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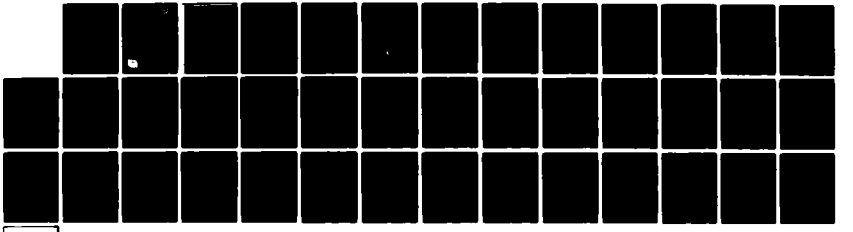

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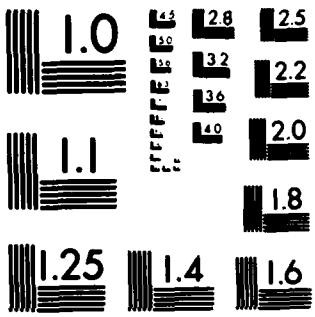

IDA RECORD DOCUMENT D-27

R&M PARAMETER ANALYSIS DOCUMENT

(IDA/OSD R&M Study)

Lt. Col. Larry D. Griffin, USAF

George A. Kern
Hughes Aircraft Company

August 1983

Prepared for
Office of the Under Secretary of Defense for Research and Engineering
and
Office of the Assistant Secretary of Defense
(Manpower, Reserve Affairs and Logistics)

INSTITUTE FOR DEFENSE ANALYSES
SCIENCE AND TECHNOLOGY DIVISION

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This document describes the four categories of R&M parameters (Readiness, Reliability, Maintainability and Manpower) used by each of the Services (Army, Navy, Air Force) for typical military systems and equipments. In addition to the descriptions of each parameter (and its subsets), its strengths and weaknesses and a discussion of each parameter are included. Typical factors and a Glossary of terms are also included.

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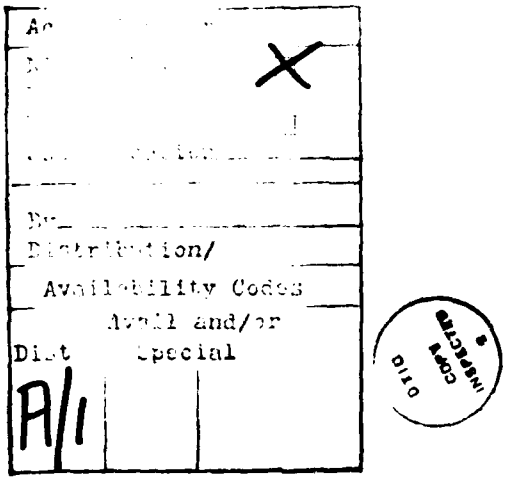


