

TL0790-AB-PRO-010

# LOGISTICS SUPPORT ANALYSIS

## PROCEDURES FOR MAINTENANCE REQUIREMENTS PLANNING

### (LSA II)



Draft

1 December 1982

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## 1. INTRODUCTION

### 1.1 Purpose

This document describes the tasks, responsibilities, and requirements for implementing the Logistics Support Analysis (LSA) process to determine maintenance resource and other Integrated Logistics Support (ILS) requirements for Navy ships and ship equipments. The procedures described in this manual fulfill the requirements of Department of Defense guidance (MIL-STD-1388) for tailoring LSAs. The manual also incorporates procedures for using Reliability-Centered Maintenance (RCM) concepts in the LSA to determine maintenance requirements.

#### 1.1.1 Applicability

The concepts and procedures in this manual apply to logistic support planning for ship acquisitions and for new systems and/or equipments to be provided as Government Furnished Equipment (GFE) for current or future weapons platforms. Chapter 2 of the Manual addresses tailoring procedures and other requirements unique to ship acquisitions. Chapter 3 discusses LSA requirements for system acquisitions. The remainder of the manual describes the LSA process and except where indicated is applicable to both ship and weapon system support planning. Moreover logistic planning for systems and equipments must consider the missions of the ship platform and the relationship of the end item to the functions of other ship systems with which it will interface.

### 1.2 Scope

The LSA procedures described herein cover the selection of equipment for analysis, the conduct of maintenance task analysis, and the general output requirements. It also integrates into the procedure the Preventive Maintenance requirements (all acquisitions) and Fitting-Out Management Information System requirements (Ship Acquisitions) specified by the following documents:

- o Military Specification, MIL-P-24534 (Navy), Planned Maintenance Subsystem; Development of Maintenance Requirement Cards, Maintenance Index Pages and Associated Documentation
- o Appendix F to Military Specification, MIL-P-24534 (Navy), Reliability-Centered Maintenance Approach to Preventive Maintenance
- o Military Standard, Fitting-Out Management Information System MIL-STD-1626 (Ships)

### 1.3 Background

The LSA concept was developed to provide a systematic, analytic approach to determining maintenance resource requirements for new weapon systems. During the design phase of a new system, LSA is used to estimate life-cycle maintenance costs and other critical factors, such as the manpower requirements of competing engineering approaches. Once an optimum design has been determined, the LSA process in concept can define all maintenance requirements (trained manpower, technical data, spare parts, support and test equipment, etc.) that must be procured and put in place to support the weapon system when it is deployed. After deployment, LSA can be used to update and revise support requirements.

Thus, LSA is a continuous, iterative maintenance planning process that applies throughout the life-cycle of a weapon system. However, since the analysis emphasis shifts at key points in the life-cycle, it is convenient to divide the LSA process into three phases:

LSA I: Trade-off and Life Cycle analysis during the design stage of an acquisition to ensure that technical designs can be supported to meet operational goals at the lowest possible life-cycle cost.

LSA II: Maintenance Requirements Planning during full scale development and production to identify the specific logistic elements that will be required.

LSA III: Feedback analysis to evaluate the adequacy of logistics support after the system is operational and improve or modify support as required.

This manual provides guidelines for LSA II, Maintenance Requirements Planning (MRP). The philosophy behind MRP is to concentrate analysis efforts on new systems and to identify and prepare for all significant and probable failures (not every conceivable failure) which might occur over a ship or systems expected life. Emphasis is placed on ensuring that those failures which would affect safety or operations goals receive adequate attention during the LSA process. The results of MRP form the basis of the Maintenance Plan (MP) and Planned Maintenance Subsystem (PMS).

The analytic techniques used in LSA II are similar to, but supercede those originally developed for Maintenance Engineering Analysis (MEA). They include the following:

- o Development of the hierarchical structure of the ship or weapon system to identify Functionally Significant Items (FSIs)[1]
- o Failure Modes and Effects Analysis (FMEA);
- o Level of Repair Analysis (LORA);
- o Preventive Maintenance (PM) Analysis;

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[1] FSIs are systems, subsystems, equipments or assemblies that provide a discrete function whose loss would have a significant impact on the mission capability of the ship or weapon system or pose a threat to operating safety.

- o Corrective Maintenance (CM) Analysis;
- o Inactive Equipment Maintenance (IEM) Analysis; and
- o Task analysis to identify logistic element requirements.

This manual provides guidance on how each of these analyses are to be conducted and the rigor and depth of analysis appropriate for different elements of the ship or system. Although detailed engineering analyses may provide the most complete and accurate estimate of logistics requirements, they are time consuming and expensive. Procedures are needed to ensure that the methods used in conducting an LSA on a particular ship or system are related to the importance, complexity and stability (newness) of the system and that the overall LSA process can be completed in time to have maintenance resources in place when the ship or system is deployed.

These concerns are particularly critical when a weapon system is as complex as a naval ship, consisting of hundreds of systems and equipments. Not only is the potential cost of conducting complete detailed engineering analyses on all of these elements very high, but initial Navy experience in applying the LSA process to ships has shown that unless the analysis is carefully focused, the analysis cannot be completed in time to support initial deployment.

In the LSA II process described in this manual, analysis is first concentrated in the system and subsystem level to identify those maintenance tasks which are critical to safe and effective operation. Detailed engineering analytic methods to determine corrective maintenance requirements are used only on selected systems and equipments. By tailoring the LSA process in this manner, the time and cost of the analysis is significantly reduced.

#### 1.4 NAVSEA Acquisition Programs

NAVSEA is responsible for various types of acquisitions including total ships, system/equipments, modernization, conversion and modification programs. Each program has unique ILS requirements and most are interrelated, e.g., individual system/equipment acquisitions become Government Furnished Equipment

(GFE) in ship acquisitions; modernization conversion and modifications upgrade the capabilities of prior ship and system programs.

Ship acquisition programs generally fall into one of three categories:

- o The multiple buy program of only a few ships over an extended period with very limited technical risk, e.g., AO-177
- o The lead/follow ship program of a number of ships planned for production with technical risks, but where the need, urgency, risk and worth assessment indicates that follow ship production should start prior to completion of the lead ship, e.g., FFG-7. This results in a decision to delay construction of follow ships approximately one to two years to take advantage of design developments and establish the design baseline of the ship class prior to construction for follow ships.
- o The prototype ship program where the need, urgency, risk and worth assessment indicates that a prototype ship be completed and tested prior to initiating production of additional ships, e.g., PHM-1.

Systems/equipments may also be categorized into several grouping:

- o New Complex Systems (Developmental Programs) - combat systems and propulsion systems where new technology is involved and the procurement includes all phases of the acquisition process (Conceptual, Validation, Full Scale Development and Production). When complexity warrants, such systems may also include construction of Land Based Test Sites.
- o Modified-Standard - the system/equipment is similar but not identical to hardware in Navy use. The acquisition involves design changes required to meet product improvement goals or to interface with a new application.

- o Standard - the equipment is identical to hardware in Navy use. (It is already supported with technical documentation, test equipment, allowance parts lists, and has repair parts already positioned in the supply system).

The maintenance requirements determination process for a ship must consider both the constraints of the system/equipment acquisition process and the ship design and construction schedule. Ship Systems and Combat Systems Project Managers (PM) who are responsible for the development and implementation of their own ILS programs also act as Participating Managers (PARMS) providing ILS support to the Ship Acquisition Project Manager (SHAPM). Examples of the interrelationships of the ship acquisition and system acquisition can be seen from Figure 1-1, a matrix of representative systems/equipments installed in examples of each ship category.

Figure 1-1  
SHIP/SYSTEM RELATIONSHIPS

SYSTEM/EQUIPMENT CATEGORY	SHIP CATEGORY		
	MULTIPLE BUY (AO-177)	LEAD/FOLLOW (FFG-7)	PROTOTYPE (PHM-1)
New Complex	Automated Central Control Consoles	MK 92 GPCS	Gas Turbine Propulsion Sys
Modified-Standard	UNREP Equipment	AN/UYK 7 Computer	Fire Fighting System (AFFF)
Standard	Communications Equipment	Various Electric Motors, Controllers, Valves, etc.	MK 75 Gun

Each ship category is built using systems/equipments of all three types. Systems categorized by each cell of the matrix provide a different set of ILS planning problems. For example, the impact of poor ILS planning for a new complex system installed in a lead/follow shipbuilding program can be significantly greater than the impact would be if the same system were installed in a prototype program. Savings derived from an effective and efficient ILS program for a lead/follow class of ships will be greater than that derived from a smaller multiple buy acquisition.

### 1.5 Role of the ILS Manager

The ILS manager for the acquisition plays a key transition role after the completion of the LSA-I process and during the development of LSA-II requirements. He provides continuity to the LSA development since he was involved in the early stages of the acquisition process when the basic logistics concepts were developed, and he has managed the ILS effort through the sequence of logistics planning steps required to move the program to the Detail Design/Construction Phase for ships and Full Scale Development for major system acquisitions. His efforts result in supportability inputs in the areas of:

- o Reliability and Maintainability Requirements
- o Technical Documentation Requirements
- o Support and Test Equipment Concepts
- o Packaging, Handling and On-Site Storage Requirements
- o Facilities Requirements
- o Personnel Requirements
- o Supply Support Concepts

Prior to the start of LSA-II, most of the LSA-type analyses were system level support analyses which considered the trade-offs between the ship or systems operational design characteristics and logistics support system design considerations. The analysts involved in the LSA I process considered broad maintenance concepts and maintenance planning factors in defining functional requirements and support system alternatives. They were logistics specialists with additional training in the areas of simulation, modeling, economic analysis and life cycle costing. During LSA-II, the analysis shifts to ILS element level support analyses which identify the specific maintenance requirements. This is a labor intensive effort requiring many analysts with different sets of skills. They must be familiar with the operation and maintenance of the

hardware being procured and capable of defining and evaluating individual maintenance tasks at the micro-level, i.e., numbers and kinds of parts and test equipment required, drawings, technical manuals, manpower quantity and skills, etc. Typically, the LSA-II analyst has either military or private sector experience operating and maintaining mechanical, electrical, or electronic equipment. For ship acquisitions each analyst will normally be involved in analyses of systems/equipments within a single Functional group, e.g., Propulsion Plant, Electrical Plant, Command and Surveillance, etc.

