes
Total:	41 minutes

The operator is assumed to be free to do other work during these 41 minutes. It is further assumed that the operator loads one program initially, starts it running, loads the second one while the first is still running, and loads each successive program while the previous one is running. Because these activities are done in parallel, and to keep the accounting method (table III-39) consistent with the method of summing activity times used in analyzing the other jobs (all activities being done in series in handling one input, none in parallel), we were forced to translate these parallel activities into two equivalent series activities:

- Total operator time for loading the 5 programs is 1 minute for each program for a total of 5 minutes. The total time is the sum of 1 minute for loading the first program plus 41 minutes for running all the 5 programs, or a total of 42 minutes. Thus, this combined operation may be reviewed as 2 activities in series:

  - An equivalent operator load program activity (g_1) of 5 minutes; this is done first.

  - Then an equivalent machine execute program (g_2); this is done second.

Since the total time is 42 minutes, and the two equivalent activities are in series, the time for g_2 is 37 minutes, as shown in table III-39.

- Activity h. Check diagnostic errors. After each program is completed, the operator checks the diagnostics for errors. This requires an average operator time of 1 minute for each program. This check, shown as decision node i, determines whether the computer run was successful (when path i_2 is followed), or whether the operator must correct the diagnostic errors and then rerun the program (when path i_2 is followed). The time for node i is included as part of the time for activity L. Table III-39 shows the time for successful execution of the five programs in activity g_2 (always the last run of the program). The additional time required for any unsuccessful executions is described elsewhere as part of the main program correction activities. When the programs are all run successfully, the operator determines whether SFAC must be run (depicted by decision node k, whose time is also included in the time for activity h). When SFAC must be run, path k_2 is followed to activity l_1; if not, k_1 is followed to activity p_1.

- Activity g. Check error diagnostics. The operator checks for errors as indicated by the diagnostics from the SFRD run. This time includes the time for decision node r. If the run was successful, the flow proceeds to activity t (path r_2); if not, it proceeds to activity s for program correction.

- Activity t. Place files on-line. The operator places updated data base files on-line. Since the operator is working for an average of 2 minutes, this is the activity requirement, even though the computer is only operating an average of 1 minute.

- Activity u. Load FILELOD program. The operator loads the FILELOD program to update the backup disk pack.

- Activity u_2. Execute FILELOD program. This includes the time for decision node v. If FILELOD was successful, path v_1 is followed to activity x_1; if not, path v_2 is followed to activity w.

SFAC Activities

If it is determined, in decision node k, that SFAC must be run, the activity goes to 1_1.

- Activity 1_1. Load SFAC program.

- Activity 1_2. Execute SFAC program. Activity 1_2 is 1 minute of computer (rather than operator) time. But if the operator cannot do other work during this short time, it should be charged to operator time.

- Activity m. Check diagnostic errors. The operator checks the diagnostics from the SFAC run. This time includes decision node n, which indicates which of the two possible paths (n_1 and n_2) are to be followed if diagnostic errors were received. If there is none, path n_2 is followed to activity p_1. If errors were received, return to step 1_1. Again, table III-39 shows the time for successful execution of the program for activity 1_2. The additional time required for unsuccessful runs of 1_2 are covered elsewhere.

List and File Activities

- Activity x_1. Load list programs. Guam's activity x consists of the operator's loading programs to list, on the medium-speed printer, SFAS, SFBU, SFMR, SFTS, SRAT 2, and SRAT 3 files. Since this work consists of operator and computer activities done in parallel, activity x was also converted into 2 equivalent series, activities x_1 and x_2.

- Total operator time required is 15 minutes (900 seconds).

- The initial part of this time is what is required to load the first program -- 15/6 = 2.5 minutes (150 seconds).

- This is followed by operator and computer activities, in which the computer is running 160 minutes (9,600 seconds); of this time, the operator works 12 minutes (720 seconds).

These activities thus can be represented by:

- x_1, an operator activity of 900 seconds.

- x_2, a computer activity, where the total time of x_1+x_2 is 9,600 + 150 = 9,750 seconds.

- Activity y. Decollate file listings. The operator decollates file listings. The files are listed on 3-part paper (3 copies and 2 carbons). The operator must separate the copies and remove the carbons.

- Activity z. File cards. The operator files update cards used to update the data base.

Program Correction Activities

The remainder of this section describes the various rework activities associated with unsuccessful computer runs.

Card-Correction Activity

- Activity e. Correct cards. If, in decision node d, the operator determines that some cards must be corrected (path d_1), he deletes, adds, or corrects the cards, as necessary, using the card-punch/interpreter to cut new cards.

Correct Program Activity

- Activity j. Correct main program diagnostics. If, in decision node i, the operator determines that the runs were not successful (path i_1), he must correct the diagnostic errors associated with any of the programs. He then returns to activity g_2 to rerun the program (assuming no additional loading is necessary).

- Activity g_2. Execute main programs (unsuccessful computer runs). The additional program execution time required because of an error in any of the five main programs involved in activity g_2 were calculated this way:

  - The program is rerun until it is finally run correctly (m diagnostic errors, which need the operator corrections indicated).

  - Since the last successful run has already been accounted for, the previous unsuccessful runs must be accounted for.

It is not clear whether the entire series of 5 programs must be rerun every time a correction to any of them is required. The time listed in table III-39 for activity g_2 (unsuccessful computer runs) should be the average computer time lost whenever a rerun of all or part of the set is required. For example, if all the programs must be rerun completely, the time would be 41 minutes. This is the time used in table III-39 for illustration only. However, the time for an unsuccessful run could be shorter (that is, the programs could compile, but do not run), or that only the subprogram receiving the diagnostic must be rerun.

In either case, the average time for unsuccessful runs (g_2) should be corrected. This time for an unsuccessful run is then multiplied by the total number of unsuccessful runs, D/365, to obtain the total time required per day for unsuccessful computer runs, as shown in the man-hour calculations of table III-40.

- Activity o. Correct SFAC diagnostics. If, in decision node n, the operator determines that the SFAC run was not successful, he follows the path n_1 to activity o and corrects diagnostic errors from the SFAC run, then returns to activity l_2 for the activity l_1 computer rerun (unsuccessful runs). Again, the time used in table III-39 for l_2 was the total time required to run program SFAC successfully. But this time should be revised if unsuccessful running time differs from successful running time.

- Activity s. Correct programs. If, in decision node r, the operator determines that the SFRD run was not successful, path r_1 is followed to activity s. Guam's activity sequence at this point becomes unclear. When the SFRD run is not successful, that station indicates that it checks to see whether corrections to SFAC are required. If not, the work returns to activity j, which, in turn, returns to activity g (which reruns the main program). Since we did not understand the relationship of SFRD to SFAC and the main program, we generalized decision node r to "is program correction required?"

For SFRD to run successfully, all necessary corrections must be made to SFRD itself, SFAC, or the main program. The time for the corrections listed as activity s (table III-39) the main program -- for SFRD to run successfully. The time for activity p_2 (unsuccessful computer run) should be the average computer time lost whenever SFRD does not run successfully. The time we have used for p_2 in the table is simply the time to completely rerun SFRD. The actual time, which should be supplied by the sites, could be quite different, particularly if, for example, the 41-minute main program must be rerun.

- Activity w. Correct FILELOD. If in decision node v, the operator determines that FILELOD was not successful, path s_2 must be followed to activity w. The operator corrects the problem and returns to activity u_2.

- Activity u_2. Execute FILELOD (unsuccessful runs).

Calculating Working Man-hours Required

Table III-40 shows the calculations for the working man-hours per year required by a hypothetical site, using Guam's activity times. The nontime planning factors are illustrative, since Guam did not supply this data. The calculation is described in an earlier section. The t 0.3 deviation from the 500-card standard applies to the times for activities a_2, b, and c.