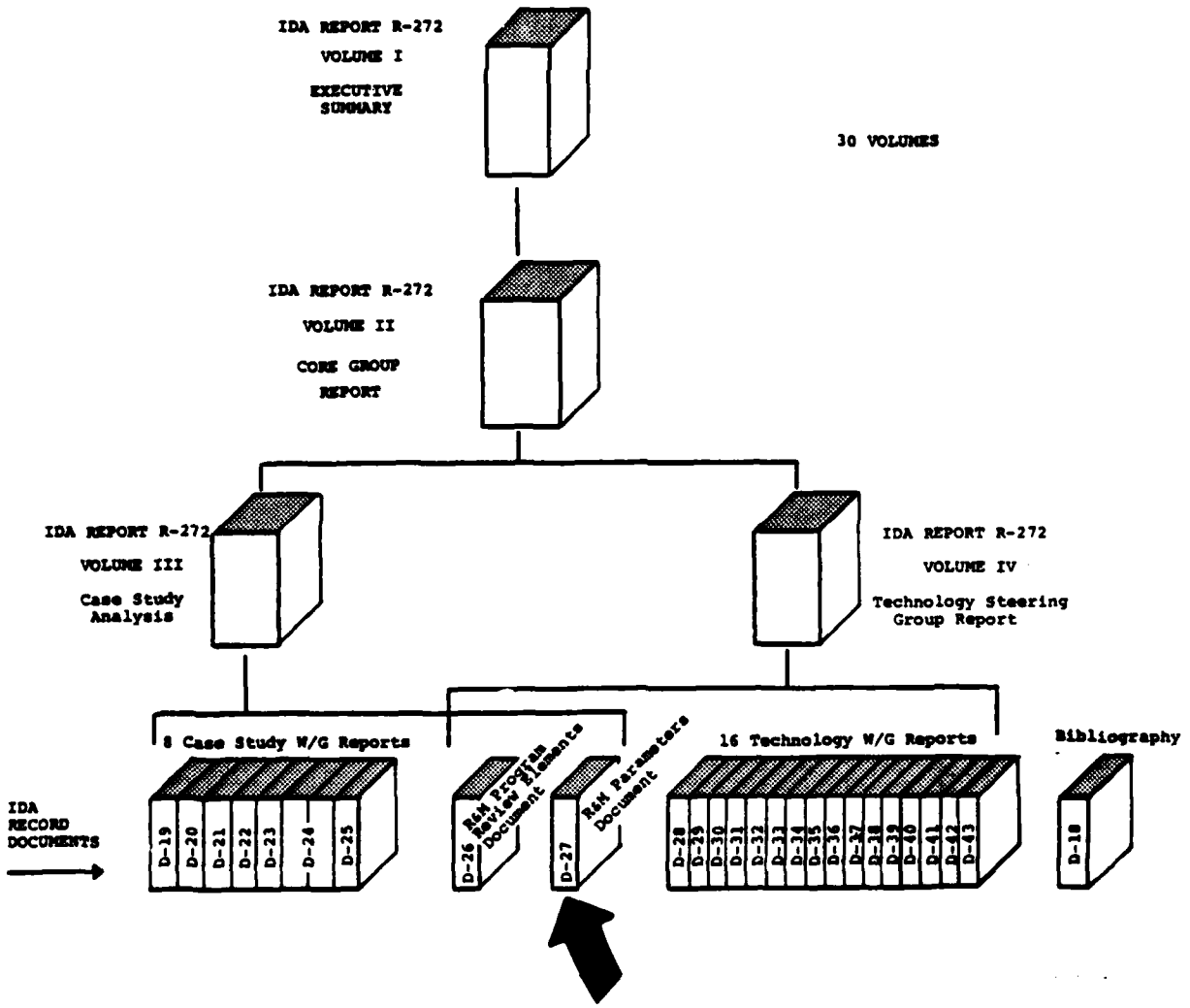
August 1983

INSTITUTE FOR DEFENSE ANALYSES
SCIENCE AND TECHNOLOGY DIVISION
1801 North Beauregard Street, Alexandria, Virginia 22311

Contract MDA 903 79 C 0018
Task T-2-126

RELIABILITY AND MAINTAINABILITY STUDY

— REPORT STRUCTURE —



THIS DOCUMENT

(IDA RECORD DOCUMENT D-27)

PREFACE

As a result of the 1981 Defense Science Board Summer Study on Operational Readiness, Task Order T-2-126 was generated to look at potential steps toward improving the Materiel Readiness Posture of DoD (short title: R&M Study). This task order was structured to address the improvement of R&M and readiness through innovative program structuring and applications of new and advancing technology. Volume I summarizes the total study activity. Volume II integrates analysis relative to Volume III, program structuring aspects, and Volume IV, new and advancing technology aspects.

The objective of this study as defined by the task order is:

> "To identify and provide support for high payoff actions which the DoD can take to improve the military system design, development and support process so as to provide quantum improvement in R&M and readiness through innovative uses of advancing technology and program structure."

The scope of this study as defined by the task order is:

> To (1) identify high-payoff areas where the DoD could improve current system design, development program structure and system support policies, with the objective of enhancing peacetime availability of major weapons systems and the potential to make a rapid transition to high wartime activity rates, to sustain such rates and to do so with the most economical use of scarce resources possible, (2) assess the impact of advancing technology on the recommended approaches and guidelines, and (3) evaluate the potential and recommend strategies that might result in quantum increases in R&M through innovative uses of advancing technology.

The approach taken for the study was focused on producing meaningful implementable recommendations substantiated by quantitative data with implementation plans and vehicles to be provided where practical. To accomplish this, emphasis was placed upon the elucidation and integration of the expert knowledge and experience of engineers, developers, managers, testers and users involved with the complete acquisition cycle of weapons systems programs, as well as upon supporting analysis. A search was conducted through major industrial companies, a director was selected, and the following general plan was adopted.

GENERAL STUDY PLAN

Vol. III	• Select, analyze and review existing successful program
Vol. IV	• Analyze and review related new and advanced technology
Vol. II	• Analyze and integrate review results • Develop, coordinate and refine new concepts
Vol. I	• Present new concepts to DoD with implementation plan and recommendations for application.

The approach to implementing the plan was based on an executive council core group for organization, analysis, integration and continuity; making extensive use of working groups, heavy military and industry involvement and participation, and coordination and refinement through joint industry/service analysis and review. Overall study organization is shown in Fig. P-1.

The basic case study approach was to build a foundation for analysis and to analyze the front-end process of program structuring for ways to attain R&M, mature it, and improve it.