There will be a relatively large number of LSA II analysts involved in a single acquisition and the Navy ILS manager must ensure that the contractor's LSA plan and schedule are clear as to how and when the LSAs are to be conducted and what uses are to be made of the LSA II output. In scheduling LSAs, initial analyses should be focused on those systems/equipments where the maintenance concepts or planning factors are most subject to error. For example, if the Preliminary Ship Manning Document (PSMD) estimate of workload for a critical enlisted skill category appears in doubt, the ILS manager should ensure that systems/equipments requiring that maintenance skill receive early analysis. If the onboard requirements for a critical skill can be reduced by changing the Level of Repair (LOR) for some equipments, he should ensure that the analyses specifically investigate manpower requirements under alternative LOR strategies, or require that LOR decisions will be constrained to always choose the maintenance strategy that minimizes onboard manning for that critical rate. He should then close the support loop by ensuring that the revised LOR decisions are reflected in the supply documents, i.e., Provisioning Technical Documentation and Allowance Parts Lists, and in crew training.

### 1.6 LSA II Plan

Under the direction of the Navy ILS manager, the hardware contractor will be required to prepare a LSA plan. The plan should describe the specific organization, methodology, and schedule for implementing the LSA process described in this Manual. Included should be the following:

- o Procedures for fulfillment of the requirements of the Provisioning Requirements Statement (PRS).
- o Procedures for fulfillment of the Technical Manual Contract Requirements (TMCR).
- o Listing (in CDRL format) of proposed deliverables to the Navy as a result of the LSA process.
- o Description and justification for any proposed changes to LSA procedures.
- o A plan for maintaining the Logistic Support Analysis Record (LSAR)[1] including data entry, data base upkeep, and report generation.
- o The procedure to be used in tracking the LSA process.
- o The quality assurance program supporting the LSA process.

#### 1.7 General Guidelines for Tailoring LSAs

DoD requires the use of Logistics Support Analyses in weapon system and equipment acquisitions. LSAs are not an end in themselves. They are tools to be selectively applied in helping meet the following ILS objectives:

- o Cause support considerations to influence requirements and design:
- o Define support requirements that are optimally related to the design and to each other:

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[1] The LSAR is the medium for recording and storing LSA data. Depending upon the size of the acquisition, the LSAR may be recorded using Automatic Data Processing (ADP) equipment or manual methods.

- o Acquire the required support; and
- o Provide the required support during the operational phase at minimum cost.

MIL-STD-1388 allows the acquisition manager to tailor his LSA efforts to the specific program characteristics and acquisition phase. Before developing contract specifications for detail design (Ships) or full scale development (major systems), the Project Manager should develop his strategy for tailoring the LSA II effort. The Project Manager's objective is to meet his ILS goals within the time and cost constraints of the acquisition program. LSA II analyses should be limited to those tasks which will make a positive contribution to the ILS program.

In developing the scope of LSA II, the Project Manager should review the current status of his LSA program (LSA I), and his ILS plan. The objectives of the review are to:

- o Identify the program requirements which dictate changes in conventional logistic support methods, e.g., new maintenance strategies, unusual training requirements, supply support innovations, etc. and determine the system/equipments involved.
- o Identify systems/equipments that involve advances in technology and high technical risk.
- o Identify any standard/modified standard systems or equipments that might be part of the planned acquisition and have a history of poor performance/support or have a high maintenance burden, such as those currently on the DART List.
- o Determine the status of the LSAR developed during LSA I. Identify those equipments/systems where Failure Modes and Effects Analyses (FMEAs) have been completed. If a new contract is to be awarded, the LSAR will become Government Furnished Information (GFI) for

the next phase of the acquisition process. If a full LSA has already been performed on equipment to be provided as GFE in a ship acquisition, obtain the LSAR for the equipment and limit the shipbuilders analysis to the ship/system interfaces for that equipment.

Depending upon the type of acquisition, this preliminary review may have identified a small number of equipments requiring intensive LSA II analysis or may have simply confirmed that the entire ship or system requires some level of additional LSA.

The next step in the process should be to determine the analysis tasks that are feasible and productive. The following procedure is recommended prior to finalizing the LSA II Statement of Work in the contract specifications.

- o Develop a plan for use for LSA II output. Identify potential use during both Production and Deployment (if any). Limit the scope of the LSA II to the requirements of the plan for use.
- o Estimate the earliest date that various LSA II analyses can begin and be completed. Compare these dates to established ILS milestones. Eliminate or modify those analyses which cannot be completed in time to support applicable ILS events. Identify effective alternatives to the formal LSA process, e.g., as specified in this manual, use conventional provisioning procedures vice extracting parts data from the LSAR, if the LSAR cannot be available when required.
- o Do not add data requirements to the LSA Statement of Work simply to fill voids in the LSAR. If for an equipment, provisioning is to be done conventionally, do not require the full range of piece part data to be added to the LSAR.

- o Develop the Contract Data Requirements List/Data Item Descriptions (CDRL/DID) recognizing that most of the data identified in the MIL-STD-1388 procedures is duplicative of data specified in other contract requirements, e.g., PTD, FOMIS, Technical Data, etc. Eliminating part of the LSA requirement reduces contractor analysis requirements not data requirements.<sup>1/</sup>

### 1.8 Overlap of Requirements

To be cost effective the LSA must integrate the determination of maintenance support requirements with the other system engineering programs that are part of the acquisition. When an LSA is invoked, unless specifically excluded, the contractor, by reference, is required to conform to parts or all of the following specifications, standards and directives:

<u>Publication Number</u>	<u>Title</u>
DOD-4100.38M	Department of Defense Provisioning and Other Preprocurement Screening Manual
DOD-4100.39M	Defense Integrated Data Systems (DIDS) Procedures Manual
DOD-5000.12M	Data Elements and Data Codes Standardization Program
DOD-D-1000	Drawings, Engineering and Associated Lists
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities

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[1] By the same token, in evaluating contractor cost proposals, ensure that the data collection costs do not appear in several line items. This may indicate that the proposed LSA effort is not integrated into the contractor's systems engineering/logistic support organization or that the contractor does not understand the purpose of and techniques for accomplishing LSA.

<u>Publication Number</u>	<u>Title</u>
MIL-M-63001E	Manual Technical: Repair Parts and Special Tools List
MIL-STD-12	Abbreviations for Use on Drawings and Technical-Type Publications
MIL-STD-100	Engineering Drawing Practices
MIL-STD-470	Maintainability Program Requirements for Systems and Equipment
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-482A	Configuration Status Accounting Data Elements and Related Features
MIL-STD-680	Contractor Standardization Plans and Management
MIL-STD-721	Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors and Safety
MIL-STD-726	Packaging Requirements Code
MIL-STD-785	Reliability Programs for Systems and Equipment, Development and Procedures
MIL-STD-881	Work Breakdown Structures for Defense Material Items
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for
MIL-STD-965	Parts Control Program
MIL-STD-1367	Packaging, Handling, Storage, and Transportability Program Requirements for Systems and Equipment
MIL-STD-1388-1	Logistic Support Analysis
MIL-STD-1390	Level of Repair
MIL-STD-1517	Phased Provisioning
MIL-STD-1519	Test Requirements Document, Preparation of

<u>Publication Number</u>	<u>Title</u>
MIL-STD-1552	Uniform DOD Provisioning Technical Documentation
MIL-STD-1561	Provisioning Procedures, Uniform DOD
MIL-STD-1626 (Ships)	Fitting-Out Management Information System
MIL-STD-1629	Procedures for Performing a Failure Mode, Effects and Criticality Analysis
MIL-HDBK-217	Reliability Stress Analysis for Electronic Equipment
MIL-HDBK-472	Maintainability Prediction
MIL-HDBK-245A (Navy)	Preparation of Statement of Work
MIL-P-24534	Military Specification: Planned Maintenance Subsystem; Development of Maintenance Requirements Cards, Maintenance Index Pages and Associated Documentation
NAVFAC P.72	Category Codes for Real Property, Navy
NAVPERS 15839	Manual of Navy Officer Manpower and Personnel Classifications
NAVPERS 18068D	Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards
OPNAVINST 4410.2	Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability Codes
MCO 4400.120	
H4-1	Cataloging Handbook - Federal Supply Code for Manufacturers, United States and Canada - Name to Code
H6-1	Cataloging Handbook - Federal Item Identification Guides for Supply Cataloging
M1-4	Federal Manual for Supply Cataloging - Operating Procedures
M1-6	Federal Manual for Supply Cataloging - Operating Forms

<u>Publication Number</u>	<u>Title</u>
M1-7	Federal Manual for Supply Cataloging - Chapter 7 Format, Content and Preparation of the Federal Supply Catalog Publications
ANSI-Y32-16	References Designations for Electrical and Electronic Parts and Equipment

To demonstrate this potential overlap in analytical effort, Figure 1-2 was developed using a set of typical contractor requirements for a ship acquisition. The MIL-STDs listed down the side of the matrix are usually invoked as part of the systems engineering and individual logistic element requirements. The LSA II requirements[1] listed across the top of the matrix use information or analyses identical to that specified by the cited MIL-STDs and other documents listed in the matrix. Maximum use should be made of the output of the other programs and, where applicable, LSAR data should be traceable to the system engineering or logistic element source.

