MINICOMPUTER MAINTENANCE AND OPERATIONS GROUP

CENTER—MINICOMPUTER MAINTENANCE GROUP

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1. INTRODUCTION

1.1 Purpose

The Minicomputer Maintenance Group (MMG), which is part of the Minicomputer Maintenance and Operations Center (MMOC), is described in this practice. See Practice BR 007-555-352 for a description of the MMOC.

1.2 Reasons For Reissue

This practice is being reissued due to changes incurred by divestiture.

2. GENERAL

2.1 MMOC Overview

The MMOC is an operations center responsible for the operation of clustered minicomputer hardware associated with system-stranded operations systems and locally-designed systems. Also, the MMOC is responsible for the maintenance of clustered and remote minicomputer systems within its geographic boundaries and for which self-maintenance is feasible.

The work functions of an MMOC are divided into two categories; (1) Minicomputer Operations, and (2) Maintenance. Each of these categories is normally cared for in one of two subgroups, the Minicomputer Operations Group (MOG) or the MMG. The MOG and MMG in a model MMOC are joined under common management. The specific level at which they are joined is dependent on the magnitude of the organization, span of control, and local practices. The organization of a typical MMOC Model B company is illustrated in Figure 1.

2.2 MMG Responsibilities

The MMG is responsible for conducting preventive maintenance routines for performing corrective maintenance of computer subsystem hardware. This includes the processors and peripherals (disks, tapes, etc.) and terminal equipment associated with the computer system (console terminal). It is responsible for stocking spare parts, managing the spare parts inventory at efficient levels, and maintaining an inventory of installed hardware components. The MMG is also responsible for the installation and administration of field changes, the reflection of these changes in the records, and, where necessary and possible, installing these changes in stocked spare parts.

3. OPERATIONS PROCESSES

Bellcore recommends clustering minicomputer hardware to achieve the benefits associated with centralized operation and maintenance. Personnel in the user work centers (UWCs) are the intended users of a minicomputer-based system. For a system that is not clustered, the UWC also operates the minicomputer system hardware. There are some user-operated clusters remaining, but most minicomputer clusters are operated by the MOG. The terms "user-operated" and "MOG operated" are used to distinguish these two classes of systems.

For MOG-operated systems, the minicomputer operations functions are incorporated into the MOG. For user-operated systems, the UWC handles these functions.

Computer hardware maintenance functions are either incorporated into the MMG or contracted to a vendor.

TYPICAL MMOC ORGANIZATIONAL STRUCTURE

TYPICAL MMOC ORGANIZATION

**MMOC District Manager
(3rd Level)**

**MOG
Manager (2nd Level)**

**MMG
Manager (2nd Level)**

Cluster
B

Cluster
A

Cluster
C

Minicomputer
Trouble
Report
Control
(MTRC)
Supervisor
(1st Level)

Minicomputer
Operations
Trouble
Response
(MOTR)

Minicomputer
Operations
Administration
(MOA)

Normal
Computer
Operations
(NCO)

Supervisor
(1st Level)

CM, PM, FCO
Supervisors
(1st Level)

Minicomputer
Maintenance
Administration
Supervisor
(1st Level)

Spare Parts
Management
(SPM)
Supervisor
(1st Level)

Logging &
and
Referral

Initial
Diagnosis

Trouble
Managing
And
Escalation

Computer
Operators
'A'

Computer
Operators
'B'

Computer
Operators
'C'

Hardware
Craft Force

Pricing & Loading
Scheduling
Performance
Analyzation

Maint. Stocking
Levels
Budgeting For
Spare Parts

Figure 1. Typical MMOC Organizational Structure

3.1 Minicomputer Hardware Preventive Maintenance and Changes

Preventive maintenance involves the physical inspection of a system and the application of diagnostic tests and procedures to detect and correct conditions that, if not corrected, might progressively degrade system operation and ultimately result in a system failure. Preventive maintenance routines are scheduled in advance so that the user can plan operations accordingly.

A limited number of preventive maintenance tasks can be incorporated into the normal computer operation (NCO), e.g., cleaning tape heads. These are termed "operator-performed" preventive maintenance procedures. Preventive maintenance procedures involving hardware expertise are included in the minicomputer preventive maintenance (MPM) work function of the MMG.

Occasionally a system may require the application of hardware changes. either to enhance the capability of the system or to correct a design deficiency. These hardware changes are scheduled in advance and are carried out by personnel assigned to the minicomputer hardware change (MHC) work function in the MMG.

Any parts needed for preventive maintenance (e.g., filters and fans) or hardware changes are supplied by spare parts management (SPM) personnel in the MMG.

3.2 Minicomputer Trouble Response

Shown in Figure 2, is a diagram of the minicomputer trouble response process. User trouble reports are received by personnel assigned to the minicomputer trouble report control (MTRC) work function. The MTRC personnel do the preliminary diagnosis required to sectionalize the source of the trouble (e.g.. check status of data set). A log is opened for each trouble. Trouble tickets are referred to the work group responsible for maintaining the subsystem in which the trouble seems to be located. The MTRC personnel are informed by computer operators when potential user-affecting problems are discovered. A trouble can be caused by faults in communications hardware, e.g., data sets and lines, user data terminals; system remote interface equipment, e.g., Centralized Automatic Reporting on Trunks (CAROT). Remote Office Test Line (ROTL), Engineering and Administrative Data Acquisition System (EADAS), EADAS Traffic Data Converter (ETDC); or the minicomputer itself. An important part of the MTRC work function is to determine the most probable location of a fault and to refer the trouble to a designated work group for more detailed investigation.

For faults that are sectionalized to a minicomputer, the trouble will be referred to a person assigned to the Minicomputer Operations Trouble Response (MOTR) work function (Figure 3). The trouble response operator can try a procedural fix (e.g., system reboot) or can refer suspected hardware faults to the MMG or responsible vendor for corrective maintenance.