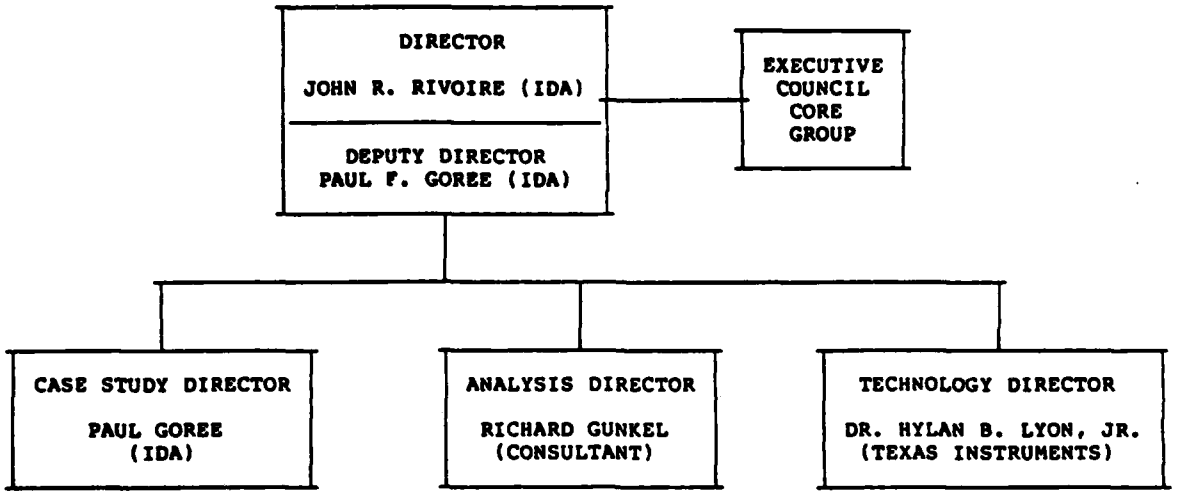


FIGURE P-1. Study organization

Concurrency and resource implications were considered. Tools to be used to accomplish this were existing case study reports, new case studies conducted specifically to document quantitative data for cross-program analysis, and documents, presentations, and other available literature.

This document records the results of the R&M parameter analysis review activities performed during the initial phase of the study to identify the four categories of R&M parameters used by each of the Services (Army, Navy, Air Force) for typical military systems and equipments. The four categories of R&M parameters defined herein consist of Readiness, Reliability, Maintainability and Manpower measures, and are supplemented by specific examples of typical factors used and a Glossary, which defines each of the commonly used terms. In addition to the descriptions of each parameter (and its subsets), its strengths and weaknesses and a discussion of each parameter are included.

These R&M parameters were used to provide quantitative measures of R&M performance as appropriate to each of the subsequently developed Case Study and Technology Working Group

reports (D-19 to D-43) and Volumes I through IV of the final study report.

The views expressed within this document are those of the working group only. Publication of this document does not indicate endorsement by IDA, its staff, or its sponsoring agencies.

R&M PARAMETER ANALYSIS DOCUMENT

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R&M PARAMETERS ASSESSMENT

R&M PARAMETER DESCRIPTIONS

1.0 READINESS PARAMETERS

The measures of peacetime and wartime readiness currently in use are essentially variations of availability measures. The dominant readiness parameters identified as currently in use by the Services are listed and discussed below.

1.1 MISSION CAPABLE (MC) RATE--The percentage of possessed time that a system is capable of performing at least one of its assigned missions.

- Subsets

  Full Mission Capable (FMC) Rate--the percentage of possessed time that a system is capable of performing all of its assigned missions.

  Partial Mission Capable (PMC) Rate--the percentage of possessed time that a system is capable of performing at least one but not all of its assigned missions.

  Not Mission Capable (NMC) Rate--the percentage of possessed time that a system is not capable of performing any of its assigned missions.

Assessment of suitability of MC rate as an indicator of peacetime system/equipment readiness:

Strengths:

(1) Established reporting system.
(2) Is related to ability to train.
(3) Is related to system support effectiveness.
(4) Is related to ability to transition to war posture.
(5) Is related to mission critical subsystems.
(6) Since peacetime utilization rates are mandated as a result of peacetime requirements and budgets, it is a more meaningful measure of peacetime readiness than utilization rates.
(7) Historical information is generally available.

Weaknesses:

(1) Multimission systems/equipment can be mission capable, but not able to perform primary mission. (Navy reporting system for aircraft differentiates by each assigned mission.)
(2) Strongly scenario-dependent; value is a function of amount and type of usage, and support policies. Less use usually means fewer required maintenance actions, hence higher mission capable rates.
(3) Is perceived to be used by services as management evaluation tool. This increases potential for gaming.
(4) Uses "possessed" system/equipment hours as the basis for determining mission capable rate. "Possessed" is defined as the total hours in a given period that assigned systems/equipments are under the control of an operational unit. This means that systems/equipment at the depot or in the pipeline don't count.
(5) Most people don't understand the details of how mission capable rates are calculated, hence may draw erroneous conclusions from this information.