Appendix B of the Navy/Marine Corps Logistic Support Analysis Handbook (DRAFT) contains sample Statements of Work for LSA programs and provides an index by logistics area (reliability, maintenance planning, support equipment, etc.) of DIDs for each logistic area where part or all of the data requirement could be satisfied from the LSA data base. ILS managers should use this appendix to integrate their data requirements and minimize duplication and overlap in the analysis effort.

### 1.9 LSA II Overview (Ideal Process)

The ideal LSA II is represented by the serial process of Figure 1-3. For each end item the process would begin with the determination of the hardware configuration (Phase 1). During phases 2 and 3 all logistic analyses would be

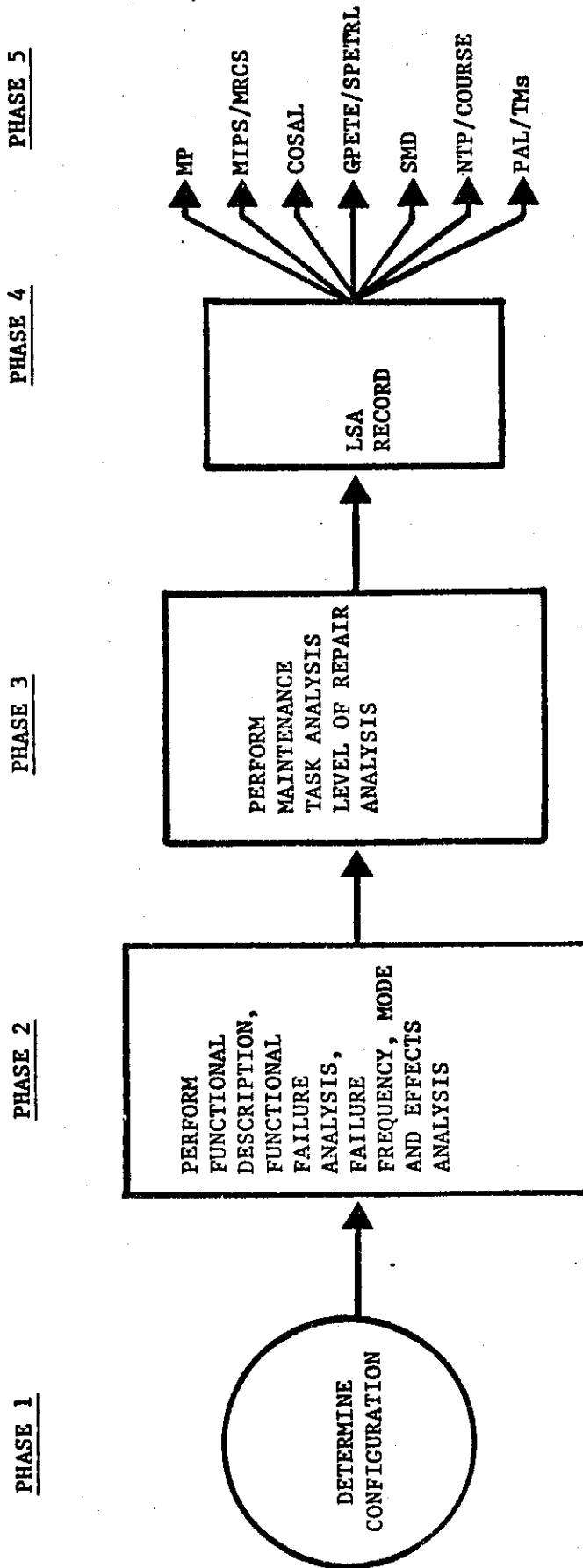
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[1] The section numbers listed next to the LSA II analysis procedure in the matrix are the sections of this manual where the procedures are described.

Figure 1-2  
PROCEDURES OVERLAP MATRIX

DOCUMENT	ANALYSIS PROCEDURES											
	FHEA (5.1)	RCM (5.4)	LORA (5.3)	MAINTENANCE TASK ANALYSIS (5.3, 5.4, 5.5, 5.6)	MAINTENANCE TASK REQUIREMENTS DEFINITION (6.2, 6.4)	TOOL AND TEST EQUIPMENT DETERMINATION (6.2)	MANPOWER, TRAINING AND SKILL REQUIREMENTS (7.4)	TECHNICAL DATA TRAINING MANUALS (7.5, 7.7)	PROVISIONING TECHNICAL DOCUMENTATION (7.6)	PROVISIONING (7.6)	MEC DETERMINATION (4.6)	SHIP BLOCK DIAGRAM INDEX (2.3)
1. MIL-STD-470 Maintainability Program Requirements				•	•	•	•	•				
2. MIL-STD-471A Maintainability Demonstration				•		•	•	•		•		
3. MIL-STD-8882A System Safety Program					•			•			•	
4. MIL-STD-785B Reliability Program Requirements	•			•	•	•		•		•		
5. MIL-STD-965 Parts Control Program					•					•		
6. MIL-STD-1367 PHS&T			•		•		•	•				
7. MIL-STD-1375 (NAVY) Provisioning Requirements									•	•		
8. MIL-STD-1379B Contract Training Programs							•					
9. MIL-STD-1390B Level of Repair			•									
10. MIL-STD-1517 Phased Provisioning										•		
11. MIL-STD-1552A PTD									•			
12. MIL-STD-1561A Provisioning Procedures										•		
13. MIL-STD-1626 FOMIS												•
14. MIL-STD-1629A FMEA	•											
15. MIL-P-24534 (APPENDIX F) PMS	•	•		•	•	•	•	•				
16. MIL-HOBK-217C (APPENDIX A) Reliability Stress Analysis	•											
17. MIL-HOBK-472 Maintainability Prediction	•			•	•	•		•				

Figure 1-3  
IDEAL LSA II PROCESS



performed and the results documented in a Logistic Support Analysis Record (LSAR). When the LSAR contains all required information, the following maintenance planning requirements would be generated using the common LSA data base:

- o Maintenance Plan (MP)
- o Maintenance Index Pages/Maintenance Requirements Cards (MIPs/MRCs)
- o Provisioning Technical Documentation (PTD)
- o Consolidated Shipboard Allowance List (COSAL)
- o General Purpose Electronic Test Equipment/Special Purpose Electronic Test Equipment List (GPETE/SPETRL)
- o Ship Manpower Document (SMD)
- o Navy Training Plan (NTP) and Course Materials
- o Publication Allowance Lists (PALs) and Technical Manuals (TMs)

In order to perform this serial process, all of the logistic disciplines within the contractor organization must provide the input and use the output of a common LSAR in accordance with the LSA plan and schedule.

Experience has shown that this approach cannot be applied to ship acquisitions, especially for Contractor Furnished Equipment (CFE) if the results of the analysis are to be used to support the lead ship in a class. This approach has, however, been used successfully in some systems acquisitions when the Full Scale Development/Production schedules provide sufficient lead time to complete the process and acquire the resources prior to system deployment. The serial process should be used for NAVSEA systems acquisitions when the acquisition manager has determined that sufficient lead time is available.

## 1.10 LSA II Overview (Modified Process)

The modified LSA II Process has been developed to allow the Project Manager to initiate early requirements determination for those logistics elements which require the longest lead times. The Modified LSA II Process flowchart (Figure 1-4) provides for concurrent development of Provisioning Technical Documentation and Technical Manuals. The modified process uses the results of the LSA to validate the accuracy and consistency of PTD and Technical Manuals rather than using a completed LSAR to develop these requirements. Feedback from the LSAs is used to modify/improve provisioning, technical documentation, manpower and training in those cases where the acquisition schedule requires that resource determination decisions be initiated prior to the completion of the LSA. The analysis requirements and procedures of this manual are tailored to the modified LSA II Process, but with the modifications indicated in the body of the manual, the procedures can also be used to support the serial process.