The maintenance person turns the system back to the trouble response operator. who restores service if the system is operable. The disposition of the referral is given to an MTRC person. who notifies the user if the trouble is fixed or continues the referral process if the problem remains.

The MTRC gives the user one place to refer all troubles and coordinates activities associated with sectionalizing problems in systems having multiple repair agencies. An indication of trouble is reported when it is discovered so the MTRC personnel will have up-to-minute knowledge of all system status. For example, the trouble response operator notifies MTRC personnel of a power failure so that they can respond to trouble calls.
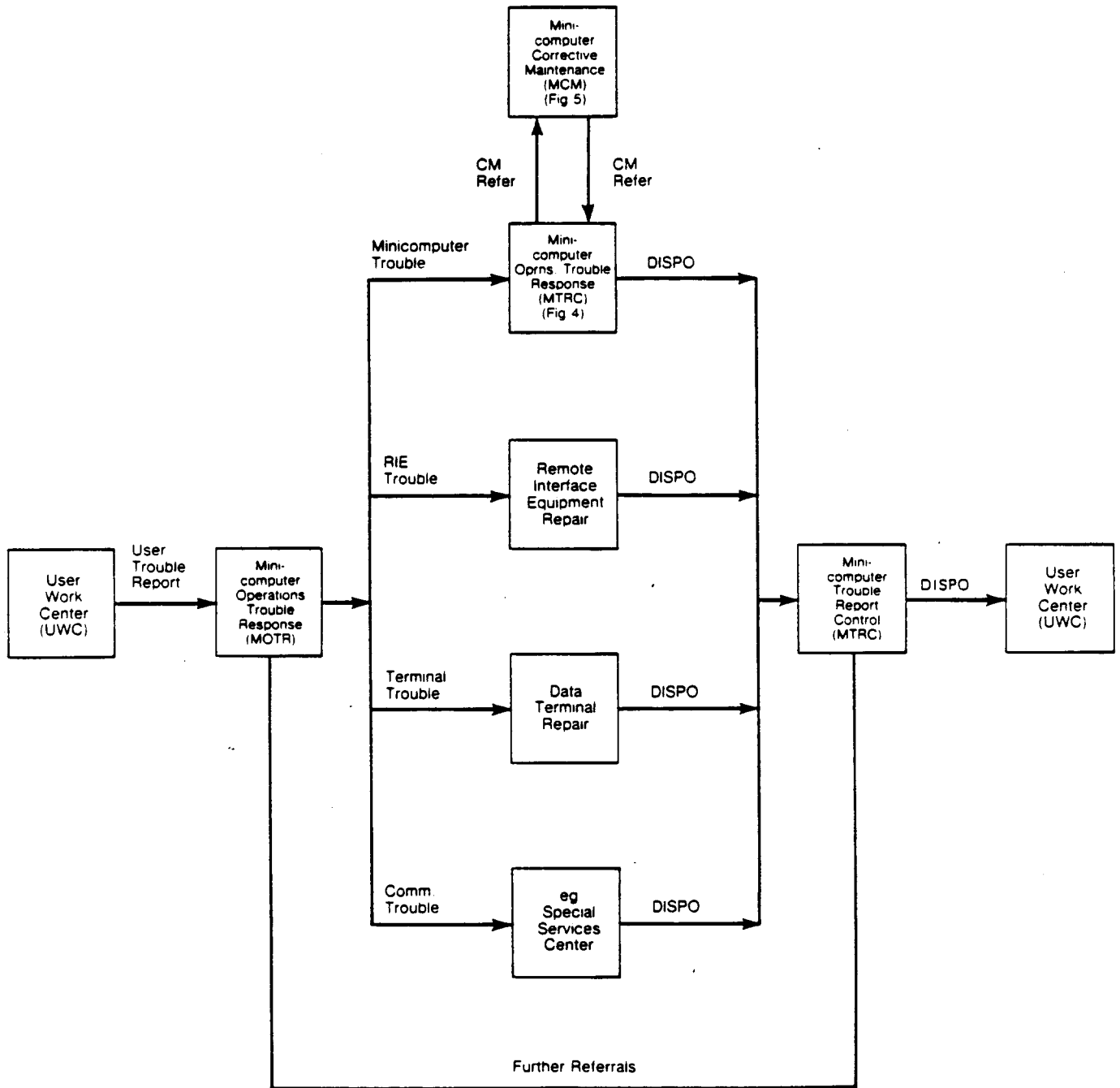
Figure 2. Minicomputer Trouble Response Process