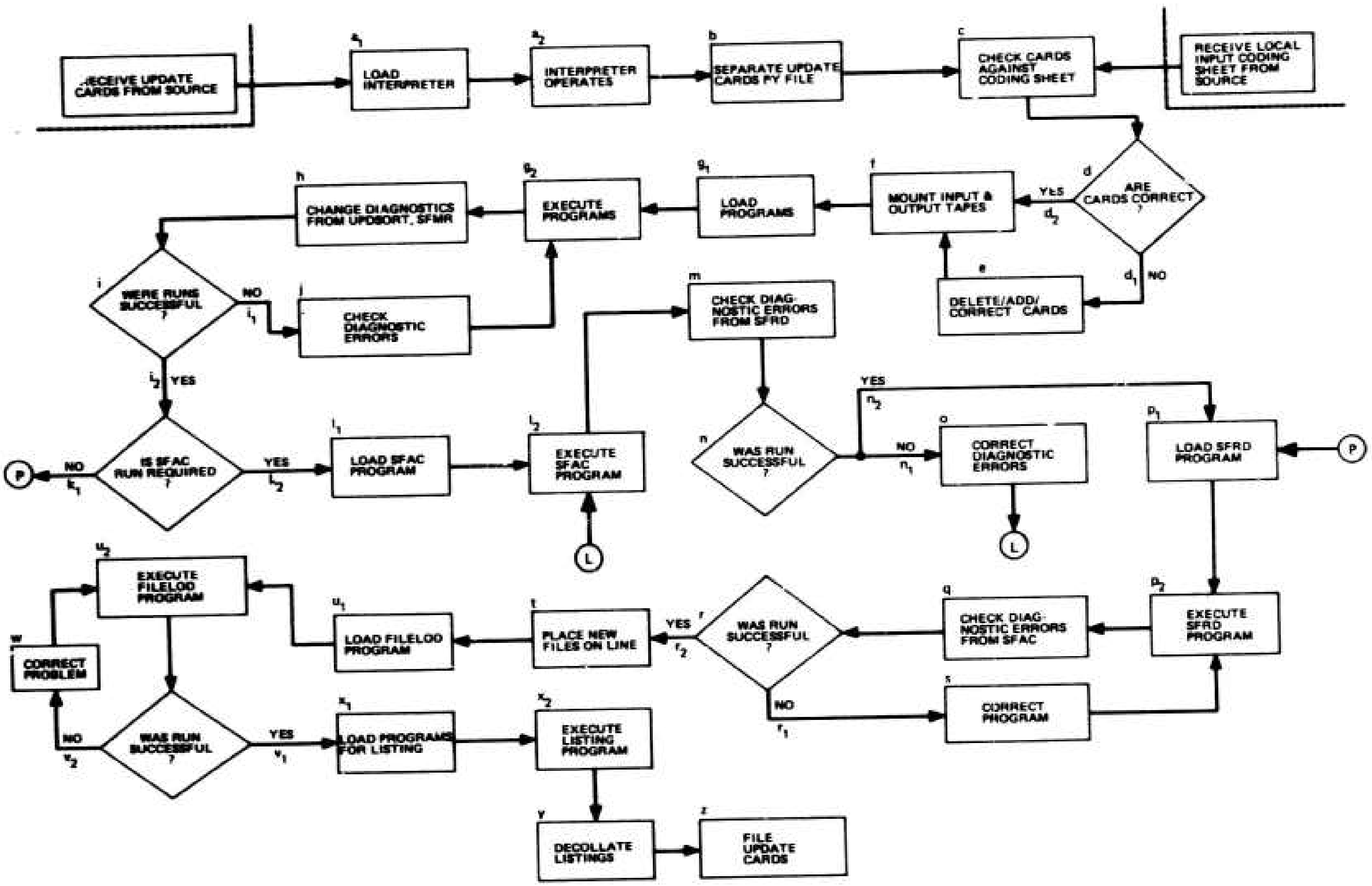

FIG. A-22a: SEQUENCE OF ACTIVITIES TO COMPLETE ONE DATA BASE UPDATE OPERATION AT GUAM

CSRF SECTION

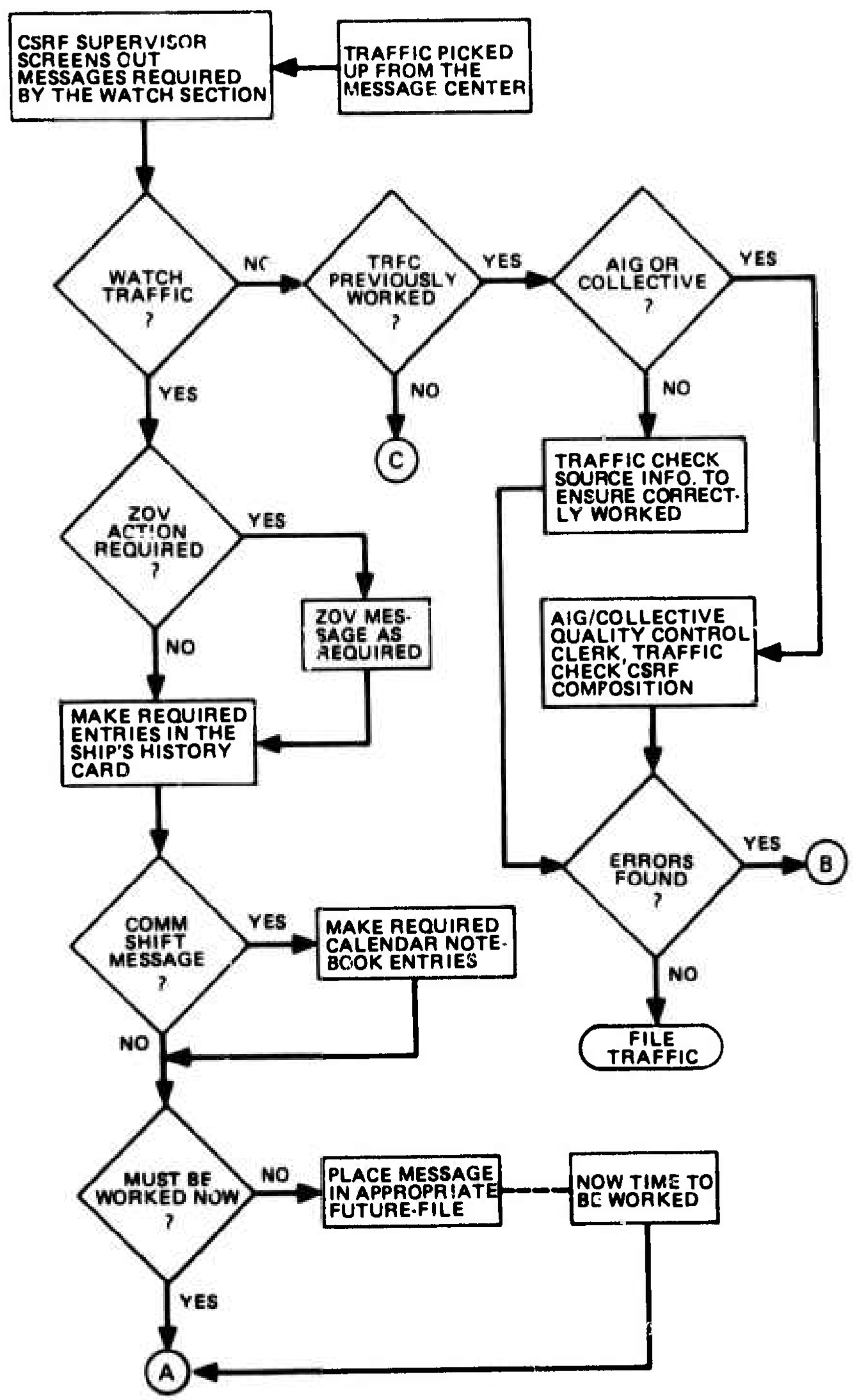

FIG. A-22b: SEQUENCE OF ACTIVITIES TO COMPLETE ONE DATA BASE UPDATE OPERATION AT HONOLULU

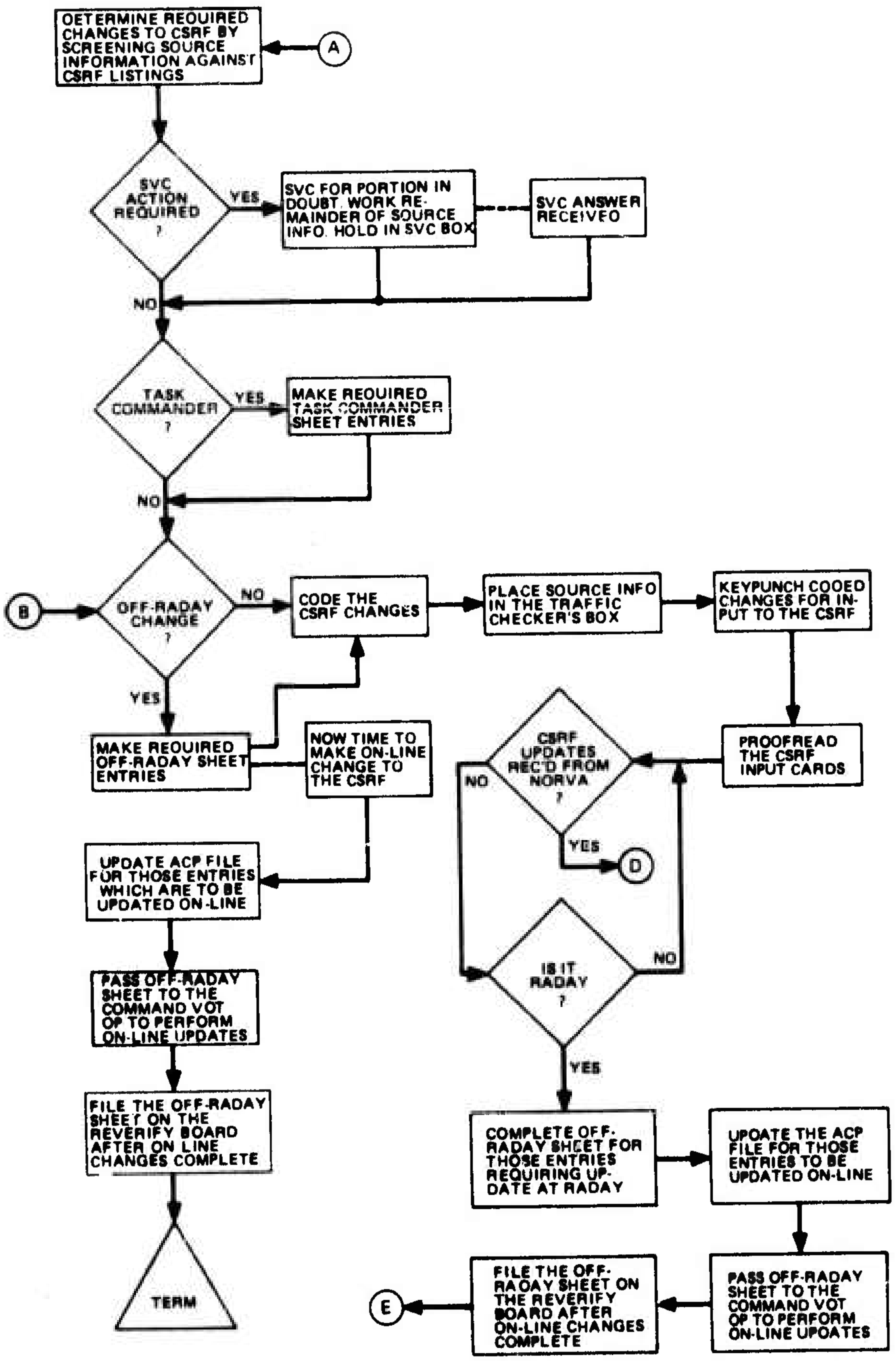

FIG. A-22b: (Continued)