(6) Reported values are averages usually over significant periods of time. Sometimes this conceals significant variations in capability.

(7) System or equipment is capable if it is not "down". "Down" has a specific definition which tends to be confusing, e.g., a system in scheduled maintenance is not "down" until a problem is found in a minimum essential subsystem/equipment which will take more than two hours to fix.

(8) Confusion in charging downtime at subsystem level.

Discussion:

Despite the limitations of this parameter, it is a meaningful measure of system readiness, particularly if it is separated by assigned mission and combined with a utilization rate. If it is not separated by assigned mission, FMC should be specified and evaluated. Management at all levels is at least aware of the parameter and it is possible to translate it into design constraints. Since this parameter is scenario dependent, any comparisons should pay special attention to this aspect to ensure that the comparisons are valid.

1.2 OPERATIONAL AVAILABILITY (A_O)--The percentage of time that a system, subsystem, or equipment is capable of performing assigned missions.

Assessment of suitability of A_O indicator of system, subsystem, equipment readiness:

Strengths:

(1) Is related to support effectiveness.

(2) Is related to ability to train.

(3) Is related to ability to meet wartime demands.

Weaknesses:

(1) Except for Navy, Services have no standardized way of computing A_O.

(2) No established reporting or tracking systems.

(3) Highly scenario-dependent. Strong function of amount and type of use and support policy.

(4) Not usually understood by management.

(5) No historical data for most systems, subsystems, or equipment.

Discussion:

This is a parameter often used by the test community. It is not familiar to management and it is calculated many different ways. If this parameter is to be a useful indicator of readiness, its method of determination must be defined. It is a potentially useful indicator for items which have only two states, functional or not functional, such as most subsystems or equipment. If it is to be widely used by the Services, the Army and Air Force should follow the Navy's example and establish instructions for its use.

1.3 UPTIME RATIO--Percentage of possessed time that a system is "up". Used primarily for ground communications equipment and simulators.

Assessment of suitability of Uptime Ratio as an indicator of system, subsystem, and equipment readiness:

Strengths:

(1) Existing data system.
(2) Used by operating commands.
(3) Historical information available.

Weaknesses:

(1) Not understood by management outside of using organizations.
(2) Requires supplemental analysis to be fully meaningful.
(3) Different ways of calculating. No universally accepted method of determination.
(4) In some cases it may not be an accurate indication of system status/capability.

Discussion:

This parameter is similar to mission capable, but has some subtle differences. It is usually associated with equipment which is being used nearly continuously, such as ground communications equipment. It is usually based on scheduled operating and standby time. A system is considered "up" if it is in use and satisfies its requirements. It is "down" if it is in use and unable to satisfy requirements. Scheduled maintenance and other inactive periods are not counted as downtime.

1.4 SORTIE GENERATION CAPABILITY (SGC)--The number of sorties per aircraft per day that can be generated under a specified operating and support scenario.

Assessment of suitability of SGC as an indicator of system readiness:

Strengths:

(1) Focuses on the most important wartime measure for aircraft-sorties.
(2) Understandable by management.
(3) Directly related to wartime requirements.

Weaknesses:

(1) Strongly scenario-dependent.
(2) Requires significant analytical capability.
(3) Not meaningful in peacetime because sorties are controlled by peacetime scenario and flying authorizations and may be significantly below capability.

1.5 ORBITAL AVAILABILITY (OA)--The percentage of time that the space segment (satellite or constellation) of a system is capable of or is performing its specified mission(s).

Assessment of suitability of OA as an indicator of space system readiness:

Strengths:

(1) Is generally understood by users and management.
(2) Is tracked.
(3) Historical information available.

(4) Is related to peacetime and wartime capability.

Weaknesses:

(1) Does not include the non-spaceborne parts of the system.
(2) Is scenario dependent, function of mission definition.

1.6 ASSET AVAILABILITY--The percentage of authorized assets available for performing assigned missions. For example, the percentage of assigned (not possessed) air-to-air missiles that pass the functional test (if required) prior to being flown. The number possessed will sometimes be less than the number assigned and the number passing checkout will sometimes be less than the number possessed.

Assessment of suitability of Asset Availability as an indicator of readiness:

Strengths:

(1) Discounts for authorized units not possessed, hence may be more relevant for systems/equipment which have little or no organizational off-equipment maintenance and have to be returned to depot for most repairs.
(2) Discounts for storage reliability.
(3) Understandable by users and management.

Weaknesses:

(1) No present information systems.
(2) No historical information readily available.

2.0 RELIABILITY PARAMETERS

2.1 MISSION RELIABILITY--ARMY

- Subsets:

a. Mean Time (operating hours, flight hours, miles or rounds Between Operational Mission Failures (MTBOMF/MMBOMF/MRBOMF).