MINICOMPUTER OPERATIONS TROUBLE RESPONSE (MOTR)
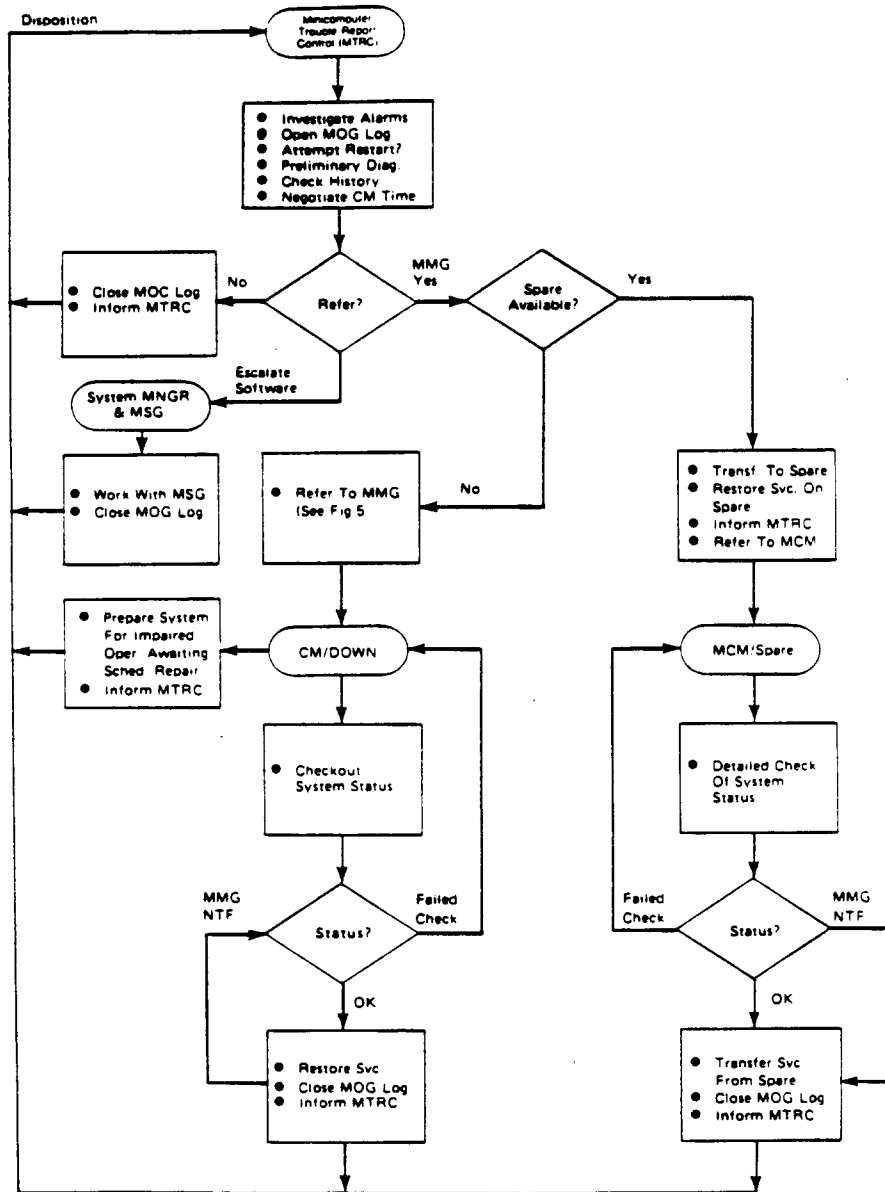
Figure 3. Minicomputer Operations Trouble Response

3.3 Minicomputer System Administration

The minicomputer system administration process includes management functions in the UWC, MOG, MMG, and MMOC Support Group (MSG). This cooperative administrative process is required to ensure efficient use, operation, and maintenance of minicomputer systems (Figure 4).

This process includes the minicomputer operations administration (MOA) function of the MOG, minicomputer maintenance administration (MMA) function of the MMG, and the system management work function of the UWC (Figure 4). A corporate minicomputer support group serves as a single point of contact for all correspondence with vendor support organizations.

The minicomputer system administration process supports distribution of software release materials, MMOC work force pricing and loading, service agreement arbitration, preventive maintenance policy and scheduling, and hardware change implementation.

4. MMG WORK FUNCTIONS

The following subparts describe work functions that are carried out by the MMG when a system is under self-maintenance. A designated vendor has these responsibilities for systems under contract maintenance.

4.1 Minicomputer Maintenance Work Loading and Logging

The MMG work is both scheduled and on demand. The scheduled work is loaded at the beginning of each shift to available crafts personnel. Maintenance requests are received and assigned to an available person in minicomputer corrective maintenance (MCM). The MMG functions are prioritized (e.g., corrective maintenance over preventive maintenance over module repair). Other activities can be interrupted for corrective maintenance work.

The maintenance activities are entered in activity logs for each system. These logs are used for several purposes, including work force pricing analysis and historical trouble analysis.

4.2 Minicomputer Corrective Maintenance

Figure 5 charts the MCM work flow. The dashed lines denote information or material transfers: the solid arrows indicate the progression of the work function through its usual stages.

Requests for corrective maintenance are received from the MOTR function of the MOG. These requests should include an indication of priority (if more than one system is down) and the time (if the system is impaired) that the user will give up the system. The person responsible for loading the corrective maintenance force receives requests for maintenance and loads the job to available MMG craft personnel.

An entry is made in the MMG Corrective Maintenance Log at the time the trouble referral is received.

If a craftsperson is available on site (i.e., for a clustered system), the troubleshooting process can start immediately. If the craftsperson must be dispatched, travel time is required. If available, remote diagnostic capabilities, e.g., remote console unit (RCU), can be used to start the troubleshooting process so that the craftsperson can be equipped with spare parts before traveling to the site. The computer operators assist in loading the appropriate diagnostic media needed for remote diagnosis.