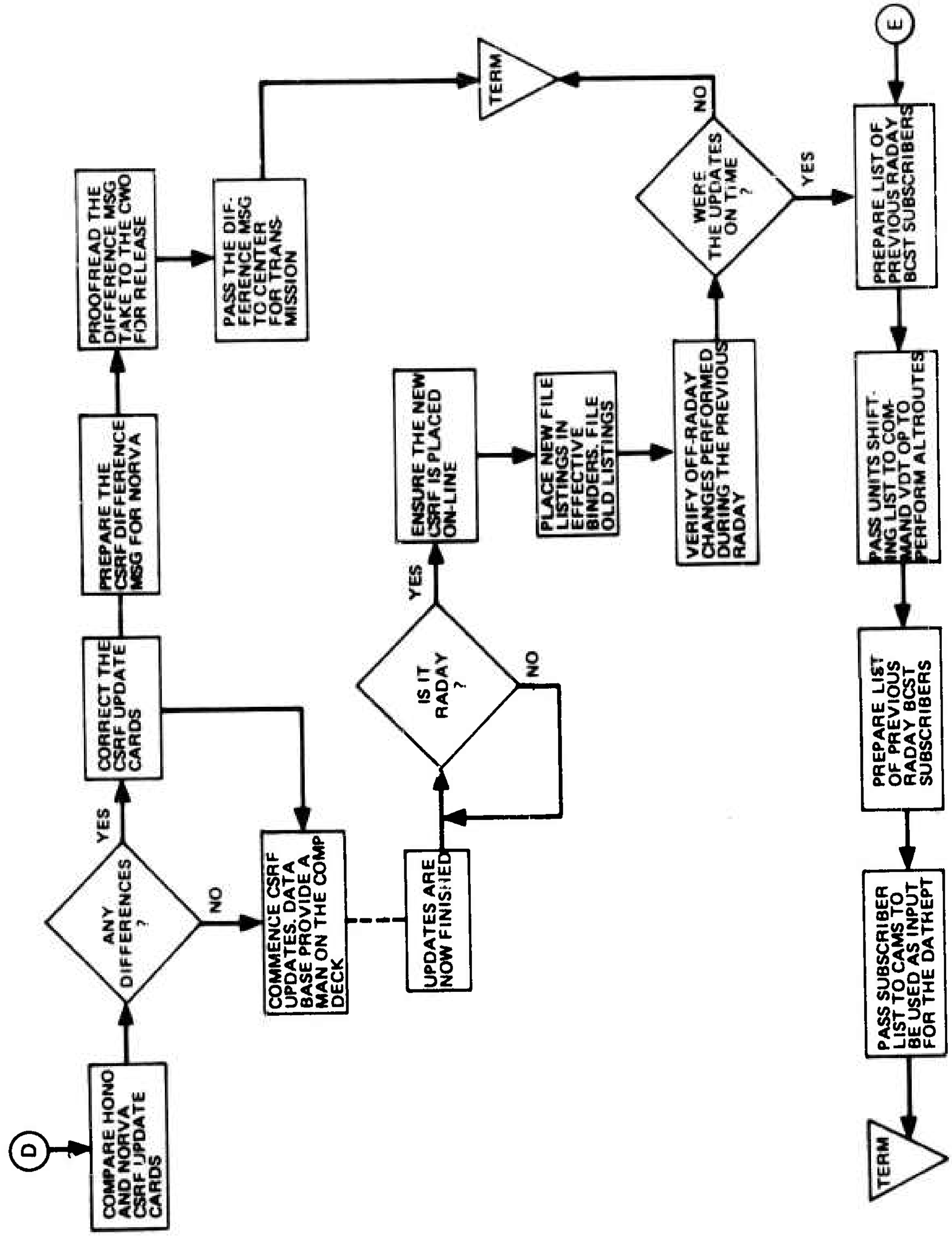

FIG. A-22b: (Continued)

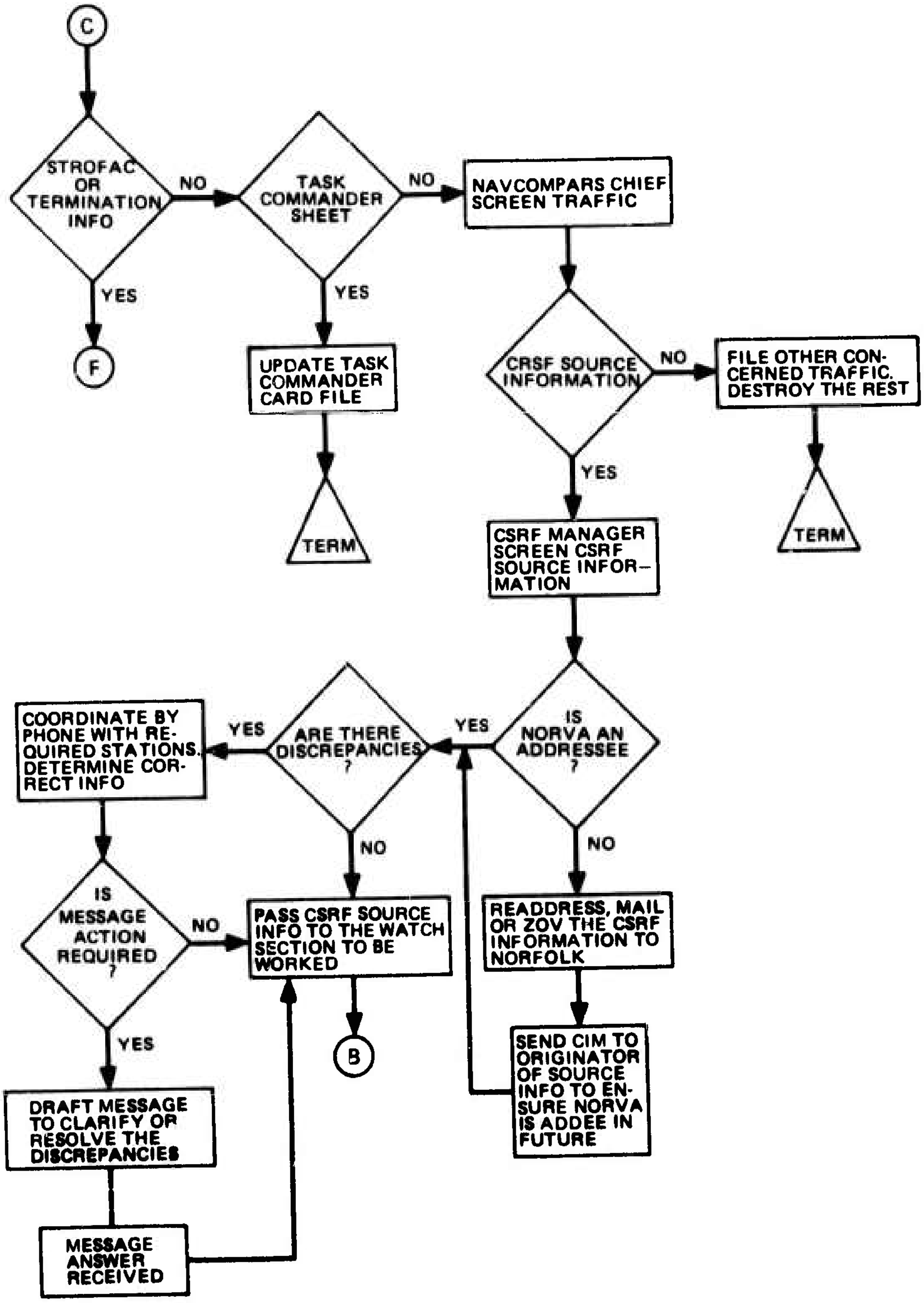

FIG. A-22b: (Continued)

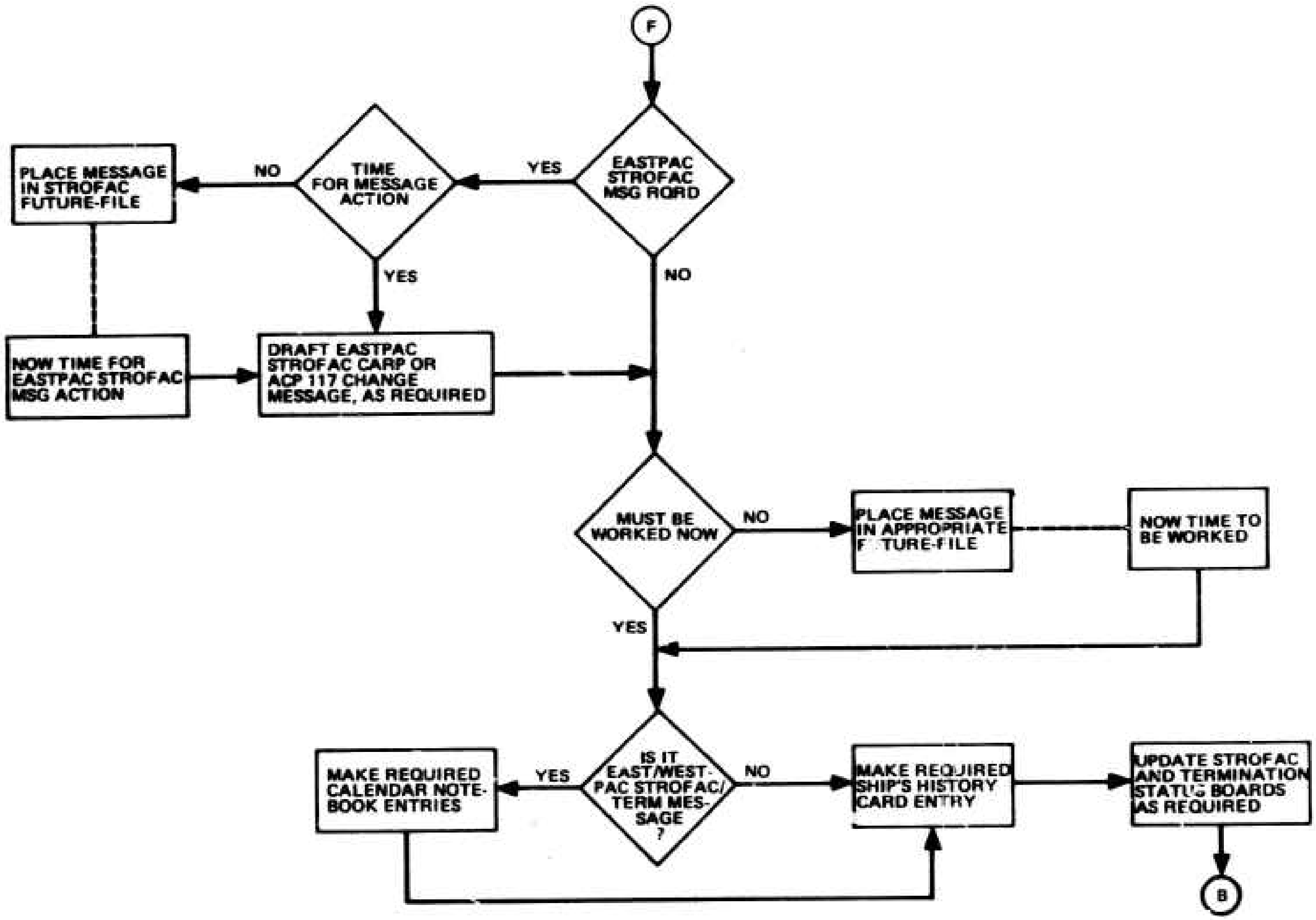

FIG. A-22b: (Continued)