Strength:

All inclusive parameter, includes loss of any mission essential function for any reason

Weakness:

Difficult to predict and allocate; valid data on the non-hardware failure rates are difficult to obtain.

b. Mean Time (operating hours, flight hours, miles or rounds) Between Hardware Mission Failures (MTBHMF/MMBHMF/MRBHMF).

Strength:

A derivative of MTBMOF which includes only "hardware" reliability per DODD 5000.40

Weakness:

Difficult to predict and allocate;

c. Mean Time (operating hours, flight hours or rounds) Between Essential Maintenance (MTBEMA/MMBEMA/MRBEMA).

Strength:

Includes all operational mission failures plus any additional unscheduled maintenance actions which require corrective action prior to starting the next mission (e.g., repair of a redundant mission essential component).

Weakness:

Difficult to predict and allocate; valid data on the non-hardware failure rates are difficult to obtain.

c. Mean Time (operating hours, flight hours or rounds) between Hardware Essential Maintenance (MTBHEMA/MMBHEMA/MRBHEMA).

Strength:

A derivative of MTBEMA which includes only "hardware" reliability per DODD 5000.40.

Weakness:

Difficult to predict and allocate.

2.2 SUPPORT RELIABILITY--ARMY

- Subsets:

a. Mean Time (operating hours, flight hours, miles or rounds) Between Unscheduled Maintenance Action (MTBUMA/MMBUMA/MRBUMA).

Strength--all inclusive parameter includes all unscheduled maintenance actions for all causes.

Weakness--difficult to predict and allocate; valid data on the non-hardware failure rates are difficult to obtain.

b. Mean Time (Operating Hours, Flight Hours, Miles or Rounds Between Hardware Unscheduled Maintenance Actions (MTBHUMA/MMBHUMA/MRBHUMA).

Strength--a derivative of MTBUMA which includes only "hardware" reliability per DoD 5000.40

Weakness--difficult to predict and allocate.

2.3 MISSION RELIABILITY--AIR FORCE

- Subsets

a. Mean Time (in Flight Hours or Operating Hours) Between Critical Failures (MTBCF).

Strength:
All inclusive term concerning essential system functions.

Weakness:
Variations in identification of essential system functions can cause difficulties in making program comparisons.

b. Mission Reliability (MR) (expressed as a probability of success or percentage, i.e., 0.95 or 95%)

Strength:

A probabilistic expression useful in assessing the performance of a group of aircraft flying sorties.

Weakness:

Normally needs to assume a failure distribution, hard to get a feel for goodness of values, i.e., how significant is the difference between .95, .98, .99, .995, etc.

c. Break Rate (1-Code 3 BR)--a field capability parameter used by TAC for tactical systems. Code 3 indicates a hard equipment failure; system performance was unacceptable and some mission requirements were not accomplished but it did not cause a mission abort.

Strength:

Field value from user.

Weakness:

Subjective decision by operator as to what category the aircraft is in.

2.4 SUPPORT RELIABILITY--AIR FORCE

- Subsets:

a. Mean Time (in flight hours or operating hours) Between Corrective Maintenance Events (MTBM). A field parameter MTBM can be further subdivided into:

MTBM (Type 1)--Inherent Malfunctions; on-equipment corrective maintenance events associated with internal equipment malfunctions.

MTBM (Type 2)--Induced Malfunctions; on-equipment corrective maintenance events associated with induced equipment malfunctions from external sources (i.e., other equipment, personnel, etc.).

MTBM (Selected Type 6)--No Defect; on-equipment corrective maintenance events resulting from erroneous failure indications or inability to confirm reported discrepancy.

Strength:

Can be used as an overall maintenance frequency indicator or broken out into its 3 subcategories.

Weakness:

Difficulty in establishing an audit trail from field values back to a development/production contract value.

b. Mean Captive Carry Hours Between Maintenance (MCCHBM). Used for air-to-air or air-to-ground missiles; similar to MTBM where the time used is the captive carry flight time for a missile before it requires unscheduled corrective maintenance.

Strength:

Good overall summary indicator for missiles.

Weakness:

Difficult to establish an audit trail back to development/production contract values.

2.5 MISSION RELIABILITY--NAVY

- Subsets

a. Mean Time (in flight hours or operating hours) Between Critical Failures (MTBF, MFHBF).

Strength:

All inclusive term concerning essential system functions.

Weakness:

Variations in identification ot essential system functions can cause difficulties in making program comparisons.

b. Mission Reliability (MR) (expressed as a probability of success or percentage, i.e., 0.95 or 95%)

Strength:

A probabilistic expression useful in assessing the performance of a group of aircraft flying sorties.

Weakness:

Normally needs to assume a failure distribution, hard to get a feel for goodness of values, i.e., how significant is the difference between .95, .98, .99, .995, etc.