For some remote systems, an operator may not be on site. In this case, the maintenance person must carry out some of the tasks usually done by the operator. These cases should be worked out in advance in the service agreement negotiations. The Computerized Maintenance and Administration Support (COMAS) System is an example of a system which may run unattended in a wire center building.
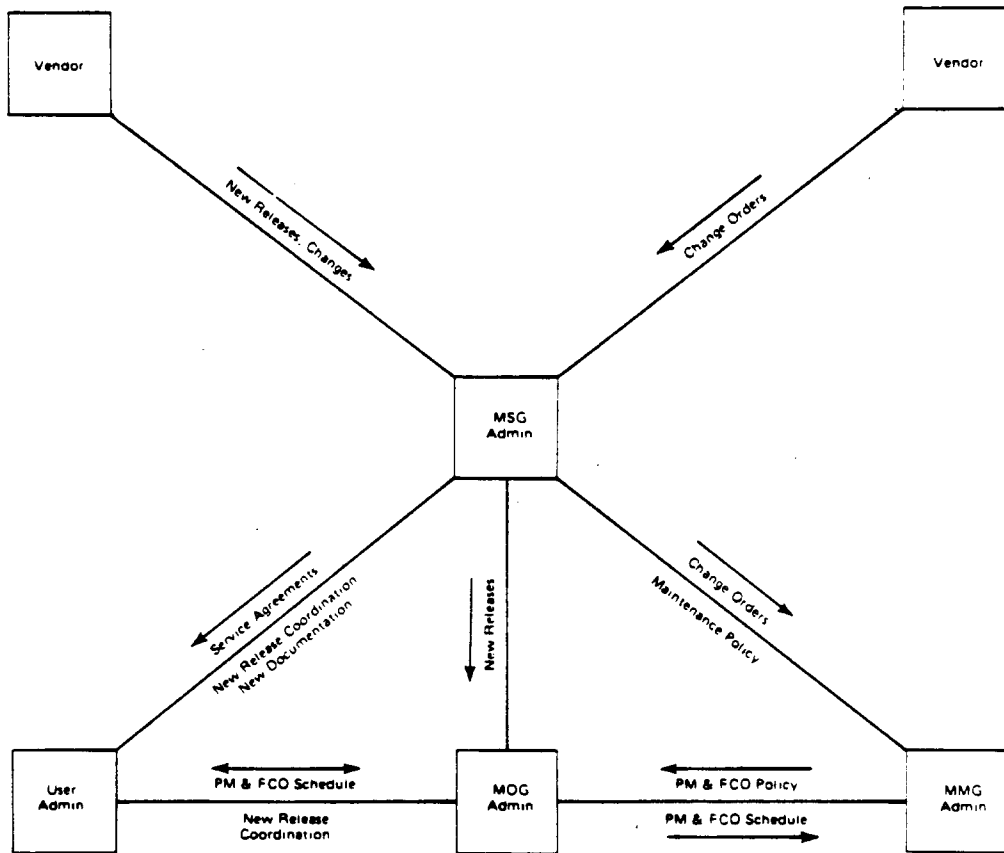
Figure 4. Minicomputer System Administration

(From Fig 4)
(MOTR)

- Negotiate Priority
- Open MMG Log
- Load Job

Craft On Site

Dispatch

- Travel
- Remote Diagnosis

Remote Diagnostics

Now

Troubleshoot

Support

Escalate

MMG/MSG Escalation

Find Trouble

No

Yes

Swapping Spares

Determine Repair Schedule

Parts Inquiry

Response

Spare Parts Mgmt. (SPM)

Emergency Parts Order

MTCE Spares

FIX

Later

- Reconfigure Impaired State

MOG

Now

Repair and Checkout

Defectives

Rep. Pts.

SPM

Escalate

Support

MMG/MSG Escalation

- Close Out MMG Log
- Return System

MOTR
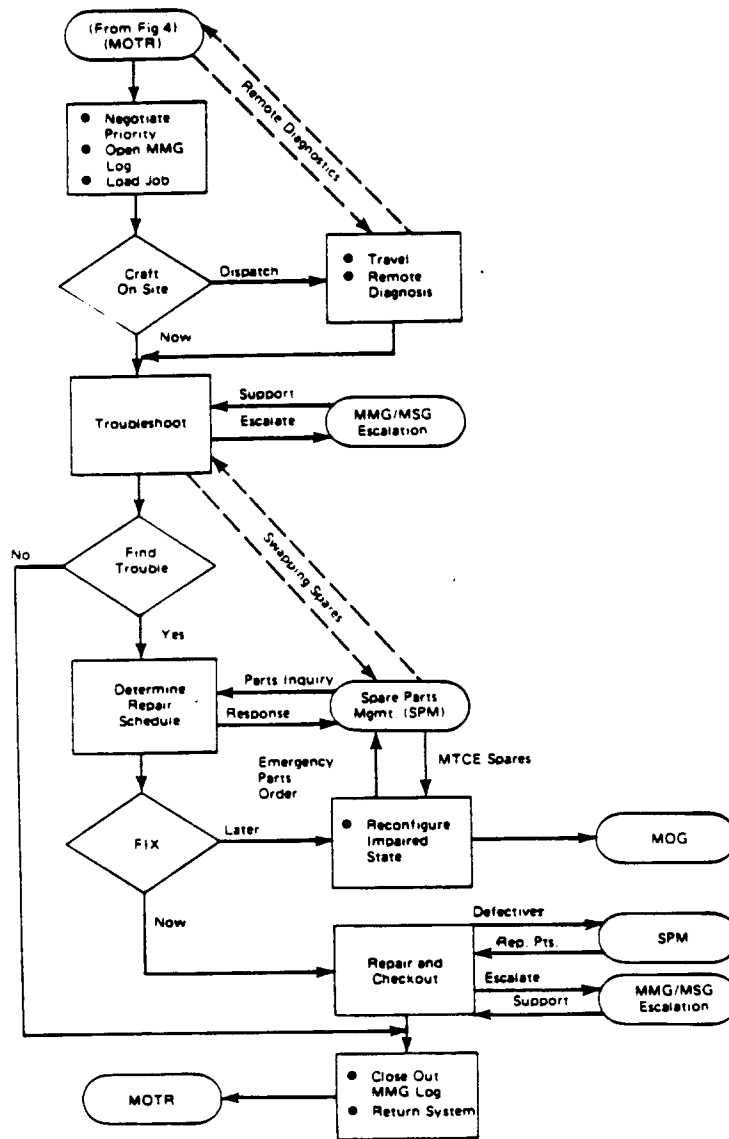
Figure 5. Minicomputer Corrective Maintenance

Once the craftsperson is on site, troubleshooting can begin. Troubleshooting first involves interpreting all available information (e.g., error log outputs, trouble history, crash program diagnostics) in order to isolate the cause of the fault. The system should be visually inspected to detect any obvious faults (e.g., no console lights, smoke).

When the trouble is isolated to a particular subsystem, the appropriate subsystem diagnostic programs can be run. If there is no hint as to the problem location, general system exercisers can be run. While the exerciser is running, all power supply voltages should be checked for proper levels.