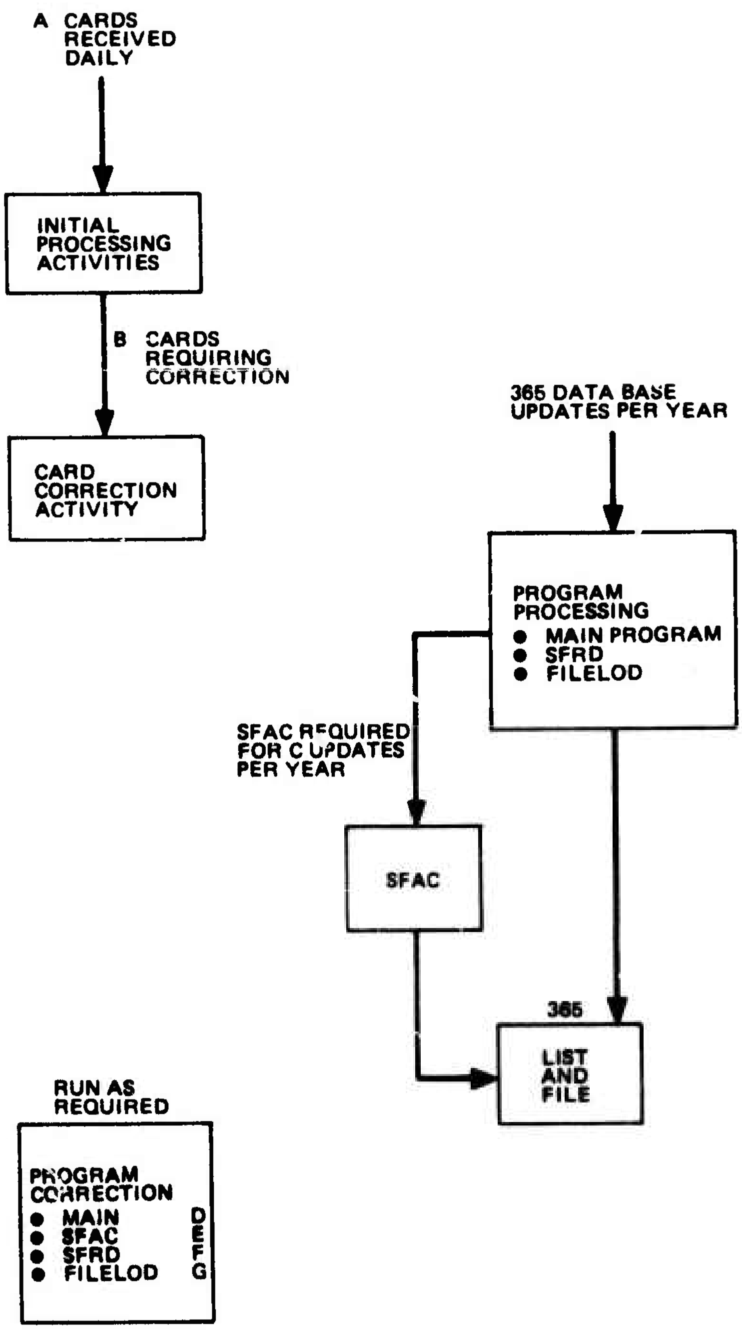

FIG. A-23: WORK FUNCTIONS ASSOCIATED WITH DATA BASE UPDATE

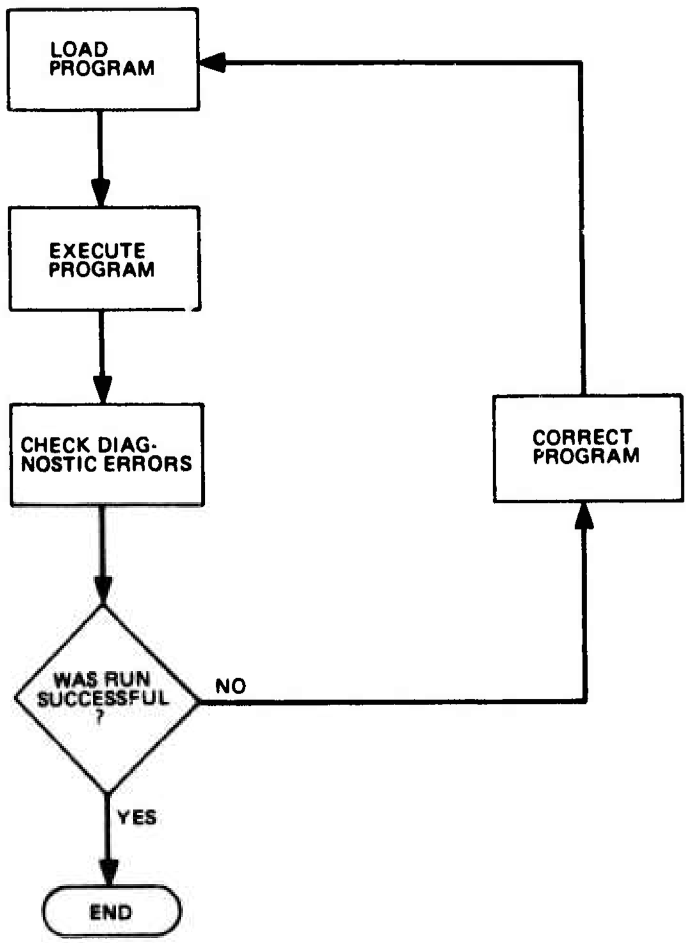

FIG. A-24: WORK ASSOCIATED WITH PROCESSING AND CORRECTING A PROGRAM

TABLE III-38

NONTIME PLANNING FACTORS FOR DATA BASE OPERATION

	Guam	Honolulu	Italy	Illustration
I. Flow characteristics submitted by sites				
(1) Number of cards received per day for updates (A)	500	700	450	650
(2) Number of cards requiring correction per day (B)				40
(3) Number of times SFAC is required per year (C)				200
(4) Number of times main program is corrected per year (D)				45
(5) Number of times SFAC is corrected per year (E)				50
(6) Number of times SFRD is corrected per year (F)				100
(7) Number of times FILELOD is corrected per year (G)				75
II. Derived characteristics				
(8) Proportion of cards corrected per day (B/500)				0.08
(9) Proportion of times SFAC is run per day (C/365)				0.55
(10) Proportion of times main program is rerun per day (D/365)				0.12
(11) Proportion of times SFAC is rerun per day (E/365)				0.14
(12) Proportion of times SFRD is rerun per day (F/365)				0.27
(13) Proportion of times FILELOD is rerun per day (6/365)				0.21
(14) Derivation of number of cards per day from 500 ((A-500)/500)				+.3

TABLE III-39

ACTIVITY TIMES FOR DATA BASE UPDATE OPERATION

(1) Activity	(2) Standard activity designation	(3) Guam: Activity designation	(4) Guam: Required time (sec)	(5) Standardized time (sec)
I. Initial processing				
Load interpreter	$\underline{a}_1$	a	60	60
Run interpreter	a_2	a	600	600
Separate cards	$\underline{b}$	b	120	120
Check cards	$\underline{c}$	c	1,800	1,800
Mount tapes	$\underline{f}$	f	540	540
Total operator time				2,520
Total time				3,120
II. Program processing				
Load main programs	$\underline{g}_1$	g	5 min	300
Execute programs successfully	g_2	g	41 min	2,200
Check diagnostic errors	$\underline{h}$	h	5 min	300
Load SFRD	$\underline{p}_1$	p	5 min	300
Execute SFRD	p_2	p	115 min	6,900
Check diagnostics	$\underline{q}$	q	1 min	60
Load FILELOD	$\underline{u}_1$	u	1 min	60
Execute FILELOD	u_2	u	12 min	720
Total operator time				1,020
Total time				10,860

TABLE III-39 (contd)

(1) Activity	(2) Standard activity designation	(3) Guam Activity designation	(4) Guam Required time (sec)	(5) Standardized time (sec)
III. SFAC				
Load SFAC	$\underline{l}_1$	l	1 min	60
Execute SFAC successfully	$\underline{l}_2$	l	1 min	60
Check diagnostic errors	$\underline{m}$	m	1 min	60
Total operator time				120
Total time				180
IV. List and file				
Load list programs	$\underline{x}_1$	z	15 min	900
Execute list programs	$\underline{x}_2$	x	160 min	8,790
Decollate file listings	$\underline{y}$	y	3 hr.	10,800
File cards	$\underline{z}$	z	3 min	120
Total operator time				11,820
Total time				20,610
V. Card correction				
Correct cards	$\underline{e}$	e	5 min	300
Total operator time				300
Total time				300

TABLE III-39 (contd)

(1) Activity	(2) Standard activity designation	(3) Activity designation	(4) Guam Required time (sec)	(5) Standardized time (sec)
VI. Program correction				
Correct main program	$\underline{j}$	j	30 min	1,800
Execute program (unsuccessful run)	g_2	g_2	40 min	2,220
Total operator time				1,800
Total time				4,020
Correct SFAC diagnostic errors	$\underline{o}$	o	3 min	180
Execute program (unsuccessful run)	l_2	l	1 min	60
Total operator time				180
Total time				240
Correct programs (from SFRD run)	s	--	--	--
Execute program (unsuccessful run)	p_2	p	115 min	6,900
Total operator time				--
Total time				6,900
Correct FILELOD diagnostic errors	$\underline{w}$	w	3 min	180
Execute FILELOD (unsuccessful run)	u_2	u	12 min	720
Total operator time				180
Total time				900

TABLE III-40

EXAMPLE OF MANPOWER REQUIRED FOR DATA BASE UPDATE

I. Calculating average time per day

(1) Time factors	(2) Operator time	(3) Total time	(4) Proportion designation	(4) Proportion value	(5) Average operator time (sec) (2) x (4)	(6) Average total time (3) x (4)
(1) Initial processing	2,520	3,120	A/A	1.0	2,520	3,120
Deviation from 500 cards per day (+0.3)	+576	+756	A/A	1.0	576	756
(2) Program processing	1,020	10,860	365/365	1.0	1,020	10,860
(3) SFAC	120	180	C/365	0.55	66	99
(4) List and file	11,820	20,610	365/365	1.0	11,820	20,610
(5) Card correction	300	300	B/500	0.08	24	24
(6) Program correction						
Correct main program	1,800	4,020	D/365	0.12	216	482
Correct SFAC	180	240	E/365	0.14	25	34
Correct SFRD	180[a]	7,080[a]	F/365	0.27	49	1,912
Correct FILELOD	180	900	G/365	0.21	38	189
(7) Total average time per day					16,354	38,086
(8) Operator time ratio ((5)/(6))					0.43	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) required per day (col 5)	16,354
(2) Operator time (in seconds) per year ((1) x 365)	5,969,210
(3) Convert time from seconds to hours ((2)/3,600)	1,658

[a]Illustrative in number; no data submitted by sites.