2.6 SUPPORT RELIABILITY - NAVY

- Subsets

a. Mean Time (Operating Hours, Flight Hours, Rounds) Between Corrective Maintenance Actions (MTBCMA).

Strength:

All inclusive parameter used to indicate maintenance frequency.

Weakness:

Difficult to predict and allocate; valid data from field, hard to relate back to development values.

b. Mean Time (Operating Hours, Flight Hours) Between Unscheduled Maintenance Action (MTBUMA).

Strength:

All inclusive parameter includes all unscheduled maintenance actions for all causes.

Weakness:

Difficult to predict and allocate; valid data from field, hard to relate back to development values.

3.0 MAINTAINABILITY PARAMETERS

The two dominant maintainability parameters are the time required to perform on-equipment repair and the frequency of no-defect (or false alarms) experienced during on-equipment diagnostics.

3.1 ON-EQUIPMENT REPAIR TIME

- Subsets

  Mean Time To Repair (MTTR)--the average (elapsed) time to accomplish an unscheduled corrective maintenance repair on-equipment (Army and Air Force).

  Elapsed Maintenance Time (EMT)--the average elapsed maintenance time required to perform an unscheduled corrective maintenance event on-equipment (Navy).

  Mean Down Time (MDT)--the average maintenance down time associated with the performance of an unscheduled maintenance event on-equipment (Air Force).

  Strengths:

  If properly documented, data can provide useful indicators of maintenance downtime contributors for analysis of impact on weapon system readiness/ availability and areas amenable to improvement.

  Weaknesses:

  Documentation ground rules and procedures do not assure uniform and consistent reporting of time

values associated with each separately identifiable element of corrective maintenance time such as administrative delays, personnel delays, material delays, fault verification time, fault isolation time, active repair time, repair verification time, etc. Hence, data do not provide meaningful information for management review/correction of resource expenditures.

3.2 DIAGNOSTICS

- Subsets:

Mean Time Between No Defect Maintenance-Selected Type 6 [MTBM(6)]--the average number of end item operating hours between "No Defect" occurrences associated with a reported discrepancy requiring unscheduled corrective maintenance. The "No Defect" can be found during either on-equipment or intermediate level of maintenance (Air Force and Navy).

Percent Cannot Duplicate (% CND)--the average percentage of on-equipment unscheduled maintenance events in response to a reported discrepancy which could not be duplicated when an on-equipment functional test was performed during maintenance (Air Force and Navy).

Percent Bench Checked-Serviceable (% BCS)--the average percentage of on-equipment unscheduled maintenance events in response to a reported discrepancy which was associated with removal of the suspect item and a subsequent intermediate level maintenance How-Malfunctioned Code "B" (Bench Checked-Serviceable) finding (Air Force and Navy).

No Fault Found (NFF)--the average percentage of on-equipment unscheduled maintenance events in response to a reported discrepancy for which no fault could be found at either the on-equipment or subsequent off-equipment level of maintenance (Army).

Strengths:

An indication of possible shortcomings of the diagnostic capability of the system which may suggest the need for changes to maintenance procedures, TOs, diagnostics methods, or diagnostics software.

Weaknesses:

Data systems do not generally provide for a meaningful (or accurate) measure of diagnostics capability; frequent false alarms are often ignored, therefore not documented; high false alarm rates tend to undermine user/maintainer confidence in diagnostics capability and may result in shotgun maintenance, non-standard procedures, etc.

4.0 MANPOWER PARAMETERS

In the context of this study, manpower is that portion of an operational unit's personnel strength devoted to maintenance and operational support of a specified system/subsystem.

4.1 WORKLOAD--Maintenance Manhour/Unit measure (unit measure can be time-, distance-, or event-related).

Assessment of suitability of MMH/XX as an indicator of workload.

Strengths:

(1) General acceptance
(2) Readily available
(3) Easy to measure
(4) Easy to compute

Weaknesses:

(1) Misunderstood
(2) Inflated data reporting
(3) Does not include OH/supervision
(4) Does not reflect ability/skill level.

Discussion

Maintenance manhour per unit measure is a relative measure of the direct maintenance workload associated with system/subsystem support. The term in itself is somewhat ambiguous. As defined, maintenance manhours are supposed to be restricted to only those tasks that are directly related to system maintenance and support actions. Job preparation, travel time, and supply or support equipment

delays should not be reflected in maintenance manhour figures. There have been, however, studies that suggest that these type actions may be embedded in the task times documented by maintenance personnel. Indications are that documented maintenance manhours are most likely inflated.

For these reasons, one must use caution when documented maintenance manhours are employed as an aid to analysis. While these may be used as a basis for comparability and sensitivity analysis, they should not be construed as an accurate indicator of maintenance manning requirements.

While the purpose of the Air Force Maintenance Data Collection Systems is to provide a valid base of historical data on maintenance resource expenditures, the data as reported may well be more influenced by the services' perception of their maintenance manning needs.