If the fault is intermittent and is not isolated, the exerciser may be run for a predetermined amount of time agreed to by the system manager. If the fault cannot be reconstructed, the MMG log is closed as "no trouble found," and the system turned back to the operator.

Once isolated to a subsystem (e.g., disk drives), particular diagnostics can be run for that subsystem. If the trouble condition is detected by a diagnostic, then enough information must be available to select a more detailed diagnostic or to start selective module swapping from the spare parts kit. Modules are swapped only if the diagnostic output indicates a probable location of the fault. After swapping, the diagnostic is run again to determine if the trouble was corrected by the swap.

If the system will not boot any software, the system power, buses, and processors should be checked to locate the problem.

The MTRC responsibilities performed by the MOG include keeping track of the time spent in corrective maintenance. If a predetermined time interval lapses (e.g., two hours without isolation of the problem) the agreed-upon escalation procedure should be followed. The maintenance craftsperson should consult with the MMG manager for assistance. Under extreme conditions or when the outage thresholds are exceeded, the MMG manager should call in the MSG maintenance support personnel for assistance.

When the location of the fault is obvious (e.g., isolated to a particular disk head out of alignment), the flow progresses to the final repair job. Once the trouble is isolated, an estimate of restoral time should be made and forwarded to the MTRC group to notify the system managers, users, and the MSG. If parts are available, repair should start immediately. Otherwise, the system may be reconfigured to run in an impaired state by using maintenance spare peripherals or whatever is feasible. In some cases, the system may remain out of service until parts are received. Emergency parts orders are placed by the SPM group.

In some cases, assistance may be needed to complete the repair process. The repair escalation should be handled by a combination of the MMG managers and the MSG.

Upon completion of the final repair, the system status is checked out with the computer operator. Assuming a computer operator is available, the MMG craftsperson will remain on site until the system can demonstrate a proper operational mode. This time (less than a half-hour) should be spent by the MMG craftsperson filling out the maintenance activity report, site log, and in preparing defective modules for module repair. (Defective modules should be tagged as "defective" and the symptoms or diagnostics failed should be stated.)

4.3 Minicomputer Preventive Maintenance

Minicomputer systems should be maintained in a manner which achieves an effective balance between corrective and preventive maintenance. Factors influencing the need for preventive maintenance are:

(a) Lack of system diagnostics designed to detect and report failures.

(b) Inability of the user or operator of a system to detect certain trouble conditions. The MPM provides an effective method for locating and repairing these troubles through the use of diagnostic

and manual testing.

(c) Infrequent use of certain subsystems may require periodic tests to ensure proper operation.

(d) Need to periodically adjust, clean, and lubricate some types of peripheral equipment.

(e) Need to replace parts, such as filters and fans.

The key to a preventive maintenance plan is the Equipment Test List (ETL). This list is prepared and updated periodically as part of the MMA function of the MMG. All tests required for each maintained minicomputer subsystem are listed in the ETL. References to detailed documentation on the required tasks involved in each test, along with the required scheduling frequency and an estimate of the required time, are also included in the ETL. Monthly preventive maintenance schedules are constructed based on the ETL and the UWC availability requirements.

Generally, a craftsperson scheduled for preventive maintenance will be loaded with a day's work. Preventive maintenance work can be interrupted to make the craftsperson available for corrective maintenance work, but the machine must first be put back into a state of user availability.

Part of the MPM work function involves recording the test results for all preventive maintenance activities in an appropriate log for each system. (See BR 007-560-309, Controlled Maintenance Plan for Minicomputer Systems.)

4.4 Minicomputer Hardware Changes

Minicomputer systems often require the field application of MHCs, called field change orders (FCOs), to achieve or maintain desired performance. The vendor applies these changes for systems under maintenance contract. The MMG must track and install these field changes for all systems it maintains. Change notices are received from the MSG by the personnel assigned to the MMA function. The MMA personnel review the change notices and decide on an appropriate schedule for its application. The FCOs are classified as:

(a) **Applicable Immediately:** These changes are critical in nature (e.g., safety hazards) and should be applied immediately.

(b) **Scheduled Separately:** These changes can be scheduled but have a degree of complexity associated with its application and/or system impact. These changes would not be scheduled coincident with system preventive maintenance but as a distinct work activity.

(c) **Scheduled With Preventive Maintenance:** Many field changes are minor and require little time to apply. These changes can generally be applied without risk to system operation. These changes could be scheduled separately or concurrent with preventive maintenance activities.

Field change work involves reviewing the nature of the change, receiving the required parts from SPM, traveling to the minicomputer site, and executing the change. The hardware change must be recorded in the Site Management Log for the minicomputer, and any required label (e.g., etch and rev identifiers on a circuit board manufactured by Digital Equipment Corporation) changes applied. After the change, operation of the system must be ensured before returning the system to the MOG.

If field changes and preventive maintenance are scheduled concurrently, the field change should be applied and verified before starting preventive maintenance procedures.

4.5 Spare Parts Management

The SPM function is vital to an MMG since almost all minicomputer maintenance activities require the use of spare parts. Minicomputer vendors specify the recommended spare parts levels which keep parts availability above some level (usually 90 percent). Part of the MMA function involves incorporating vendor recommendations and past experience to develop specific thresholds that satisfy the spare parts needs for the MMG population of hardware configurations. Spare parts levels are maintained by issuing purchase orders or by sending modules which have failed to the module repair function in the MMG or to a vendor for repair.

The SPM function must take into account the expected lead times for obtaining purchased parts and for repairing modules sent for repair to ensure continued availability of replacement parts. Excessive lead time can be reduced by advanced planning. A solid working relationship with the various vendors, engineering departments, etc., for collecting information on new devices or systems ensures proper spare parts support.

Consideration should be given to purchasing spare parts from alternate suppliers or the Original Equipment Manufacturer (OEM) that will supply the actual vendor.