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF ROUTER VDT OPERATOR JOB

This operator processes all messages rejected by the system because of format or routing errors. Only Guam submitted data relating to the flow diagram and activity times, but did not include data relating to message loads. Italy reported that it takes an average of 10 seconds per message to make each correction, 40 to 50 (out of 100) require more than one correction. While this job is part of the message center--and thus outside the scope of this analysis--the data submitted was analyzed for future use. Figure A-25 is the operational flow diagram of the activities involved in processing a message by the router.

Derivation of Nontime Planning Factors

As figure A-26 shows, and table III-41 lists, a total of A messages per week (line 1) is rejected by the NavComPARs system and sent to the router for correction. He inspects all these messages and finds that:

- B messages (line 2) require new routing designations, which is done by the router.
- C messages (line 3) require format correction, which can be done by the router.
- D messages (line 4) require format correction that cannot be done by the router but through the service center.
- The proportions B/A, C/A, and D/A are listed in lines 5, 6, and 7. (Since a message may require routing as well as format correction, B + C + D may be greater than A, and the sum of the 3 proportions may be greater than unity.)

Derivation of Time Standards

Data describing each activity shown in figure A-25 is listed in table III-42. Since only Guam submitted data for this job, its activity times are used as interim standards.

Description of Activities

Message Inspection Activity

- Activity a. Display message. The computer displays the message on the router VDT screen.

• Activity b. Scan message. The router scans the message to determine why the message was rejected by the system and what type of action is required, as indicated in decision node c. Was the message rejected because it did not contain a valid routing indicator corresponding to the address? If so, the message goes to activity d. Was the message rejected because of format errors? If so, it goes to decision node e to determine whether the router can correct message format. If correctable, the message goes to activity f; if not the message is sent to activity g. The times for decision nodes C and E are included in the total time for activity b.

Message Routing Activity

• Activity d. Message routing. For all messages requiring routing, the operator locates the correct routing indicator, uses the VDT to insert the routing, and reenters the message into the NavComPARs system.

Message Correction Activity

• Activity f. Correct format lines. The operator uses the VDT to correct format lines on all those messages he is capable of correcting, then returns the messages to NavComPARs.

Message Rejection Activity

• Activity g. Reject message to service. If the message cannot be corrected by the router, the operator rejects the message to the service printer for corrective action.

Calculating Working Man-Hours Required

Table III-43 shows calculations for the working man-hours per year required for a hypothetical site, using illustrative data (since no site submitted its data).

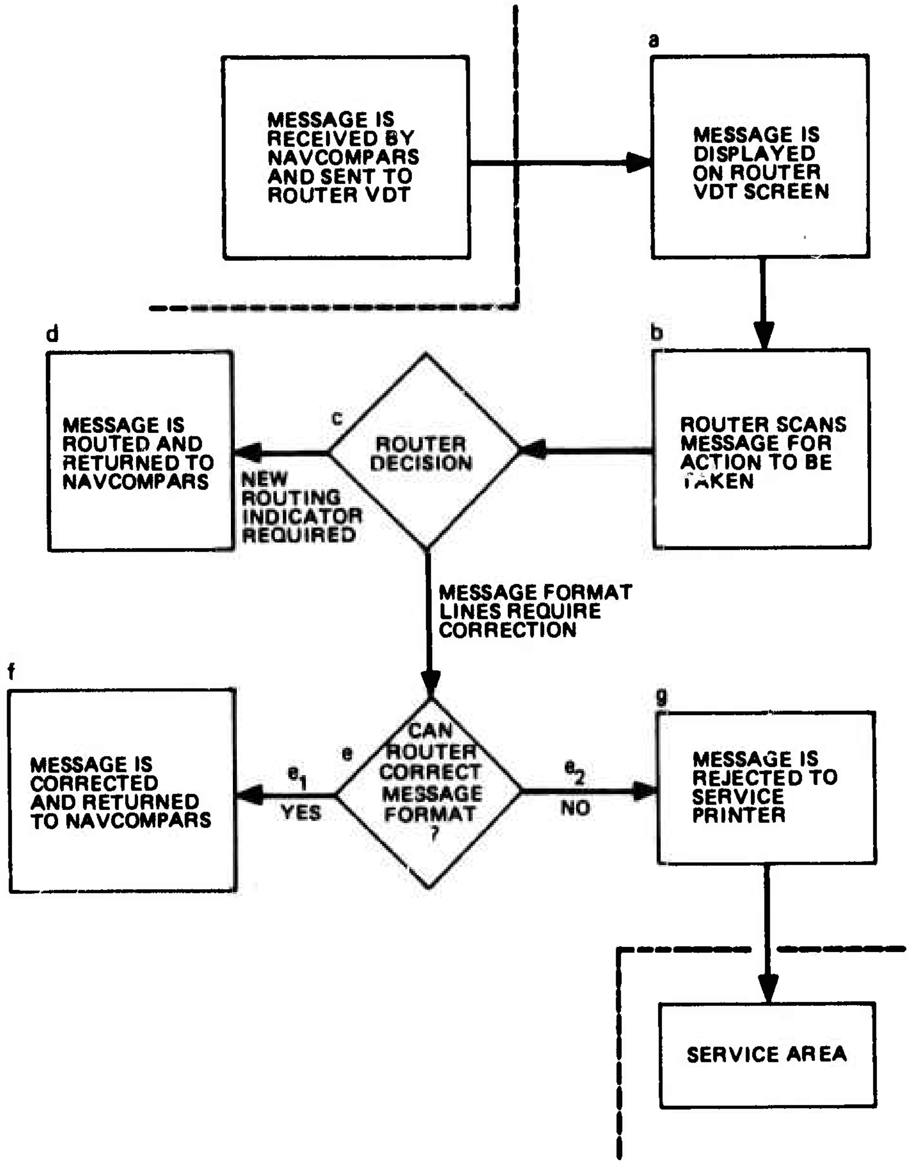

FIG. A-25: ACTIVITIES INVOLVED IN COMPLETING A ROUTER VDT MESSAGE OPERATION

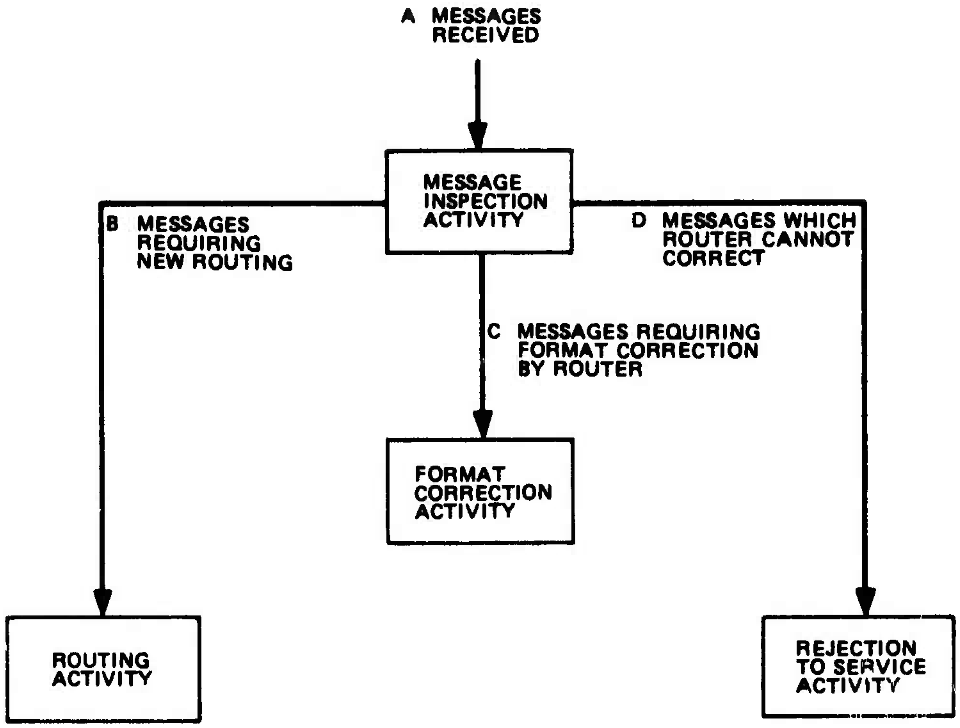

FIG. A-26: WORK FUNCTIONS ASSOCIATED WITH ROUTER JOB

TABLE III-41

NONTIME PLANNING FACTORS FOR ROUTER VDT[a]

	Italy	Illustration
I. Flow characteristics submitted by sites		
1. Number of messages received by router per week (A)	822	1,000
2. Number of messages requiring routing by router (B)		600
3. Number of messages requiring format correction by router (C)		300
4. Number of messages requiring correction by service center (D)		100
II. Derived characteristics		
5. Proportion of messages requiring routing by router (B/A)		0.6
6. Proportion of messages requiring format correction by router (C/A)		0.3
7. Proportion of messages requiring format correction by service center (D/A)		0.1

[a]Italy submitted data (as shown). Illustrative calculation can be made in table III-43.

TABLE III-42

ACTIVITY TIMES FOR ROUTER VDT

(1) Activity	(2) Standard activity designation	(3) Activity designation	Guam (4) Required time (sec)	(5) Standardized time (sec)	(6) Standard time (sec)
I. Message inspection					
Display message on VDT screen	a	a	"Instantly"	0	0
Scan message	b	b	23	23	23
Total operator time				23	23
Total time				23	23
II. Routing					
Locate routing indicator	d	d	72	72	72
Total operator time				72	72
Total time				72	72
III. Correction					
Correct message	f	f	21	21	21
Total operator time				21	21
Total time				21	21
IV. Rejection					
Reject message to service	g	g	2	2	2
Total operator time				2	2
Total time				2	2

TABLE III-43

MAN-HOURS REQUIRED FOR ROUTER VD_1
(Example)

I. Calculating average time per message

(1) Time factors	(2) Operator time	(3) Total time	(4) Proportion designation	(4) Proportion value	(5) Average operator time	(6) Average total time
(1) Message inspection	23	23	A/A	1.0	23	23
(2) Routing	72	72	B/A	0.6	43.2	43.2
(3) Router format correction	21	21	C/A	0.3	6.3	6.3
(4) Rejection to service	2	2	D/A	0.1	0.2	0.2
(5) Average time required per message					72.7	72.7
(6) Operator time ratio (col 5/col 6)					1.0	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) required per message (col. 5)	72.7
(2) Number of messages per year (supply)	(52,000)
(3) Operator time (in seconds) ((1) x (2))	3,780,400
(4) Convert time from seconds to hours ((3) / 3600)	1,050

OPERATIONAL MANPOWER REQUIREMENTS:
ANALYSIS OF INROUTER VDT OPERATOR JOB

This operator ensures proper local delivery of all message traffic. While this job is part of the message center --and thus outside the scope of this analysis -- Guam submitted the data presented here; that data was analyzed for future use. Figure A-27 is the operational flow diagram of the activities involved in message processing by the inrouter.