4.2 MANNING FACTORS--Number of personnel/system-subsystem (ACFT, VEHICLE, etc.).

Assessment of number of personnel/system-subsystems as an indicator of manning factors:

Strengths:

Readily available, easy to measure, easy to compute, includes total maintenance manpower requirement.

Weaknesses:

Does not differentiate skill requirements; no direct correlation to workload/productivity.

Discussion

Number of personnel per system or subsystem is a simple accounting term used to quantify total maintenance manpower requirements. It is not used for other than accounting purposes.

AIR FORCE

	F-15 WEAPON SYSTEMS		F-15 APG-63 RADAR	
	FOT&E RESULTS	FIELD CY'81	FOT&E AUG '76	FIELD CY '81
READINESS				
PEACETIME	(OR) MC 44.6%	MC 60.8%	Ao	Ao
WARTIME	SGC	SGC	Ao	Ao
RELIABILITY				
MISSION	MTBCF 0.8[A]	MTBCF 1.55[B]	MTBCF 10.1[A]	MTBCF 19.8[B]
SUPPORT	MTBM 0.4	MTBM 0.44	MTBM 2.8	MTBM 7.0
MAINTAINABILITY				
ON EQUIPMENT REPAIR	MTTR MDT	MDT	MTTR	MDT
DIAGNOSTICS	MTBM (6) BIT/FIT EFFECTIVE % CND % BCS	MTBM (6) 0.75 % CND % BCS	MTBM (6) BIT/FIT EFFECTIVE % CND % BCS	MTBM (6) 11.1 % CND % BCS
MANPOWER				
WORKLOAD	MMH/FH 36.1	MMH/FH 28.6	MMH/FH 2.2	MMH/FH 1.97
MANNING	#/	#/		

NOTE: [A]INHERENT MALFUNCTION (TYPE 1)

[B]MEAN TIME BETWEEN CODE 3 FAILURES

26/22

AIR FORCE (CONT'D)

	AIR TO AIR MISSILES (AIM-7M)	
	T&E	FIELD
READINESS		
PEACETIME	STOCKPILE AVAIL. %	
WARTIME	MISSION GENERATION %	
RELIABILITY		
MISSION	MR	
SUPPORT	MTBM MCCHBM	MCCHBM
MAINTAINABILITY		
ON EQUIPMENT REPAIR	GENERATION TIME	
DIAGNOSTICS	BIT/FIT EFFECTIVENESS	
MANPOWER		
WORKLOAD	% DIRECT PRODUCTIVE UTILIZATION	
MANNING	UNIT MISSILE MAIN/LOAD MANNING	

AIR FORCE (CONT'D)

	GROUND ELECTRONICS		SATELLITES (GPS/NAVSTAR)	
	T&E	FIELD	T&E	FIELD
READINESS				
PEACETIME	Ao UPTIME RATIO	MC UPTIME RATIO	ORBITAL AVAIL	ORBITAL AVAIL
WARTIME	Ao UPTIME RATIO	MC UPTIME RATIO	ORBITAL AVAIL	ORBITAL AVAIL
RELIABILITY				
MISSION	MTBCF	MTBCF	ON ORBIT LIFE	ON ORBIT LIFE
SUPPORT	MTBM	MTBM	TIME BETWEEN REPLACEMENT	
MAINTAINABILITY				
ON EQUIPMENT REPAIR	MTTR MDT		REPLENISHMENT TIME	REPLENISHMENT TIME
DIAGNOSTICS	MTBM (6) BIT/FIT EFFECTIVENESS	MTBM (6) % CND % BCS	% SUBSYSTEM COVERAGE	% SUBSYSTEM COVERAGE
MANPOWER				
WORKLOAD	MMH/OH	MMH/		
MANNING	UNIT MAINTE- NANCE MANNING			

26/21-2

AIR FORCE

	TACTICAL SYSTEMS (F-15, F-16)		SUBSYSTEM (ENGINES, RADARS, NAV (INS))	
	T&E	FIELD	T&E	FIELD
READINESS				
PEACETIME	MC	MC	Ao	Ao
WARTIME	SGC	SGC		
RELIABILITY				
MISSION	MTBCF MR	1-CODE 3 BR	MTBCF	1-CODE 3 BR
SUPPORT	MTBM	MTBM	MTBM	MTBM
MAINTAINABILITY				
ON EQUIPMENT REPAIR	MTTR MDT	MDT	MTTR	MDT
DIAGNOSTICS	MTBM (6) BIT/FIT EFFECTIVE % CND % BCS	MTBM (6) % CND % BCS	MTBM (6) BIT/FIT EFFECTIVE % CND % BCS	MTBM (6) % CND % BCS
MANPOWER				
WORKLOAD	MMH/FH	MMH/FH	MMH/FH	MMH/FH
MANNING	#/	#/		