When feasible, the MMG may keep a stock of major spare components, (e.g., disk drives) for swapping to reduce outage time. The failed component can then be repaired off-line while the user is served by the swapped-in spare. This spare component should not be considered as part of the maintenance test bench system but as part of the spare parts inventory.

Minicomputer spare parts consist of circuit boards, fans, filters, motors, drive mechanisms, individual electronic components, cables, connectors, and miscellaneous small hardware. Circuit boards are stored centrally on shelves or housed in spare parts kits. Spare parts kits are constructed to include boards needed in a particular hardware subsystem (e.g., disk, processor) and are an essential part of the corrective maintenance function. Spare parts kits are often kept at clustered computer sites for immediate availability to the repair force.

Preventive maintenance parts can be ordered in bulk supplies. Expendable items such as prefilters, filters, belts, etc., are replaced at recommended intervals. These parts should be ordered in sufficient quantities to cover a full year of scheduled preventive maintenance.

The MMG requires vendor documentation on hardware configurations and diagnostic usage. This documentation, on paper and/or microfiche, must be kept up to date. Some vendors offer special update services on hardware and software for an annual fee. Updates are usually sent on a monthly basis.

Many MMG activities require the use of special tools and test equipment. This equipment includes:

- Oscilloscopes, logic analyzers, and other measurement gear

- Test media for calibration of minicomputer peripherals

- Mechanical tools for adjustments and repair

- Maintenance "test bench" computers in the MMG

- Automatic test equipment (ATE) for module repair.

Part of the SPM function involves ordering test equipment for the MMG needs and sending it to the proper place for repair.

Methods must be set up for moving parts from the central stock to the computer site when the proper spare parts kit is not on hand. Maintenance personnel cannot always determine a minicomputer fault

location well enough to select the proper spares. Better diagnostic tools (e.g., remote diagnostics, remote diagnostic units, system error logs) and predispatch analysis of trouble symptoms by MOG and MMG personnel can help minimize the movement of parts between the central stock and the computer site.

Parts are ordered in two ways: normal purchase orders and emergency parts requests. Minicomputer vendors offer one or more types of emergency parts orders, with delivery times ranging from a day to several weeks. A premium must be paid for an emergency parts order over the price paid for a regular parts order, which has a longer lead time. Emergency parts orders are minimized by maintaining the spare parts levels within threshold values. A minimum threshold ensures parts availability, while a maximum threshold prevents costly overstocking. All parts orders require the tracking of vendor shipments and payments through a purchase order control scheme.

One of the responsibilities of the SPM involves tracking MMG spare parts inventory. The count for each stocked item must be kept within minimum and maximum values. These values are updated periodically as part of the SPM function.

An inventory must be kept for each minicomputer system maintained by the MMG. This inventory will contain the type and number of each major component, subassembly, and circuit board which are part of the machine configuration. This inventory is used for spare parts policy decisions as well as for hardware change tracking.

A computerized inventory control system may be used. Several such systems exist in MMOCs.

4.8 Module Repair

Defective circuit boards (modules) are returned for repair with a tag, similar to the example shown in Figure 6, describing where the board came from and the problem symptoms. If a diagnostic test indicated the problem, then the diagnostic name should be listed on the module repair tag. Circuit boards may be brought into the module repair area for the application of FCOs which cannot be accomplished in the field. Remarks should be made on the repair tag to identify FCOs that have been applied. A circuit board in for module repair can be disposed of in one of the following ways:

(a) Discard it if circuit board is worth less than a locally-established threshold value.

(b) Discard it if circuit board is not repairable.

(c) Send it to vendor for repair/FCO or exchange if the circuit board is too complex for local repair.

(d) Put in for local repair or FCO application.

Before a circuit board can be repaired, the faulty components must be isolated. This is accomplished through the use of ATE or by placing the circuit board in a maintenance test bench computer configuration. The ATE has specific software for functional testing of each circuit board type. Using ATE is usually quicker for isolating a faulty component than running diagnostics in a maintenance test bench computer using standard test equipment (e.g., oscilloscopes, logic analyzers) and engineering drawings. Once isolated, the faulty components are replaced using the proper equipment to avoid further damage to the circuit board.

A final test of the repaired circuit board should be performed in a maintenance test bench computer to verify that the original fault has been corrected and no other problem exists.

Occasionally, a functional circuit board will be returned for repair. If an incoming circuit board tests OK, it can be returned to stock. To control repetitive returns of intermittent circuit boards, boards which have been through module repair should be identified.

Your Telephone Co.
MINICOMPUTER MAINTENANCE
DEFECTIVE MODULE
DATE _____

SYSTEM NAME _____

TYPE _____ S/N _____

OPTION _____ DRIVE# _____

TROUBLE TICKET# _____

CHARGE _____ CC _____

PART# _____

KIT# _____

REMOVED BY _____

BRANCH _____

DESCRIBE FAULT:

_____

_____

_____

_____

DATE _____

REPAIRED BY _____

MODULE UPDATED TO CKT. REV.

_____

DESCRIBE REPAIRS:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

FRONT   BACK

Figure 6. Example Defective Circuit Board Repair Tag

4.7 Minicomputer Maintenance Administration

The MMA function is responsible for the administration of minicomputer self-maintenance activities for an MMG. This organization interfaces with the MSG and the minicomputer operations administration (MOA) area of the MOG.

The major work items included in the MMA function are to:

(a) Set preventive maintenance policy and work with the MOA to establish preventive maintenance schedules for each system. This involves adjustment to preventive maintenance routine periods to achieve an effective balance between preventive and corrective maintenance costs. This is achieved through the establishment of an MOC controlled maintenance plan. (See BR 007-560-309.)

(b) Negotiate priorities for corrective maintenance under conditions of multiple system outages.

(c) Develop training requirements for new hardware, with assistance from the MSG.

(d) Forecast and schedule training requirements for MMG personnel.

(e) Participate with MSG in minicomputer planning and installation.

(f) Determine FCO applicability to individual systems.