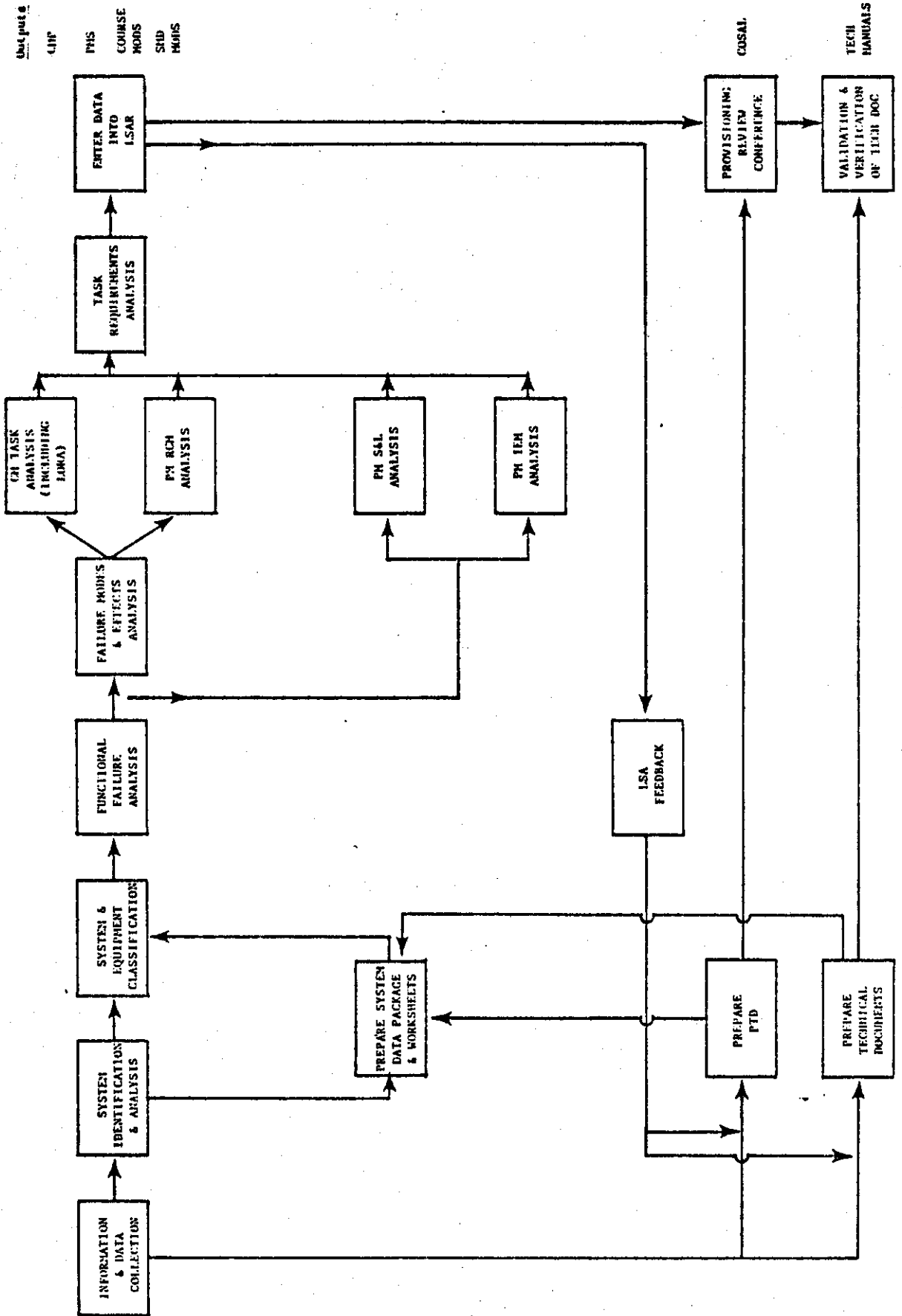
### 1.10.1 Limiting the Depth of Analysis

Tailoring of logistic support analyses has two dimensions, i.e., range and depth. Procedures for limiting the range of systems and equipments to be analyzed are discussed in Chapter 2 (Ship Acquisitions) and Chapter 3 (System Acquisitions). The depth of the analysis is also limited, based upon criticality of the system and the failure characteristics of most shipboard equipment.

A process in which logistics requirements are determined solely by detailed analysis of all possible maintenance tasks is time consuming and not always cost effective. Moreover, empirical studies of failure and maintenance resource consumption have demonstrated that a relatively small percentage of all the possible failure modes of a ship system or equipment are repetitive and account for a high percentage of its total failure events (cumulative failure rate). Maintenance resource consumption has also been found to be highly correlated to this cumulative failure rate.

Typically, the historical relationship between the cumulative number of failure modes and the cumulative number of failure events and/or cumulative resource consumption is of the following type:

Figure 1-4  
MODIFIED LOGISTICS SUPPORT ANALYSIS (LSA II)  
PROCESS FLOW CHART



Cumulative % of Failure Modes	Cumulative % of Total Failures (or Resource Consumption)
20	50
30	70
37	80
50	90
70	95

This implies, for example, that if the maintenance planner ensures that all necessary resources are in place to repair the top 50% (in frequency) of a systems failure modes, these resources can be expected to support approximately 90% of the probable system failures. In order to constrain the time and cost of the LSA and concentrate the analysis on the most important system failures, corrective maintenance task identification and analysis is limited by the Mission Essentiality Code (MEC) of the subsystem in the following manner:

MEC	Depth (% of Failure Events)
5 and 4	90%
3 and 2	75%
1	50%

This limitation is placed upon corrective maintenance task analysis in the LSA and does not change the required depth of coverage of the other contract requirements, i.e., for Technical Manuals, corrective maintenance instructions will be provided for all repairable items in accordance with MIL-M-15071 H (Navy) and Provisioning Parts Lists will include all replaceable items within the equipment. Rules for the assignment of MECs are described in Section 4.6 of this manual.

The MEC approach to LSA is particularly applicable to ship maintenance planning because of the ship's inherent maintenance capability and capacity. Due to its size, complexity, and operating characteristics, a ship must have a wide range of skills, tools, and test equipment, as well as specific parts and

technical documentation, to repair the most probable failures, i.e., those which undergo detailed planning. This concentration of maintenance resources provides the ship with a high probability of successfully responding to unplanned failure events, given the availability of applicable technical documentation and repair parts. Ship intermediate and depot maintenance facilities have an even broader range of inherent maintenance resources than a ship, providing them an even higher degree of flexibility in accomplishing unplanned tasks.

The MRP process takes advantage of these characteristics by focusing the detailed maintenance planning on frequent or critical maintenance tasks, and by assuming that routine or infrequent tasks can be accomplished without detailed planning, as long as adequate technical documentation and spare parts are available. Therefore, MRP is made up of the three elements shown in Figure 1-4:

- o Provisioning;
- o Maintenance Task Identification and Analysis (MTI&A); and
- o Technical Manual Development.

These elements are not independent. As discussed in Chapter 7, key data are exchanged between elements to ensure that the final maintenance plan and resource requirements are fully integrated.

#### 1.11 Use of a Mechanized LSAR

The forms and worksheets described in this manual were developed to guide the analyst through the maintenance requirements determination process in a systematic and efficient manner. If the results of the analyses are to be entered into the mechanized LSAR described in MILSTD-1388 and U.S. Navy/Marine Corps Guide to Logistic Support Analysis (DRAFT), Appendix C should be used to aid in the transcription of the analysis results to the applicable data sheets.

## 1.12 Integration of LSA II and PMS Requirements

In order to minimize duplication of analysis effort, and reduce documentation requirements, a number of the procedures and worksheets used for the LSA are identical to the PMS procedures and worksheets required by MIL-P-24534 (Navy), Appendix F, Reliability-Centered Maintenance Approach to Preventive Maintenance. Common analysis procedures are documented on:

- o Master Systems and Subsystems Index (OPNAV 4790/114)
- o Functional Failure Analysis Worksheet (OPNAV 4790/116)
- o Additional Functionally Significant Item Selection (OPNAV 4790/117)
- o Functionally Significant Item Index (OPNAV 4790/118)
- o Failure Modes and Effects Analysis Worksheet (OPNAV 4790/119)
- o RCM Logic Tree Analysis Worksheet (OPNAV 4790/120)
- o Safety Related Design Change (OPNAV 4790/122)
- o Servicing and Lubrication Analysis Worksheet (OPNAV 4790/121)
- o Inactive Equipment Maintenance (IEM) Worksheet (LSA II Form)
- o Task Requirements Worksheet (LSA II Form)

## 2. PROCEDURES FOR TAILORING LSA II FOR SHIP ACQUISITIONS

### 2.1 Evolution of the Maintenance Concept

MIL-STD-1388 and NAVSEA INST 4105.1 require that the maintenance concept for a new ship acquisition first be addressed during the formulation of alternative configuration baselines. During the Conceptual Phase, the maintenance, supply support, and manning concepts are incorporated into the Top Level Requirement for the new ship class. During Contract Design, functional requirements are translated into ship specifications. When the maintenance concept is a radical departure from previous approaches to ship maintenance, e.g., FFG-7, the maintenance requirements can cause extraordinary design efforts during Contract Design to ensure that the accessibility and equipment handling requirements for maintenance are integrated into the design.

By the start of Detail Design and initiation of LSA II, all of the broad maintenance policy decisions should have been made. The LSA II process is concerned with translating these overall maintenance concepts into effective maintenance plans for the hundreds of equipments to be installed in the ship. Section 2.2 of the Manual contains specific guidelines for tailoring the LSA II effort. Section 2.3 provides instructions for the development of the Ship Block Diagram and Index which will be used to assign LSA Control Numbers (LSACNs) and initiate FOMIS data records.

### 2.2 System and Equipment Classification for Ship Acquisitions

For ship acquisitions, NAVMAT and NAVSEA policy states that Logistic Support Analyses will be conducted on:

- o All new systems installed in the ship, and
- o Existing systems where the operating environment or maintenance concept is significantly different, or observed system performance is characterized by low operational availability and/or excessive maintenance burden.

Classification is a two step process. First, each equipment in the system under analysis is categorized into one of six types. Then, using a simple assignment rule, the set of equipment classifications determines the system/subsystem classification, and the level of Logistic Support Analysis to be conducted on the system.

### 2.2.1 Equipment Categories

Equipment is currently identified as new, standard or modified standard. The identification is made by the shipbuilder during the provisioning process and is used to determine the amount of Provisioning Technical Documentation (PTD) required for the item. A second classification is required for HM&E equipments, i.e., is the equipment simple or complex? This classification is related to the decision on how the equipment maintenance plan is to be developed. For relatively small unsophisticated equipments, e.g., valves, electric motors, etc., the In-Service Engineering Agent (ISEA) has developed generic maintenance plans for the equipment. The generic plan specifies the level of repair, test equipment, and repair parts for the equipment. The maintenance plan is documented in a Lead Allowance Parts List (LAPL). If the equipment under examination has been or will be provisioned using a LAPL it is classified as "simple." All other equipments will be classified as complex. The results of these two determinations is used to locate the proper cell in the equipment classification matrix of Figure 2-1. The analyst determines the proper cell for equipment in the system and assigns the Equipment Category Number (ECN) of the cell to the equipment.