Derivation of Nontime Planning Factors

As figure A-28 shows, and table III-44 lists, there are three functional sets of activities relating to this job. All of the A messages received (line 1) are scanned for acceptability. Of these, B (line 2) are found acceptable and passed through the routing activities. The ratio B/A is listed in line 4. All of the C messages (C = A - B) that are unacceptable (line 3) are rejected to the service center for further action. The proportion of unacceptable messages (C/A) is listed in line 5. Since Guam included no data that can be used in table III-44, sample numbers are inserted for illustration, and used to calculate man-hours (table III-46).

Derivations of Time Standards

Data describing each activity shown in figure A-28 is listed in table III-45. Since only Guam submitted data for this job, its times are used as interim standards.

Description of Activities

Receive and Scan Activities

- Activity a. Receive message. The VDT, in inrouter mode, receives the message from the computer.

- Activity b. Scan message. The operator scans the message to determine whether it is acceptable or whether it requires service action. This activity time includes that of decision node c, which enables the operator to separate the acceptable and unacceptable messages. If the message is acceptable, it is sent to activity ; if not, it goes to activity d.

Routing Activities

- Activity e. Research-handling techniques. The operator researches the proper handling techniques, based on the information contained in the message subject line. The estimated operator time (85 to 180 seconds) depends on the message. The mean time of 132.5 seconds is used in table III-45.

- Activity f. Route message. The operator uses the VDT to apply proper routing to the message.

- Activity g. Transmit message. The operator transmits the message with the correct information to NavComPARs using the VDT. Estimated operator time of 2 seconds includes the machine time considered "instant."

Rejection Activity

- Activity d. Reject message to service. When the message is unacceptable at decision node c, it proceeds to activity d, where the operator rejects message to the service center for necessary action.

Calculating Working Man-Hours Required

Table III-46 shows the calculations for working man-hours per year required. This calculation, which is described in an earlier section uses Guam's data for activity times and illustrative data for site-oriented planning factors as shown in table III-45.

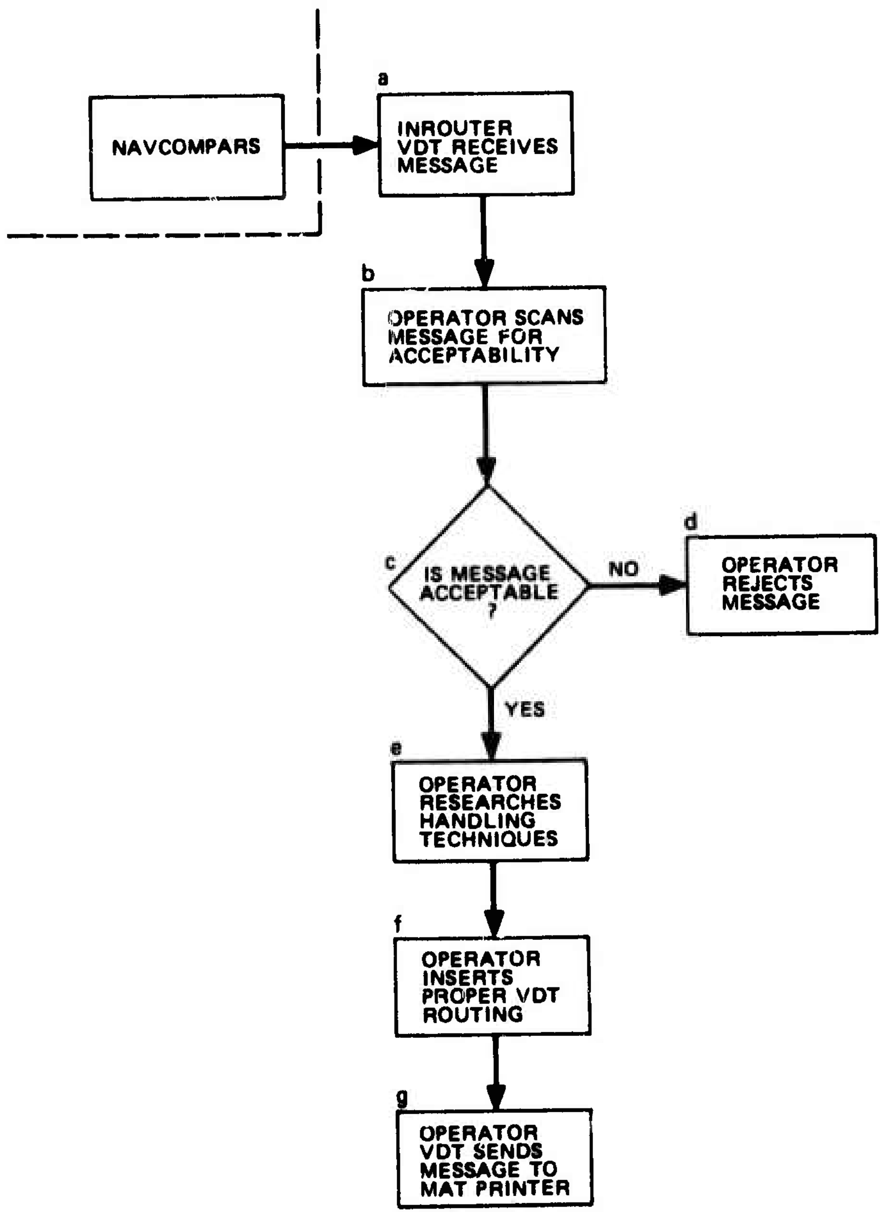

FIG. A-27: SEQUENCE OF ACTIVITIES TO COMPLETE ONE WORK UNIT OF INROUTER MODE VDT JOB

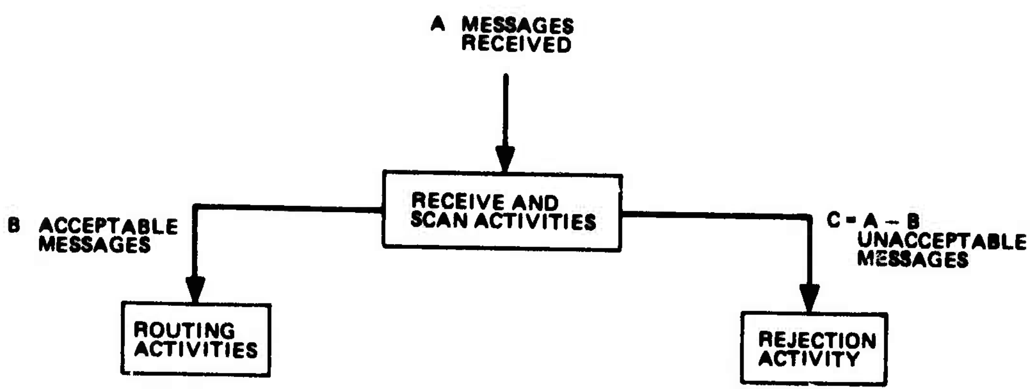

FIG. A-28: WORK FUNCTIONS ASSOCIATED WITH INROUTER VDT JOB

TABLE III-44

NONTIME PLANNING FACTORS FOR INROUTER VDT

	Italy	Illustration
I. Flow characteristics submitted by sites		
(1) Number of messages received per week (A)	63	200
(2) Number of acceptable messages (B)	--	180
(3) Number of messages rejected as unacceptable (C) (C=A-B)	--	20
II. Derived characteristics		
(4) Proportion of acceptable messages (B/A)	--	0.90
(5) Proportion of rejected messages (C/A)	--	0.10

TABLE III-45

ACTIVITY TIMES FOR INROUTER VDT

(1) Activity	(2) Standard activity designation	Activity designation	Required time (sec)	Quasi Standardized time (sec)	Standard time (sec)
I. Receive and scan					
VDT message received	a	a	"Instantly"	0	0
Scan message	b	b	7	7	7
Total operator time				7	7
Total time				7	7
II. Routing					
Research-handling techniques	e	e	85-180	132	132
Insert proper VDT routing	f	f	23	23	23
Transmit message to NavComPARs	g	g	2	2	2
Total operator time				157	157
Total time				157	157
III. Rejection					
Reject message to service	d	d	2	2	2
Total operator time				2	2
Total time				2	2

TABLE III-46

MANPOWER REQUIRED FOR INROUTER VDT

I. Calculating average times per message

(1) Time factors	(2) Operator time	(3) Total time	(4) Proportions designation	(4) Proportions value	(5) Average operator time (2) x (4)	(6) Average total time (3) x (4)
(1) Receive and scan	7	7	A/A	1.0	7	7
(2) Routing	157	157	B/A	0.90	141	141
(3) Rejection	2	21	C/A	0.10	0.2	0.2
(4) Average time required per message					148.2	148.2
(5) Operator time ratio (col 5/col 6)					1.0	

II. Calculating working man-hours required per year

(1) Total operator time (in seconds) per year (col 5)	148.2
(2) Number of messages per year (supply)	10,400
(3) Operator time (in seconds) per year ((1) x (2))	1,541,280
(4) Convert time from seconds to hours ((3)/3,600)	428