(g) Interface with MSG on the application of FCOs. Work with system managers to provide an implementation schedule for these changes.

(h) Track maintenance efforts (costs and hours) on an individual system basis. (See BR 007-560-201 and BR 007-560-300.) History can be used to estimate work force requirements in advance.

(i) Pricing and loading are used to produce work schedules for the MMG work force to use for daily work loading. (See BR 190-130-130.)

(j) Evaluate and maintain MMG performance within established objectives.

(k) Review and approve disbursements for spare parts, test equipment, and MMG supplies.

(l) Monitor system performance by observing maintenance trouble reports, MMG logs, and any performance reports, e.g., Minicomputer Reliability Study System (MRSS) outputs.

(m) Provide assistance to MMG crafts personnel when troubleshooting times have exceeded predetermined times for escalation.

(n) Escalate difficult and recurring hardware/software problems to the MSG.

(o) Determine FCO applicability to individual systems.

(p) Maintain documentation for all hardware, diagnostics, and equipment related to MMG work functions.

(q) Review and recommend spare parts levels.

(r) Review corrective maintenance activities and MRSS reports to identify systems, locations, and equipment causing excessive trouble.

5. MMG EXTERNAL INTERFACES

The MMG has external interfaces with various UWCs, maintenance vendors, MSG, engineering departments, etc. These interfaces can be classified as:

(a) The MMG center inputs

(b) The MMG center outputs

(c) The MMG negotiations involving other work centers.

Table A provides a list of MMG center inputs. This table shows, for each input, the media, relative frequency, the external organization from which the input is received, and the MMG work function receiving the input. The acronym "UWC" is used to denote any user work center which uses the operations or maintenance services of the MMG.

Table B lists the MMG center outputs. The external organization receiving each output, as well as the associated MMG work function. are listed in this table.

Table C lists the negotiations in which the MMG participates. The external organizations with which the negotiations take place are shown in this table, along with the corresponding MMG group responsibilities.

TABLE A. MMG INPUTS

INPUT	MEDIA	FREQUENCY	FROM	FUNCTION
Corrective Maintenance Requests	Telephone	As Required	MOTR	MCM
Parts Shipment	Parts and Bills	Daily (as required)	Vendor	SPM
Training Requirements	Written	As Required	MSG	MMA
New Release Material	Documentation and Tapes	Yearly (as required	MSG Vendor	MMA
User Operated System Maintenance Request	Telephone	As Required	UWC	MCM
Hardware Change Order	Written	Monthly (as required)	MSG	MMA

TABLE B. MMG OUTPUTS

OUTPUT	MEDIA	FREQUENCY	TO	FUNCTION
Escalated Trouble Assistance	Telephone	As Required	MSG	MMA
User Operated System MCM Disposition	Telephone	As Required	UWC	MCM
Preventive Maintenance Schedules	Written	Quarterly	MOA and UWC	MMA
Purchase Order	Purchase Order Form	As Required	Vendor	SPM
Emergency Parts Orders	Telephone and Written	As Required	Vendor	SPM
Tools and Test Equipment	Purchase Order Form	As Required	Vendor	SPM and MMA
Scheduled Reports	Computer Printouts	Daily (as scheduled)	Various Departments	MMA
Training Schedules Documentation	Telephone and Written	As Required	MSG	MMA
Documentation Updates and New	Telephone and Purchase Order	As Required	Vendors	MMA
Hardware Change Orders	Written	As Required	MOA	MMA

TABLE C. MMG NEGOTIATIONS

NEGOTIATION	MEDIA	FREQUENCY	TO	FUNCTION
Preventive Maintenance Scheduling	Verbal and Written	Monthly (as required)	MOA UWC	MMA MMA
Hardware Change Scheduling	Verbal and Written	As Required	MOA UWC	MMA
Service Agreement Negotiation	Written	Yearly (as required)	MOA UWC	MMA
Intermittent Trouble Investigation Scheduling	Telephone	As Required	MOA UWC	MMA
Escalated Technical Assistance	Telephone and On-site Support	As Required	MSG	MMA

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6. CENTER ORGANIZATION

The center organization is based on a typical Model B company environment. It assumes recognized standards for span of control/supervision and averages for Model B company minicomputer systems, processors, and clusters. Also included in these assumptions are those management functions and responsibilities specific to the MMOC (Figure 1).

The MMG organization consists of 28 nonmanagement maintenance personnel responsible for corrective maintenance, preventive maintenance, and FCOs. The SPM function requires an additional four non-management personnel (could include module repair). An estimated two clerical personnel are needed for the MMA function. The management organization includes four first-level managers to supervise the corrective maintenance, preventive maintenance, and FCO activities; one first-level manager to supervise the SPM function; and one first-level manager for MMA. These six first-level supervisors report to one second-level manager.

7. RESOURCES

The MMG center resources include the following:

- Minicomputer system-provided features

- Logs and history files

- Environmental monitors

- Operation and maintenance documentation

- Diagnostic programs

- Maintenance tools.

7.1 Minicomputer System-Provided Features

Minicomputer systems have features intended for use by the MMG personnel. These include system console messages, system alarms, system error log listings, system-provided diagnostics, and vendor-supplied diagnostics.

7.2 Logs

The logs needed are as follows:

(a) **System Operation Activity Log:** All computer operation activities that could affect the system user or that should be added to the system history file are recorded on this log. The MMG personnel should check this log periodically to determine if there are intermittent or system (hardware or software) problems. Logged activities include:

- System backups

- System failures and restarts (including key register readings following a system crash)

- System alarm and console message investigations

- System maintenance referals.

(b) **System Maintenance Activity Log:** All pertinent information pertaining to system preventive and corrective maintenance procedures, as well as hardware change activities, are recorded on this log. Logged activities include:

- Trouble symptoms (either preventive maintenance or corrective maintenance)
- Diagnostic programs used
- Boards or modules swapped
- Trouble disposition
- Updates on hardware changes.