Figure 2-1  
EQUIPMENT CATEGORY MATRIX

	<u>STANDARD</u>	<u>MOD</u>	<u>NEW</u>
Complex	3	2	1
Simple	6	5	4

### 2.2.2 System Categories

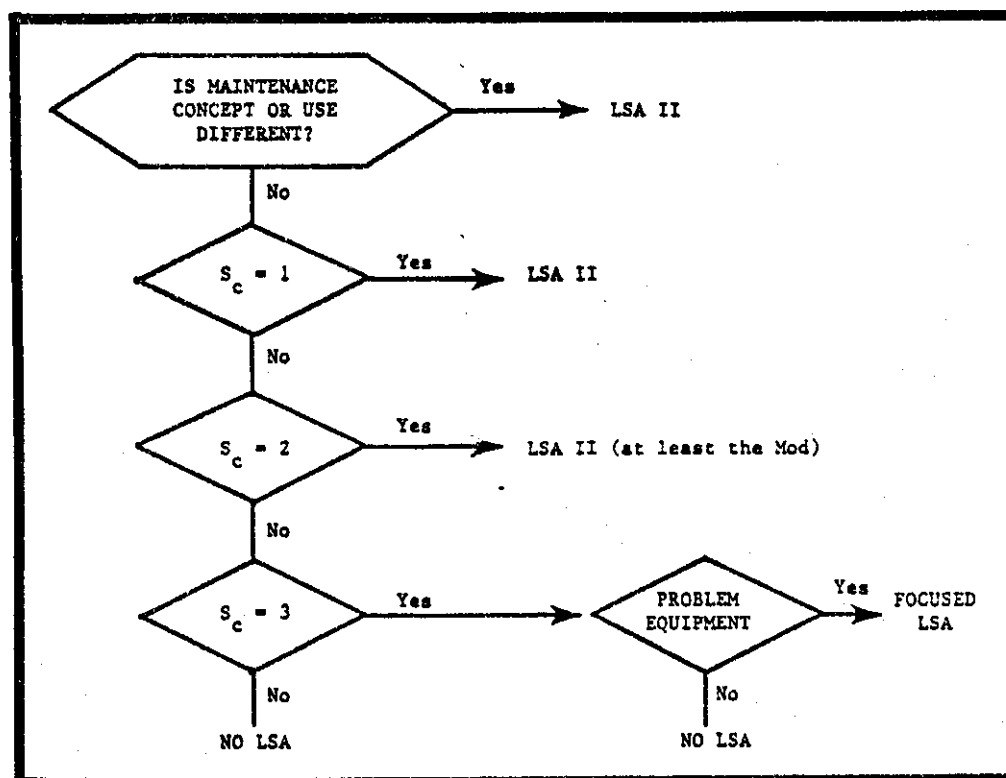
When an Equipment Category Number has been assigned to all equipments in the system/subsystem under analysis, the system is classified using the following simple rule:

- o The System Category Number ( $S_c$ ) is the lowest ECN assigned to any component of the system, e.g., if the system contains an equipment whose ECN is 1,  $S_c$  is also 1.

### 2.2.3 Tailoring Logic

Having categorized the system, the tailoring logic shown in Figure 2-2 is used to determine if corrective maintenance analysis is to be performed.

Figure 2-2  
TAILORING LOGIC FOR SHIP SYSTEMS



As stated previously, if the maintenance concept or use of the system is different from previous applications a corrective maintenance analysis will be performed. For systems with new complex equipments ( $S_C = 1$ ), CM analyses will always be conducted. For systems containing modified complex equipments ( $S_C = 2$ ) the extent of analysis will depend upon the reasons for the modifications. If the purpose of the modification was reliability or availability improvement, i.e., the earlier version of the equipment proved unsatisfactory in service use, the analysis should include the entire system. If the modifications were made to interface the equipment in the current ship design, and the operational performance of the original equipment was satisfactory, the analysis may be limited to the areas of modification.

For standard complex systems ( $S_C = 3$ ), the LSA will be performed only if the equipment/system has been identified during LSA I as a problem item. In this case the analysis should be guided by what was uncovered during problem identification and analysis. If, for example, the problem is limited to technical documentation, the LSA should focus on the quality and utility of the revised documentation.

Results of the classification process are recorded on the LSA Data Collection Worksheets (Figure 4-2) which are prepared for each system/subsystem to be analyzed.

### 2.3 Ship Block Diagram and Index (SBDI)

The Functional Block Diagrams (FBDs) with an LSACN assigned to each item provide the configuration reference for the remainder of the LSA and will be used to facilitate the review of each item in more detail. The FBDs and LSACNs will be merged by the Contractor to form a preliminary Ship Block Diagram and Index (SBDI). Although corrective maintenance analysis will only be performed on the system categories selected by the tailoring procedures of Section 2.2, the SBDI will include all ship systems, since it is also an input to PMS and FOMIS analyses.

The SBDI will have an introduction and two major parts:

- o The introduction will contain a brief description of the methods and symbols used.
- o Part I will contain separate Functional Block Diagrams for each of the seven major functional groups.
- o Part II will be an LSACN Index, listing all LSACNs in hierarchical order, with item nomenclatures and quantities for each LSACN.

Figures 2-3 and 2-4 illustrate the two parts of the SBDI.

The preliminary version will be forwarded to the SHAPM for approval of configuration and then will be submitted to Ships Parts Control Center (SPCC) to open records in the FOMIS Data Bank. MIL-STD-1626 "FOMIS General Requirements", NAVSEA T0753-AA-GYD-010 "FOMIS User Guide", and Appendix B of this manual should be used by those responsible for FOMIS submissions.

The preliminary version also will be used to make easier the examination of an item's:

- o function(s),
- o criticality (to mission and safety), and
- o need for detailed maintenance analysis.

When determined, this information will be documented in and complete the SBDI.

### 2.3.1 Construction of Functional Block Diagrams (FBDs) for Ship Acquisitions

Each identified element of the ship system will have its functional and hierarchical relationships to other elements illustrated by an FBD. Lower levels of the hierarchy are said to be indentured (belonging) to the parent equipment or system, resulting in the concept of indenture levels.

TEMPERATURE LEVEL

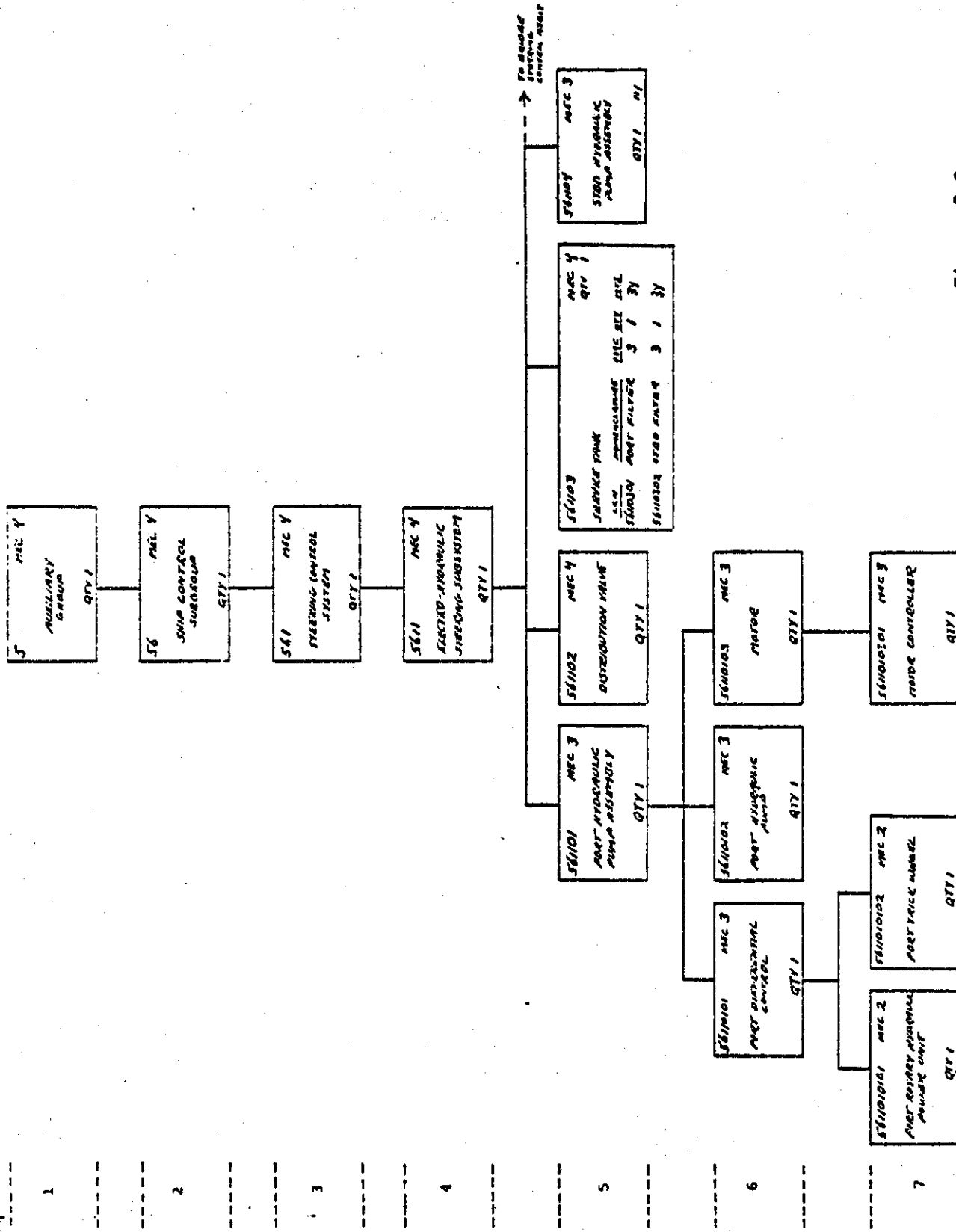


Figure 2-3  
SAMPLE FUNCTIONAL BLOCK DIAGRAM

NOTES:  
1) IDENTICAL AND IN THE 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