TABLE IV-1a

CORRELATION OF ACTIVITY TIMES FOR DIFFERENT JOBS

Activity	FPT receive		Data speed reader		Primary ship/shore		FPT send		CW broadcast		PG broadcast		NATO receive		NATO send	
	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time	Std. activity designation	Mean time
Punch tape and print copy	a	144			a	144	a	144	a	144	a	144	a	144	a	144
Tear message off machine	b	3			b	5	b	4	b	3	c	3	b	5	b	9
Inspect message	c	12	a	4	c	22							c	8	c	5
Receipt for message	e	26			e	48										
Log-in message	g	8			i	60	c	12	g	16	b	14	g	10	f	5
Carry message	h	12	i	12	H	25							h	—		
Request retransmission	j	27			C_1	20										
Place or correct message	k	174	k	42	L, 4	186, 30									v,t	10
Dispose of old messages	m	17			m	20										
Place tape on machine			d	4	L	22	d	8	e	6	e	9[a]	j	5	g	5
Transmit message (DSR)			e	17												
Transmit message					M	144	e	144	f	640	f_1	144	k	144	h	144
Check channel log			f	5	N	30										
Log-in FBN and file message			h	12												
Make master tape											d	192				
Add header			l	5	h_1	175					z	15[a]				
Remove tape and page copy					P	30										
Place TOD on original message					Q	12										
Initial call from ship					A	24										
Assign turn to ship					C_1	25										
Place frequency on page copy					f	—										
Prepare tape					G	28										
Place message in basket					J	5										
File message					S	8			h	9					i,o	–, 5
Convert to CW format									c	143						
Schedule for transmission									d	15						
Teletype for response							f	47								
Log-out message					R	10	h	3					i	10		
Check monitor							i	0								
Set up CW keyer									a_1	92						
Draft service message											l	180	L	180	l	180
Review service message													m	20	(m)	10
Place on terminal													O	—		
Send service message													p	37	p	20
Rephase broadcast											f_1, g_2	60, 20				
Retransmit broadcast											g_1	144				
Tear off and file											h	33				
Request for retransmission received											j	90				
Look up message											k	60				
Send requested message and service											m	144+ 144(D/E)[b]				

[a]These transmission activities are done only once per broadcast. The other transmission activities are done for each message.
[b]This time is actually 144 + 144(D/E) for each message serviced.

TABLE IV-1b

OPERATIONAL USAGE AND CURRENT COR FOR DIFFERENT JOBS

(1) Functions	Current cor (no. circuits) (2) Guam	(3) Norfolk	(4) Honolulu	(5) Italy	Average circuit – days (6) Guam	(7) Norfolk	(8) Honolulu	(9) Italy	Average no. circuits (10) Guam	(11) Norfolk	(12) Honolulu	(13) Italy	Peak circuit – days (14) Guam	(15) Norfolk	(16) Honolulu	(17) Italy[b]	Peak circuits (18) Guam	(19) Norfolk	(20) Honolulu	(21) Italy[b]	Recommended manning No. circuits man/watch (22) Guam	(23) Norfolk[b]	(24) Honolulu	(25) Italy
Ship/shore																								
Secondary	3	1	0	0		75				0.2														
Primary	5	8	4	1		2,920		365		8.0		1.0												present
Single channel	6	5	3	3	2,340	1,825	831	730	6.4	5.0	2.3	2.0	300	11	98		10	1	3.5				2	manning
Multichannel	27	30	28	6	13,580	1,095	606	1,825	37.2	3.0	1.7	5.0	1,710	11	106		54	1	3.8		} 7		1	listed in
Dedicated circuits	0	3	6	8	780	2,920	2,920	1,520	2.2	8.0	8.0	4.2	256	2,920	2,920		12	8	8.0				1	Table I-1
Broadcasts																								
Multichannel	6	6	6	7	2,808	2,190	2,190	438	7.7	8.0	8.0	1.2	434	2,190	2,190		14	8	8				1	
Single channel	1	1	1	1	98	365	112	365	0.3	1.0	0.3	1.0	18	365	18		4	1	1				1	
Submarine	1	0	1	0	365	365[a]	365		1.0	1.0[a]	1.0		31		365		1		1		1		1	
TACAMO	1	0	1	0	340		0		0.9		0		31		0		1		0				0	
CMP	1	1	1	0	365	365	365		1.0	1.0	1.0		31	365	365		1	1	1				1	
Allied/NATO/SEATO	1	1	1	0	365	116	22		1.0	0.3	0.1		31	9	15		1	1	1				1	
Watchstanders																								
Supervisor		4																					5	
Command VDT operator		4																			1		1	
Orderwire operator/		4																			1		1	
file clerk																					2		3	
Data speed reader		4																						
operator																					1			
GCMP/torn-tape operator																					1			
GSPG/GMUL quality																								
control operator																					1			
GABN operator																					1			
Fleet center supervisor																					1			
Service supervisor																					4			
Service operator																					1			
Router VTD operator																					1			
Communications																								
equipment operator																					1			
Computer operator																					1			
Fleet operator																					1			
Data base operator																					1			
Continuous trainee																								
Dayworkers																								
Data COMM processing officer		1																						
Fleet center chief		1																						
Fleet center traffic checker		1																						

[a]PG broadcast, used 7.5 hours per day for 365 days

[b]No data

The average circuit days for multichannel broadcasts for Italy (column 9) were reported for a 2½-month period only, since NCS Italy assumed keying of KMUL BCST during October 1975. These have been adjusted to a year.

The peak circuit period for Guam (column 14) was during the communications test Phase IV, which occurred in the month of June.

The peak circuit periods for Norfolk (column 15) were two exercise periods. The 11-day period for single channel/multichannel terminations was 27 May-6 June 1974 for Exercise Solid Shield. The 9-day period for NATO broadcast was 4-13 March 1974 for NATO Exercise Safe Pass. Dedicated circuits, single channel/multichannel broadcasts, and CMP broadcasts are always operating at a peak circuit period since they operate continuously.

The number of days in the peak circuit period for Honolulu (column 16) was not defined. Therefore, the data in column 20 is as reported by Honolulu. Dedicated circuits, multichannel, submarine, and CMP broadcasts appear to operate continuously.

In column 24 for Honolulu, the multichannel, single channel, and submarine broadcast duties are carried out by the Command VDT Operator. The XRTT BCST for the Allied/NATO/SEATO Broadcast is activated for support of allied units during major exercises. The supervisors include: COW (4), Ship/Shore supervisor (4), Data Base supervisor (4), and Computer Center supervisor (4). The Orderwire Operator is really a Fleet Center supervisor. The duties of the data speed reader operator are carried out by the FPT operator.

The data for Norfolk includes Sugar Grove data where two numbers appear in a box. The first number is as reported by Norfolk and the second by Sugar Grove.

To obtain the recommended manning for Italy, see Table I-1.

TABLE IV-2

ADDITIONAL OPERATIONAL ACTIVITIES REQUIRED
(percent time)

Operator position/job	Honolulu	Guam	Norfolk	Italy
Full period termination operator				
• FPT send: requests that the Command VDE Operator hold the outgoing LRN for two reasons: (1) it is necessary to communicate with the ship to determine the quality of the transmitted signal or to obtain a QSL for traffic sent (2) the ship has requested a retransmission of a message already sent.	X			
Allied/NATO/SEATO operator				
• Assists NATO area supervisor in routing, servicing and security aspects of message delivery to NATO subscribers			X	
• Additional operator assistance is required when NATO broadcast activated			1RM from watch	
• Additional operators employed on the basis of 1 for every 3 circuits when NATO ships are terminated			X	
• May be called to help with termination of allied ship	X			
• May be called to help with operation of allied broadcast	X			
C.W. Broadcast operator				
• Converting messages, maintaining files, transmitting messages in accordance with schedules	50	X	75	
• Performing quality control checks on equipments	10	X		
• Observing monitor of transmission to detect possible equipment failure	15		15	
• Housekeeping chores, including field days	10		10	

TABLE IV-2 (contd)

Operator position/job	Honolulu	Guam	Norfolk	Italy
• On the job training for other positions in fleet center	15			
• Operates point to point unclassified circuits		X		
Off-line crypto operator				
• Encrypting messages	10		37.5	
• Decrypting messages	2		18.75	
• Handling top secret or special-category messages that require neither encrypting nor decrypting	8		15	
• Maintaining accountability of crypto material at the admiral's house			5	
• Housekeeping functions and maintenance	15		15	
• Training and required reading	65		8.75	
Service center supervisor				
• Screening messages on service printer for required action	20			
• Using VDT to fix messages, in order that the NavComPARs can process them for delivery	50			
• Assigning messages to service clerks to fix	10			
• Drafting services to originators of messages that cannot be fixed	10	X		
• Training and doublechecking work of service clerks	10			X
• Directs all service activities		X		
• Maintains logs ensuring proper handling of all computer rejected messages		X		
Service center clerk				
• Process replies to service message		X		
• Answer Broadcast Screen requests		X		
• Corrects rejected messages and reenters them for automatic processing		X		X

TABLE IV-2 (contd)

Operator position/job	Honolulu	Guam	Norfolk	Italy
Data base operator				
• Cutting cards for data base updates	25	X	25	X
• Making on-line updates of odd-hours shifts in routing for a command (about 6 per 8 hour watch, at 15 minutes each)		X	20	X
• Coding changes to data base	25	X	30	X
• Assisting computer center in placing new data-base file on line at beginning of radio day		X	10	X
• Performing housekeeping functions (field days, making coffee, etc.)			15	
• Screening source information for data base changes	20			
• Assisting Command VDT in performing on-line updates to data base	10			
• Initiating service messages when data base discrepancies are found	10			
• Comparing locally prepared data base with daily update from Norfolk	10			
Command VDT operator[a]				
• Providing supervisory assistance to fleet center supervisor	10		10	
• Performing housekeeping functions, (field days, making coffee, and burn-runs)			10	
• Operating the VDT, responding to problems by shipboard operators, etc.	75		70	
• Liaison with FPTO in operation of shore send sides of full-period terminations	15			
• Monitors and controls all input/output lines to/from NavComPARs, including fleet broadcasts (multi-channel and single-channel) and on-line terminations	X	X	X	X
• Detects possible crypto or computer malfunctions		X		X
• Maintains status board	X	X	X	X
• Helps Fleet center supervisor in his duties	X	X	X	X

TABLE IV-2 (contd)

Operator position/job	Honolulu	Guam	Norfolk	Italy
Orderwire operator/file clerk				
• Coordinating between the fleet center and tech. control via orderwire all circuit difficulties	X	Ordwire operator	65	
• Maintaining file boxes of traffic received from terminations after SDR operator has completed his actions		File clerk	15	
• Housekeeping duties			5	
• Assisting the F.C. supervisor, in particular, supervising the full-period terminations operation			10	
• Occasionally utilized as data speed reader operator			5	
• Monitors fleet BCST, Allied interchange, ship/shore terms and CW BCST	X			
Router VDT operator				
• Corrects all format lines necessary to complete the processing of messages using NavComPARs pointing indicator		X		X
o Routes messages not automatically routed by computer		X		
Inrouter VDT operator				
• Assigns proper internal routing to incoming messages not automatically processed by NavComPARs		X		X
• Makes changes to internal routing on computer processed messages when required		X		

[a]Note: As message load approaches 50 percent of maximum capability, the operator must place full attention on his VDT, supplying the CWO or watch chief with constant data on which channels are backlogging and making necessary commands to computer to cause message flow to additional channels or least-used channel, as the case may be.