(c) **User Trouble Referral Log:** Every user trouble referred to the MMOC, including the symptom, the agency referred to for investigation or repair, and the disposition of each referral is recorded on this log. The MMG personnel may need to contact the user for further details of a trouble and to assist in fault location.

(d) **Purchase Order Log:** All purchase orders and incoming vendor shipments, bills, and payments are recorded and tracked on this log.

7.3 Information Files

Several information files are required for MMG functions. These include:

(a) **System Media Location File:** This enables the minicomputer operators to locate any retained system media (e.g., backup tapes). Although normally used by the minicomputer operators, MMG personnel will use it if an operator is not available (e.g., during an uncovered off tour) or in the case of a remote location (e.g., COMAS) that contains an unattended system.

(b) **System Error Log History File:** Minicomputer system-generated error log listings should be retained for at least one year for analysis purposes.

(c) **Inventory Files:** Inventories are needed to keep track of spare parts and to have a detailed breakdown of all minicomputer hardware components deployed in systems for which the MMG is responsible.

(d) **Minicomputer System Operation Documentation File:** Self-explanatory.

(e) **Minicomputer System Maintenance Documentation File:** Self-explanatory.

(f) **Minicomputer System Diagnostic Program Library:** Self-explanatory.

7.4 Environmental Monitors

Equipment is needed for monitoring and recording temperature, humidity, and electric power levels in the minicomputer equipment rooms. The MMG personnel should check these monitoring devices periodically to ensure that proper environmental guidelines established by the vendor, engineering departments, etc., are being adhered to for optimum performance of a system.

7.5 Maintenance Tools

Maintenance tools are needed to support many MMG activities. These tools include:

(a) Electronic measurement equipment

(b) Test Media for peripheral calibration procedures

(c) Mechanical tools

(d) Maintenance test bench computers for testing boards

(e) Automatic circuit board test equipment

(f) Special mechanical and electronic alignment tools and test equipment purchased from the various vendors

(g) Special tools and equipment used to repair modules

(h) Special lighting with optical instruments such as a stereo microscope to check modules before and after repair

(i) Special equipment used for washing flux and dirt from boards after repair.

8. PHYSICAL DESCRIPTION

Some of the MMG work functions require specially-designed work locations. These are:

(a) **Office Space:** A location isolated from the noise of the equipment room is needed to house the desks and files for MMG personnel. This room should be large enough to include cabinets for a master file of diagnostic libraries from various vendors. Cabinet space is also needed for all diagnostic listings, hardware manuals, engineering drawings, and vendor maintenance manuals.

(b) **Spare Parts Stockroom:** The spare parts needed for an MMG are kept on specially-built shelves and in spare parts kits housed in appropriate centralized and on-site locations. Space is also needed in the central location for dispatching parts and for receiving defective and purchased parts.

(c) **Module Repair Facility:** This location needs test equipment, board repair equipment (e.g., desoldering tools), and maintenance test bench computers for testing modules. This location also needs specially-built shelving for holding defective modules waiting for repair but separate from the spare parts storage room. Small bin cabinets are needed to handle the large volume of small components used in module repair.

Reissues of this practice will address more physical description and layout recommendations.

9. COMMUNICATIONS DESCRIPTION

The MMG personnel use voice telephone communications to receive trouble referrals from personnel assigned to MOTR in the MOG. The MMG personnel also use voice telephone communications to contact various vendors concerning spare parts, software or hardware documentation, training courses, etc. The MSG personnel are contacted through telephone voice communications for information or on-site support.

A terminal or terminals with dial-up facilities are needed to establish remote diagnostic capabilities or monitor remote locations in order to identify and isolate troubles to a specific device. This will aid MMG personnel in determining which part or parts are needed before they leave for the trouble site.

Links between the MRSS and/or other mechanized trouble reporting systems are also needed.

10. GLOSSARY

Abbreviations/acronyms used in this practice are defined as follows:

ATE

Automatic Test Equipment. This equipment runs tests on a circuit board to determine its functional status and to isolate faulty components.

BCR

Bell Communications Research Inc.

CCTAC

Computer Communications Trouble Analysis Center.

COMAS

Computerized Maintenance and Administrative Support. This is a BTL-developed minicomputer operations system which does ineffective attempt analysis for electromechanical central offices.

EADAS

Engineering and Administrative Data Acquisition System.

ETDC

EADAS Traffic Data Converter.

ETL

Equipment Test List. This is a list of required preventive maintenance routines for a given minicomputer hardware subsystem.

FCO

Field Change Order. This is a minicomputer vendor engineering change which is incorporated into hardware deployed in working systems. The MMG is responsible for applying FCOs.

MCM

Minicomputer Corrective Maintenance. This is an MMG work function.

MHC

Minicomputer Hardware Change. This is an MMG work function.

MMA

Minicomputer Maintenance Administration. This is an MMG work function.

MMG

Minicomputer Maintenance Group.

MMOC

Minicomputer Maintenance and Operations Center.

MOA

Minicomputer Operations Administration. This is an MMG work function.

MOG

Minicomputer Operations Group.

MOTR

Minicomputer Operations Trouble Response. This is an MMG work function.

MPM

Minicomputer Preventive Maintenance. This is an MMG work function.

MRSS

Minicomputer Reliability Study System. This is an AT&T system which keeps reliability and inventory information for all Bell System minicomputer systems.

MSG

MMOC Support Group. This is the operating telephone company organization responsible for minicomputer system technical support and planning.

MTRC

Minicomputer Trouble Report Control. This is an MMG work function.

NCO

Normal Computer Operation.

OEM

Original Equipment Manufacturer.

RCU

Remote Control Unit.

ROTL

Remote Office Test Line.

SPM

Spare Parts Inventory Management. This is an MMG work function.

TNOP

Total Network Operations Plan.

UWC

User Work Center.