Figure 2-4  
LSACN INDEX

<u>FOMIS DEN</u>	<u>ITEM</u>	<u>ENTRY</u>
A002	UIC	_____
E134	Originator	<u>    C    </u>
E165 & E211	Card Control	<u>  10AA  </u>
E033	Transaction Code	<u>    A    </u>

2. SERIAL NUMBER	_____
3. PREPARED BY	_____
DATE	_____
4. REVIEWED BY	_____
DATE	_____
5. APPROVED BY	_____
DATE	_____

<u>(6) LSACN</u> FOMIS DEN E212	<u>(7) NOMENCLATURE</u> FOMIS DEN E901	<u>(8) QUANTITY</u> FOMIS DEN E206	<u>(9) MEC</u> FOMIS DEN C0034	<u>(10) ACCESS NUMBER</u> FOMIS DEN E133
56	Ship Control Sys	1	4	00836
561	Steering Control Sys	1	4	00837
5611	Flare-Hyd Steer Sys	1	4	00838
561101	Port Hyd Pump Allen	1	3	00839
56110101	Port Diff. Control	1	3	00840
5611010101	Port Rot. Hyd. ParU.	1	2	00841
5611010102	Port Trick Wheel	1	2	00842
56110102	Port Hyd Pump	1	3	00843
56110103	Motor	1	3	00844
5611010301	Motor Controller	1	3	00845
561102	Distribution Valve	1	4	00846
561103	Service Tank	1	4	00847
56110301	Port Filter	1	3	00848
56110302	Star Filter	1	3	00849
561104	Star Hyd. Pump Allen	1	3	00850
56110401	Star Diff. Control	1	3	00851
5611040101	Star Rot. Hyd ParU.	1	2	00852
5611040102	Star Trick Wheel	1	2	00853
56110402	Star Hyd. Pump	1	3	00854
56110403	Motor	1	3	00855
5611040301	Motor Controller	1	3	00856

The highest indenture level (Level 0) is represented by a single block, indicating an entire ship. The ship's seven major functional groups comprise the first indenture level:

1. Hull Structure;
2. Propulsion Plant;
3. Electrical Plant;
4. Command and Surveillance;
5. Auxiliary;
6. Outfit and Furnishings, General;
7. Armament.

Each Group is progressively divided into more specific functions. For example:

<u>Indenture Level</u>	<u>Category</u>	<u>Nomenclature</u>
1	Group	Auxiliary
2	Sub-group	Ship Control Systems
3	System	Steering Control System
4	Sub-system	Electro-hydraulic Steering

The first four indenture levels equate to the Ship Work Authorization Boundary (SWAB) as described in NAVSEA 0900-LP-098-6010. The numbering system outlined in Section 2.3.3 should be adequate for tracing functions to the lowest equipment/component level.[1]

In some cases, the relationship between equipments/components may be ambiguous:

- o They may be physically part of one system, yet be functionally part of another, or

---

[1] The SHAPM and contractor will decide jointly on the number of indenture levels required.

- o They may be functionally part of several systems.

An example of the first case would be a remote sensor assembly, attached to a diesel engine, which feeds information to a control console. The question arises whether the sensor assembly is part of the engine system or control system. Since the Functional Block Diagram describes functional relationships, the sensor assemblies should be included in the control system.

An equipment/component will be shown in only one block diagram. Where it is shared by two or more higher assemblies, it will be assigned to the one with which it is used most frequently. If this criterion is not adequate, essentiality, location or other factors are considered.

### 2.3.2 Special Procedures for Functional Block Diagrams

Certain conventions will be used to facilitate the construction of FBDs. A basic functional block is shown below:

LSACN	MEC
NOMENCLATURE	
QTY	NOTES

- o LSACN ... An LSA Control Number (LSACN) will be assigned as explained in Section 2.3.3.
- o MEC ... The Mission Essentiality Code (MEC) is a numeric indicator of the importance of the FSI's function(s) as described in Section 4.6.
- o NOMENCLATURE ... A concise name of the item.
- o QTY ... The Quantity of identical items within the system or subsystem.

- o NOTES ... Notes, e.g., "#1," "#2," "\*", will be used to call attention to equipments/components that provide functions to more than one higher level item. Details of each note will be provided on the FBD.

When construction of an FBD reaches the equipment level, the components/assemblies/sub-assemblies of the equipment may be depicted as shown below:

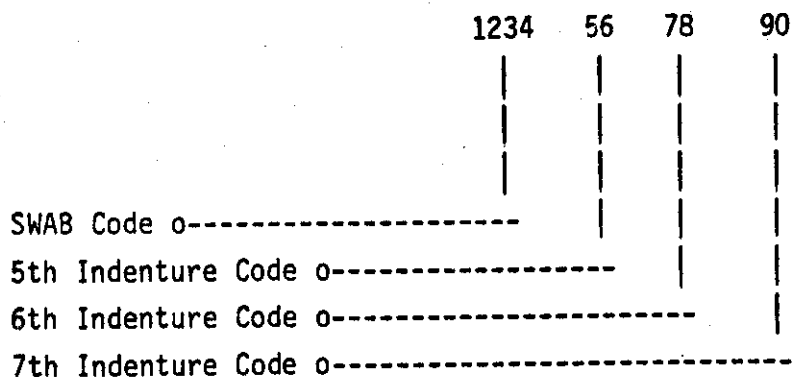
LSACN		EQUIP MEC		
EQUIPMENT		EQUIP QTY		
COMPONENT LSACNs	NOMENCLATURE	MEC	QTY	

In cases where there are multiple, identical equipments below the 5th indenture level (in the same system/subsystem) the equipment breakdown may be shown once. Other branches of the system/subsystem will be appropriately annotated to reference the LSACN having a detailed breakdown.

### 2.3.3 Assignment of LSA Control Numbers (LSACNs)

The FBD graphically displays the system hierarchy. It also facilitates the assignment of LSA Control Numbers (LSACNs). The LSACN is an alpha-numeric code that uniquely identifies each item during the remaining steps of the LSA.

For example, an LSACN for a system with 7 levels of indenture is made up of the 4 digit SWAB Code and 2 characters for each lower indenture level of the FBD:



The SWAB Code will be assigned in accordance with NAVSEA 0900-LP-098-6010. In the example of the Steering Control System, the SWAB Code for indenture levels 1 through 4, i.e., down through the Electro-Hydraulic Steering Subsystem is 5611. Accordingly, the LSACN for the Electro-Hydraulic Steering Sybssystem is 5611. (Trailing zeros are not used.)

The LSACN for an item at the 5th indenture level consists of the SWAB Code plus 2 alpha-numeric characters -- from 01 through ZZ, as necessary.[1] Continuing the above example, the Port Hydraulic Pump Assembly indentured to the Electro-Hydraulic Steering Subsystem could be assigned an LSACN of 561101. The assignment process continues down the FBD; an item at the 7th indenture level would have a 10 character LSACN, consisting of the 8 character LSACN of the next higher item and 2 additional alpha-numeric characters.

#### 2.3.4 Distribution of the SBDI

In addition to the Acquisition Manager, all offices and commands involved in the acquisition and those performing or reviewing the LSA will receive copies of the preliminary and final SBDI. Any modification thereto will

[1] Alpha characters "O" and "I" will not be used.

2-12

be provided to recipients. This will ensure that all parties have a common reference for conferences, discussions, and additional data submissions to FOMIS.

### 3. PROCEDURES FOR SYSTEM/EQUIPMENT ACQUISITIONS

The procedures of this chapter are applicable to all NAVSEA system and equipment acquisitions which are not a part of a shipbuilding contract. NAVSEA system/equipment acquisitions vary in complexity from major combat system procurements to the acquisition of relatively simple HM&E equipments. The acquisition process may consist of all development phases, i.e., Concept Exploration, Demonstration and Validation, Full Scale Development and Production/Deployment or may be limited to the purchase of "off the shelf" commercial items for Naval use. In both ship and system acquisitions, no two programs are exactly alike, but all require effective logistic support programs. The LSA II process for maintenance requirements planning must be tailored to the size and complexity of the acquisition and be accomplished in time to provide adequate logistic support to the system at deployment.

#### 3.1 Policy

NAVMAT and NAVSEA policy states that Logistic Support Analyses will be conducted on:

- o All new systems, and
- o Existing systems where the operating environment or maintenance concept is significantly different, or observed system performance is characterized by low operational availability and/or excessive maintenance burden.

Excluded, therefore, from the requirements of this manual are new acquisitions of "Navy Standard" equipment already in the fleet which have a history of acceptable fleet performance and adequate logistics support even if an LSA has never been performed on the equipment. Also excluded are relatively simple HM&E equipments where the acquisition manager has determined that the conventional support provided by a Lead Allowance Parts List (LAPL) is adequate for the requirement. If, however, he determines that similar equipment, in fleet use, has been a maintenance burden or has not received adequate logistic support, an LSA should be performed and a maintenance plan developed in accordance with the procedures of this manual.