26/21-1

NAVY FIGHTER AND ATTACK AIRCRAFT

	SYSTEMS (F-18)		SUBSYSTEMS	
	T&E	FIELD	T&E	FIELD
READINESS				
PEACETIME	MC	MC	Ao	Ao
WARTIME	?	?	?	? NAVY ACTION
RELIABILITY				
MISSION	MR	?	MR	? NAVY ACTION
SUPPORT	MFHBF MFHBMA	MFHBF MFHBMA	MFHBF MFHBMA	MFHBF MFHBMA
MAINTAINABILITY				
ON EQUIPMENT REPAIR	EMT	EMT	EMT	EMT
DIAGNOSTICS	BIT/FIT EFF FALSE ALARM RATE	MTBND	BIT/FIT EFF	MTBND
MANPOWER				
WORKLOAD	DMMH/FH	MMH/FH	DMMH/FH	MMH/FH
MANNING		#/		

ARMY

	HELICOPTERS (AH-60A) TEST & FIELD	GROUND VEHICLES (FVS) TEST & FIELD	GROUND ELECTRONICS (FIREFINDER) TEST & FIELD
READINESS			
PEACETIME	Ao	Ao	Ao
WARTIME	Ao	Ao	Ao
RELIABILITY			
MISSION	MFHBMOF MFHBMHF MFHBEM	MMBMOF MMBMHF MMBEM	MOHBMOF MOHBMHF MOHBEM
SUPPORT	MFHBOMA MFHBHMA	MMBOMA MMBHMA	MOHBOMA MOHBHMA
MAINTAINABILITY			
ON EQUIPMENT REPAIR	MTTR	MTTR	MTTR
DIAGNOSTICS	NFF (RIW ITEMS)		
MANPOWER			
WORKLOAD	MMH/FH	MMH/M	MMH/OH
MANNING	#/	#/	#/

26/17

GLOSSARY

A_o	Operational Availability
BCS	Bench Checked-Serviceable
BIT	Built In Test
CND	Can Not Duplicate
DMMH/FH	Direct Maintenance Man Hours/Flight Hours
EFF	Effectiveness
EMT	Elapsed Maintenance Time
FIT	Fault Isolation Test
FOD	Foreign Object Damage
GSE	Ground Support Requirement
INS	Inertial Navigation System
MC	Mission Capable
MCCHBM	Mean Captive Carry Hours Between Maintenance
MDT	Mean Down Time
MFHBEM	Mean Flight Hours Between Essential Maintenance
MFHBF	Mean Flight Hours Between Failures
MFHBHMA	Mean Flight Hours Between Hardware Maintenance Action
MFHBMA	Mean Flight Hours Between Maintenance Action
MFHBMHF	Mean Flight Hours Between Mission Hardware Failure
MFHBMOF	Mean Flight Hours Between Mission Operational Failure
MFHBOMA	Mean Flight Hours Between Operational Maintenance Action

MMBEM	Mean Miles Between Essential Maintenance
MMBHMA	Mean Miles Between Hardware Maintenance Action
MMBMHF	Mean Miles Between Mission Hardware Failure
MMBMOF	Mean Miles Between Mission Operational Failure
MMBOMA	Mean Miles Between Operational Maintenance Action
MMH/FH	Maintenance Man Hours/Flight Hours
MMH/M	Maintenance Man Hours/Mile
MMH/OH	Maintenance Man Hours/Operating Hours
MOHBEM	Mean Operating Hours Between Essential Maintenance
MOHBHMA	Mean Operating Hours Between Hardware Maintenance Action
MOHBMHF	Mean Operating Hours Between Mission Hardware Failure
MOHBMOF	Mean Operating Hours Between Mission Operational Failure
MOHBOMA	Mean Operating Hours Between Operational Maintenance Action
MR	Mission Reliability
MTBCF	Mean Time Between Critical Failures
MTBCMA	Mean Time Between Corrective Maintenance Action
MTBCR	Mean Time Between Component Removal
MTBHMA	Mean Time Between Hardware Maintenance Action
MTBIFA	Mean Time Between In Flight Abort
MTBOMA	Mean Time Between Operational Maintenance Action
MTBM	Mean Time Between Maintenance
MTBMHF	Mean Time Between Mission Hardware Failure

MTBMOF	Mean Time Between Mission Operational Failure
MTBND	Mean Time Between No Defect
$MTBR_XC$	Mean Time Between Red X Condition
MTBUMA	Mean Time Between Unscheduled Maintenance Action
MTTR	Mean Time To Repair
NFF	No Fault Found
RIW	Reliability Improvement Warranties
T&E	Test and Evaluation
1-Code 3 BR	Type 1 Code 3 Break Rate
#/	Maintenance Personnel/Aircraft


ATE
LME