TABLE IV-3

SUPPORT COLLATERAL DUTY JOBS

	Honolulu		Guam		Norfolk		Sugar Grove		Italy	
	Job#	Total Man-hours	Job #	Total Man-hours	Job#	Total Man-hours	Job#	Total Man-hours	Job#	Total Man-hours
Other operational activities							1-6, 9-13	3934		
Cleaning	1, 2, 5	3640	1, 2, 4-8	2978	1, 4, 6	2191			1	702
Burn-runs	3	832			2, 8	312	7	3224	3	260
Supply, inventory, etc.	6	520			5, 7	265				
Security	4	728			3	730	8	1456		
Customs, sponsor			3	208					5	2496
Driving									4	8736
Mulching									2	8736
Tape cleaning									6	218

TABLE IV-4

CURRENT SUPPORT MANPOWER REQUIREMENT

Page ___ of ___ pages

SITE LOCATION: NCS HONO FUNCTION: TRAFFIC DIVISION 12 MONTH PERIOD COVERED: From JAN 74 To DEC 74

(1) JOB	(2) DESCRIPTION	(3) WORK UNIT	(4) HOURS TO COMPLETE	(5) NUMBER OF WORK UNITS PER WEEK	TOTAL HOURS PER YEAR	(7) BILLET NUMBER
	FLEET CENTER BRANCH					
1. Cleaning	Routine cleaning, 2/30 mins sweepdowns per watch, 1 2 hr field day each mid watch.	Cleaning	5.0 hrs	7.0	1820	13 (4), 18 (12), 20 (4).
2. Head cleaning	1 man to clean head 8 hrs/day, 1 wk/month.	Cleaning	8.0 hrs	1.75	728	13 (4), 18 (12), 20 (4), 45 (12)
3. Burn runs	Burn classified material, twice weekly, 2 men, 4 hrs each burn runs	Burn Run	8.0 hrs	2.00	832	13 (4), 18 (12), 20 (4), 45 (12)
4. Security Escorts	Escorts required for repairmen, visitors, etc.	Escort	1.0 hr	14	728	13 (4), 18 (12), 20 (4), 45 (12)
	COMPUTER CENTER BRANCH					
5. Cleaning	Routine cleaning of spaces and exterior of equipment	Cleaning	1.0 hr	21	1092	27 (6), 34 (5).
6. Supplies	Ordering, storing, breaking out supplies	Tour	1.0 hr	10	520	H (2)

TABLE IV-4 (Cont'd)

CURRENT SUPPORT MANPOWER REQUIREMENT

Page of pages

SITE LOCATION: NAVCOMMSTA GUAM FUNCTION: FLEET CENTER DIVISION 12 MONTH PERIOD COVERED From 31 OCT 73 To 30 SEP 74

(1) JOB	(2) DESCRIPTION	(3) WORK UNIT	(4) HOURS TO COMPLETE	(5) NUMBER OF WORK UNITS PER WEEK	(6) TOTAL HOURS PER YEAR	(7) BILLET NUMBER
	MANAGEMENT GROUP (OFFICE)					
1. Cleaning	Maintain cleanliness of work area, sweep down at end of each work day	Cleaning	10 min	5	56	E(1)
2. Cleaning	Field day once a week	Cleaning	1.5 hours	1	78	E(1)
3. Customs	Assigned to COMNAVMAR customs office. Inspects personnel property, ships, aircraft entering or leaving Guam.	Custom	8 hours	5	208	I(2)
	FLEET CENTER BRANCH					
4. Cleaning	Maintains cleanliness of work areas, light house keeping at end of each watch	Cleaning	15 min	21	1092	19 (1) 45 (1) 18 (1) 1[illegible] (1)
5. Cleaning	Complete field day twice weekly	Cleaning	2 hours	2	448	20 (1) 31 (1) 30 (1) 32 (1)
	COMPUTER CENTER BRANCH					
6. Cleaning	Maintains cleanliness of work area, light house keeping at end of eve and day watch	Cleaning	10 min	14	446	27 (1), 34 (1)
7. Cleaning	Mid watch holds light field day	Cleaning	45 min	5	335	Q (1), 51 (1)
8. Cleaning	Thorough field day twice weekly	Cleaning	2.5 hours	2	520	27 (1), 34 (1)
	Data Base Maintenance Branch combines duties with Computer Center Branch					

TABLE IV-4 (Cont'd)

CURRENT SUPPORT MANPOWER REQUIREMENT

SITE LOCATION: NCS NORFOLK FUNCTION: FLEET CENTER BRANCH 12 MONTH PERIOD COVERED From 10/20/73 To 10/20/74

(1) JOB	(2) DESCRIPTION	(3) WORK UNIT	(4) HOURS TO COMPLETE	(5) NUMBER OF WORK UNITS PER WEEK	(6) TOTAL HOURS PER YEAR	(7) BILLET NUMBER
	FLEET CENTER BRANCH					
1. Cleaning	Maintain general cleanliness of spaces, sweep after every watch 15 min/3 times per day. Mash trash in compactor, make coffee and clean coffee area.	Cleaning	3.0	7.0	1095	17 (4), 15 (4), 21 (4)
2. Burn Run	Carry burn bags to disintegrator and place in concentrated area. Place bags in disintegrator one at a time. Account for bags.	Burn Runs	2.0	1.0	104	Various
3. Security Checks	Check station grounds, check door alarms and crawl spaces	Security Check	2.0	7.0	730	7 (4), 23 (4)
	COMPUTER CENTER BRANCH					
4. Cleaning	Maintain general cleanliness of spaces. Clean and maintain associated equipment.	Cleaning	1.5	7.0	548	27 (4).
5. Supplies	Load supplies from crawl space and carry to work area	Supplies	.5	5	135	27 (4)
	DATA BASE MAINTENANCE BRANCH					
6. Cleaning	Maintain general clean-up of work areas.	Cleaning	1.5	7	548	51 (4), 52 (4)
7. Supplies	Ordering, storing and breaking out supplies as needed	Supplies	.5	5	130	46 (4), 51 (4)
8. Burn run	Supply man for burn run detail	Burn run	2.0	2	208	51 (4)

TABLE IV-4 (Cont'd)

CURRENT SUPPORT MANPOWER REQUIREMENT

SITE LOCATION: Sugar Grove, W. Va. FUNCTION: FLEET CENTER 12 MONTH PERIOD COVERED: From ________ To ________

(1) JOB	(2) DESCRIPTION	(3) WORK UNIT	(4) HOURS TO COMPLETE	(5) NUMBER OF WORK UNITS PER WEEK	(6) TOTAL HOURS PER YEAR	(7) BILLET NUMBER
1.	Patches off equipment when trouble in equipment	Patching	2 min	12	20.8	
2.	Sets up crypto blocks	Crypto Set Up	1-1/2 hr	7 (2 men)	1092	
3.	Files sent/receive traffic	File messages	1-1/2 min	75	97.5	
4.	Hold publication inventory	Inventory	5 min	21	91	
5.	Change paper, paper tape and ribbon when needed	Printer preparation	3 min	275	715	
6.	Changes monitor roll, circuit cards, master log, and sets up crypto gear	Daily set up preparation	15 min	7 (3 men)	273	
7.	Burn runs and cleanup of building	Burn run Clean-up	2 hrs 4 hrs	3 7 (2 men)	312 2912	
8.	Hold security checks of communications buildings each hour after 1630	Security checks	10 min	168	1456	
9.	Orderwire coord	Coordination		630		
10.	Maintain log	Log keeping	1 min	1140	988	
11.	Maintain status board	Update status board	1/2 min	68	29.5	
12.	QC checks of lines	QC of circuits and lines	4 sec	218	12.6	
13.	Sets up, patches and monitors receivers for ship and point to point terminations	Set up receivers	2-1/4 min	315	614.3	

TABLE IV-4 (Cont'd)

CURRENT SUPPORT MANPOWER REQUIREMENT

Page ___ of ___ pgs

SITE LOCATION: NCS ITALY FUNCTION: FLEET CENTER DIVISION 12 MONTH PERIOD COVERED From JAN 74 To DEC 74

(1) JOB	(2) DESCRIPTION	(3) WORK UNIT	(4) HOURS TO COMPLETE	(5) NUMBER OF WORK UNITS PER WEEK	(6) TOTAL HOURS PER YEAR	(7) BILLET NUMBER
	FLEET CENTER BRANCH					
1. Cleaning	Sweep down at end of each watch, 30 min/3 times day. Field day held each Sunday - 3 hrs	Cleaning	4.5	13.5	702	10, 11, 15, 14, 22, 27, C, 29, 30, 31, 39, 45, 51
2. Mulching	1 man per watch. 3 watches daily 8 hours a watch	Mulching	24	168	8736	11, 18, 19, 22, C, 27, 29, 30, 31, 39, 45, 51
3. Burn runs	Material taken to incinerator, 2 men	Burn Run	5	5	260	11, 16, 19, 22, C, 27, 29, 30, 31, 39, 45, 51
4. Duty driver	On-call duty driver. 1 man assigned from each watch	Driving	8	168	8736	11, 16, 19, 22, C, 27, 29, 30, 31, 39, 45, 51
5. Sponsor	Checking in newly arrived personnel	Sponsor Duty	16	48	2496	All billets
	COMPUTER CENTER BRANCH					
6. Mag tape cleaning	Tape degausing, cleaning and labelling	Daily	.6	4.2	218.4	26, 27

TABLE V-1

SUPERVISORY OVERHEAD ANALYSIS RESULTS
(Percent)

	Honolulu	Guam	Norfolk	Italy
Total supervisory overhead	26.9	12.3	35.1	2.4
Watch operations	20.6	2.6	27.9	0
Day operations	49.3	66.7	96.4	0
Total operations division	22.8	10.4	33.6	0
General management	5.3	2.5	1.5	1.2