### 3.2 System and Equipment Classification

In the previous chapter on ship acquisitions, equipments and systems were categorized as new, modified or standard and further stratified as complex or simple. For the purposes of system and equipment acquisitions, the following classifications provide a more suitable breakdown for the purposes of tailoring the LSA process:

- o Developmental - These are end items where the procurement involved all stages of the weapon system acquisition process. NAVSEA Project Managers were involved in the design and development of the hardware, which will eventually be provided as Government Furnished Equipment (GFE) to a ship or system installation.
- o Product Improvement - A version of the end item is already in the Navy inventory. Design and development is limited to specific design changes required to meet a different installation requirement or to improve the operational performance of the item.
- o Non-Developmental - The procurement involves the adaptation of "off the shelf" commercially available hardware. No design or development is required.

### 3.3 Tailoring Requirements for Developmental Items

Developmental items can provide opportunities for the implementation of a serial LSA II program. Unlike ship acquisitions, the Full Scale Development and Production time frames may provide sufficient time to determine all logistic support requirements (including manpower, Provisioning and Technical Documentation) using the serial LSA process of MIL-STD 1388. In these cases the Logistics Support Analysis Record (LSAR) becomes the single source of logistics data and is used by all support elements in determining maintenance requirements. For developmental items the procedures of this manual are minimum requirements, applicable in those cases where a serial LSA process is not feasible or cost effective.

Prior to developing an LSA II program, the acquisition manager should make the following determinations:

1. Determine the LSA candidate list. Develop with the contractor an LSA candidate list at the subsystem, equipment and component level. Although the end item is developmental, it may contain subsystems or components which are "standard" items and do not require LSA II analyses.
2. Investigate the prime contractors data processing capabilities. If a mechanized LSAR is to be developed (or was initiated in LSA I), ensure maximum use of government furnished software and mechanically generated report capabilities.
3. Review LSA flow-down requirements. Depending upon the size of the acquisition and the subcontractors involved, the prime contractor may either task the subcontractors with performing LSAs on their components or require that the subcontractors provide source data such as reliability and maintainability inputs to the prime contractors LSA team. This decision should be driven by the capabilities of the subcontractors. If they do not have an in-place LSA capability, it may be more cost effective for the prime contractor to perform the entire LSA, obtaining the source data from the subcontractors.
4. Determine the scope of analysis by repair level. If the maintenance concept specifies that the contractor will be responsible for depot level maintenance, requirements planning may be restricted to the organizational and intermediate levels.
5. Determine if the LSAR can be used effectively as the data base for the development of applicable sections of Technical Manuals. If the corrective maintenance section of equipment manuals is to be produced using the LSAR, the task requirements worksheets described in Chapter 6 of this manual must be expanded to include a narrative of the procedural steps required to accomplish each CM task.

6. Integrate the LSA and Provisioning schedules to assure that the LSAR for each equipment/component is completed to the parts level prior to the scheduled date for submission of PTD.

If it is determined that the LSA-II process can be accomplished serially and government furnished software will be used to establish the data base, applicable sections of the ILS specification in the Statement of Work should reflect this decision, e.g.:

- o Training - Specify that the number and qualifications of personnel will be determined using the LSAR.
- o Technical Manuals - State that the LSAR will provide the data base for Technical Manuals.
- o Support Equipment - Specify that all support equipment requirements will be generated from and traceable to the LSA documentation.
- o Provisioning - Specify that Government Furnished Software will be used to generate PTD from the LSAR.

Figure 3-1, reproduced from MIL-STD-1388A (Proposed), is a sample Data Item Description (DID) which invokes the use of standard LSAR in the determination of logistic resource requirements. The tasks cited on the DID are documented in MIL-STD-1388A and are:

- o Task 205 - Supportability and Supportability Design Objectives Goals and Thresholds, Constraints and Risks
- o Task 301 - Functional Requirements Identification
- o Task 401 - Task Analysis

Tasks 205 and 301 will have been initiated during LSA I and completed during LSA II. Task 401, is normally started during Full Scale Development and completed during Production.

Figure 3-1  
SAMPLE DATA ITEM DESCRIPTION (DID)

DATA ITEM DESCRIPTION	2. IDENTIFICATION NO(S).	
	AGENCY	NUMBER
1. TITLE Logistic Support Analysis Record (LSAR) Data	DOD	DI-S-7XXX
2. DESCRIPTION/PURPOSE This DID identifies deliverable support analysis data pertaining to support and MP&T requirements identification and describes media for their delivery. These data identify support and MP&T requirements in a correlated and integrated fashion and provide the basis for support system development activities and subsequent procurement actions and decisions.	4. APPROVAL DATE	
	5. OFFICE OF PRIMARY RESPONSIBILITY US Army/DARCOM	
	6. DDC REQUIRED	
	8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP This DID replaces DI-S-6171A and identifies the support analysis data which are used in the preparation of equipment publications; maintenance procedures, manpower and personnel requirements; training requirements; tool, support, test, measurement and diagnostic equipment requirements; and other Integrated Logistic Support (ILS) element documentation. These data result from performance of Task Numbers 205, 301, and 401 of MIL-STD-1388A.	6. REFERENCES (Mandatory as cited in block 10)  MIL-STD-1388A MIL-STD-XXX	
	MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS		
<p>10.1 LSAR data formats, data element definitions, output summary formats, and procedures for recording and reporting LSAR data shall be in accordance with MIL-STD-XXX. Data requirements shall be as specified on the LSAR Data Selection Sheet.</p> <p>10.2. LSAR data shall be delivered by one or a combination of the following media, as specified by the requiring authority in the Contract Data Requirements List (CDRL), DD Form 1423.</p> <ul style="list-style-type: none"> <li>a. Hard copy (original or reproduced copies).</li> <li>b. ADP 80-column punch cards.</li> <li>c. Magnetic tape/disc/drum.</li> <li>d. Microcopy (microfiche/microfilm).</li> </ul> <p>10.3 The following LSAR data, as described in MIL-STD-XXX, are deliverable data under this DID as specified by the requiring authority on DD Form 1423.</p> <ul style="list-style-type: none"> <li>a. LSAR data sheets.</li> <li>b. LSAR output summaries.</li> </ul>		

Figure 3-1  
SAMPLE DATA ITEM DESCRIPTION (con't)

DI-S-7XXX

- c. LSAR data files.
- d. LSAR data sheet updates in card image format.

10.4 Periodic data submissions shall be in accordance with DD Form 1423 requirements. At the end of contract, or as otherwise specified on DD Form 1423, the entire LSAR data shall be delivered to the requiring authority or designated agent.

### 3.4 Tailoring Requirements For Product Improvement Items

Requirements for Logistic Support Analyses for end items, which are modifications of "standard" items, are limited in scope to the components where redesign is required. The LSA candidate list should consist of only those components. Maintenance requirements planning for the remainder of the end item should consist of a review of existing support resources and the development of an integrated package using existing resources (documentation, repair parts, test equipment, etc.) where available. The LSA for redesigned elements of the system should be tailored in accordance with the requirements of section 3.3.

### 3.5 Tailoring Requirements for Non-Developmental Items

LSA requirements for non-developmental items consist of the tasks required to develop a maintenance plan and identify the logistics resources required to support the plan. They include:

- o Review of available commercial manuals to ensure that they meet the requirements of MIL-M-7298C. 2
- o Evaluation of the adequacy of preventive and corrective maintenance instructions provided with the equipment.
- o Determination of the need for specialized training for the operation and maintenance of the item.
- o Acquisition of parts lists and sufficient technical data to identify and catalog repair parts.
- o Evaluation of established Lead Allowance Parts Lists (LAPL) to determine if a generic maintenance plan provides adequate support.

If it is determined that available documentation is insufficient or a tailored maintenance plan is required, an LSA will be conducted in accordance with the procedures described in this manual.

### 3.6 Limiting The Depth of Analysis

The depth of analysis will be determined by the criticality of the end item. For all system and equipment acquisitions, a Mission Essentiality Code (MEC) will be assigned in accordance with the procedures of section 4.6. If the acquisition is to satisfy multiple uses or is to be installed in both redundant and nonredundant configurations on different ship classes, the depth of analysis will be determined by the highest MEC installation planned for the system. The actual MEC of the installation will be used however to determine provisioning requirements for items if MEC is to be used in the computation of allowance quantities.

### 3.7 Equipment Block Diagram and Index (EBDI)

Functional Block Diagrams (FBD's) with an LSACN assigned to each item provide the configuration reference for the LSA and will be used to facilitate the review of each item in more detail. The FBDs and LSACNs will be merged by the contractor to form a preliminary Equipment Block Diagram and Index (EBDI).

The EBDI will have an introduction and two major parts:

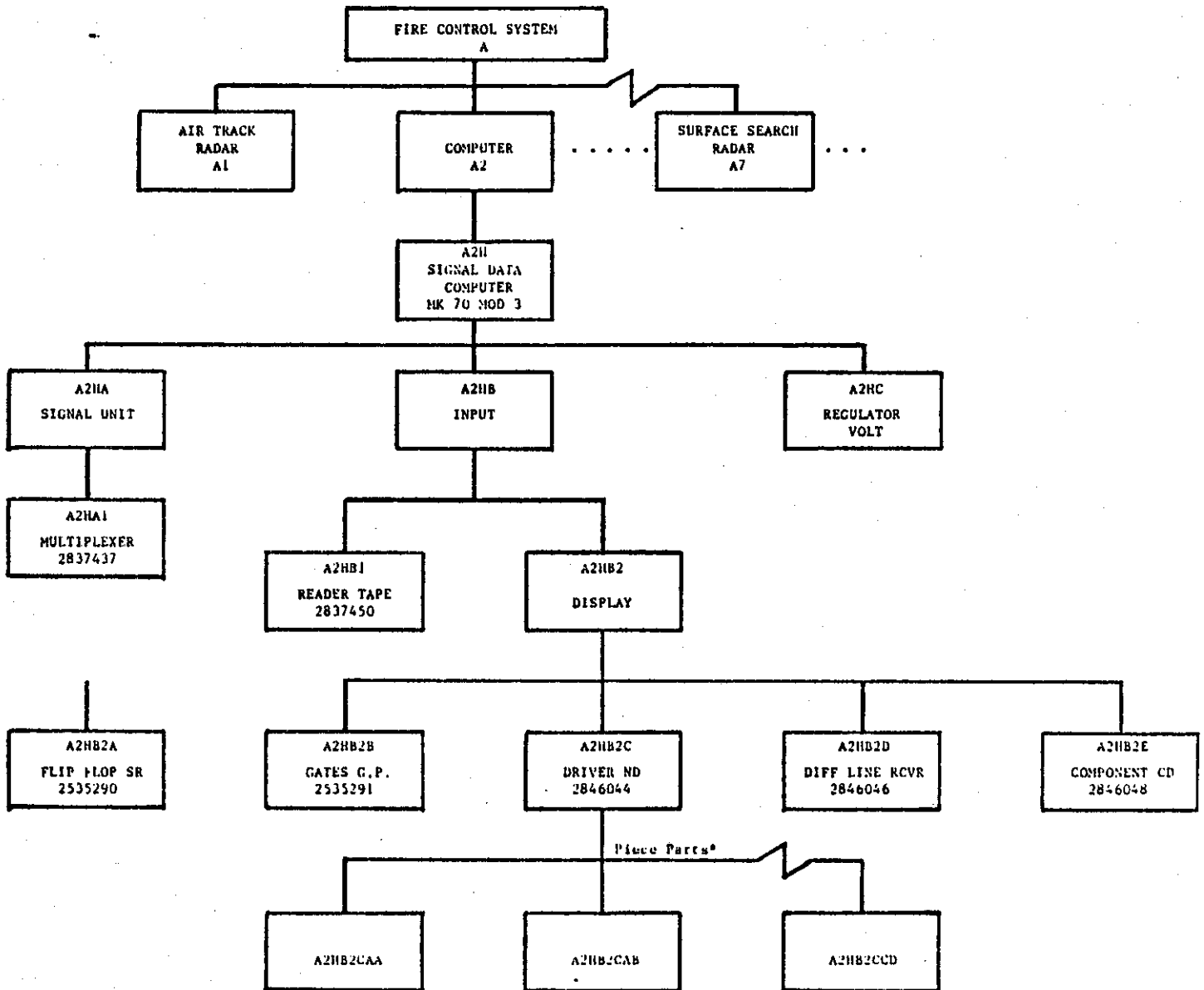
- o The introduction will contain a brief description of the methods and symbols used.
- o Part I will contain the Functional Block Diagram for the system.
- o Part II will be an LSACN Index, listing all LSACN's in hierarchical order, listing all repairable items within the system. If provisioning is to be performed using a mechanized LSAR, piece parts will also be assigned LSACNs.

Figure 3-2 is a sample Functional Block Diagram with LSACN assignments.

#### 3.7.1 Assignment of LSA Control Numbers

The FBD graphically displays the system hierarchy. With proper assignment of LSACNs the hierarchal structure can be transformed to a machinable format and used to aggregate LSA data using government furnished software.

Figure 3-2  
SAMPLE SYSTEM FUNCTIONAL BLOCK DIAGRAM



\* Required if LSAR is to be used for provisioning.

If a mechanized LSAR is to be used, the following sections of US Navy/ Marine Corps Guide to Logistics Support Analysis, MIL-HDBK-XXX (Navy) should be followed in assigning LSACNs (section numbering is from the handbook).

### 3.7.2 Extract from MIL-HDBK-XXX

The detailed LSACNs will be developed by the contractor. The LSACN is a critical data element in the LSA process. Data records are indexed with it, and reports and provisioning lists are produced using it; thus, extreme care must be used in assigning the codes. The contractor must assure continuity and compatibility of subcontractor- and vendor-prepared LSA data with the contractor's LSACN numbering system.

The LSACN represents a hardware generation breakdown/disassembly sequence of system hardware, including support and test equipment, training equipment, and installation (connecting) hardware. The LSACN consists of from one to eleven alphanumeric characters, with each character or group of characters representing an indenture level. The LSACN must uniquely identify the item in relation to its next-higher assembly. The number must not contain imbedded blanks, and unused spaces must be left blank. The LSACN is a key field utilized to input data into the LSAR data system and to extract reports from the data system. The contractor must prepare a complete breakdown of the system before assigning LSACNs.

In developing a LSACN numbering system, the contractor should first structure the hardware tree (from top to bottom) to the lowest indenture level (piece parts) before assigning any LSACNs or selecting any LSA candidate items. Next, he should reserve the number of LSACN digits required to identify all items at each indenture level. Since the LSACN is an alphanumeric field, one digit represents up to 34 possible unique items of the Next Higher Assembly (NHA) (A-Z, 0-9 except for the alpha characters 0 and I); two digits uniquely identify 1122 items to the NHA, etc. It is important that no more than the required number of digits be reserved for the LSACN at any indenture level. However, if it is likely, or even possible, that a second (more than 34 items) or third digit (more than 1122 items) will be required, they should be reserved, provided that the total number of LSACN digits will not exceed 11.

Normally, at least two digits should be reserved at the lowest indenture level for piece parts. In a relatively simple system, reserving two digits for each indenture level will not cause any problems. However, in a major system such as an aircraft, missile, or ship, using two digits at each level would consume all 11 digits after the fifth hardware indenture level, which may be one or two levels above the piece parts. The complexity of the system will dictate the method used for assigning LSACNs. The classical method for assigning LSA control numbers is described in detail below.

Once the structure has been established, LSACNs can be assigned to each item in the system. Care should be exercised in assigning LSACNs, since the order in which they are assigned is the order which will be utilized in assigning the Provisioning List Item Sequence Numbers (PLISN) and thus the order of a parts list. For example, if it is a requirement that attaching hardware appear on a provisioning parts list prior to the assembly, these items would have to be assigned LSACNs which are lower in value than the one assigned to the assembly. The above analysis should be conducted prior to assigning the LSACNs. This advance planning avoids the possibility of having to resequence later on.

### 3.7.3 Classical LSA Control Number Assignment

This method dictates assignment of a unique LSACN to every application of a part-numbered item in the system, including piece parts. The method ensures proper identification of an item in relation to its Next Higher Assembly (NHA) and insures proper roll-up/summarization of data for all LSAR output reports. Figure 3.1 is an example of the classical LSACN assignment method. From a provisioning standpoint, use of the classical assignment method would allow use of the LSA-60, Option 2 (i.e., automatic assignment of PLISN, NHA PLISN, Same-As PLISN, and Indenture Code) discussed in section 4.3

If the identical item is used in more than one assembly (multiple application), it will be assigned a different LSACN at the appropriate indenture level for each application. In those cases, it is possible to reduce the workload by using an optional computer program. The "C", "D", and "H" data sheets would be input into the automated data system once for a specific application

of the item (LSACN), and the program will duplicate all records on the master files for all other applications of the same item.

Each item of support material (e.g., support or test equipment) is assigned a unique LSACN. These items will be uniquely identified by the contractor at the unit level under the appropriate preassigned LSACN. Code assignments will be reserved on contractor request. Similarly, LSACNs will be assigned on request for any installation (connecting) hardware and cables as the need is identified.

Each item of support material (e.g., support or test equipment) is assigned a unique LSACN. These items will be uniquely identified by the contractor at the unit level under the appropriate preassigned LSACN. Code assignments will be reserved on contractor request. Similarly, LSACNs will be assigned on request for any installation (connecting) hardware and cables as the need is identified.

#### 4. PRELIMINARY STEPS

In order to determine maintenance requirements in a logical and efficient manner the analyst must first identify the ship or system configuration; determine the system boundaries; and collect sufficient information to conduct the required analyses. Also included in the preliminary tasks are the determination of how the LSA will be tailored, and a Functional Failure Analysis of the Functionally Significant Items (FSIs)[1] within each system/subsystem.

##### 4.1 Configuration Identification

To undertake a systems level analysis of the end item the analyst first develops the hierarchical structure which can be used to relate the functions of the end item to the systems and equipments which provide each function. Such a structure also provides a configuration baseline for the analysis and a means of "summing up" total requirements.

##### 4.1.1 Procedures for the Development of Hierarchical Structure

Each identified element will have its hierarchical relationships to other elements denoted by a LSACN and will be graphically shown by a Functional Block Diagram (FBD). Lower levels of the hierarchy are said to be indented (belonging) to the parent equipment or system, resulting in the concept of indented levels.

Depending upon the size and complexity and type of end item the structure will contain some or all of the following elements as defined in various MILSTD's:

End Item. A final combination of end products, component parts and/or materials which is ready for its intended use, e.g. ship, tank, aircraft etc. This is the highest level of the hierarchy.

---

[1] Functionally Significant Items (FSIs) are elements of the system whose failure would have significant impact on the availability of a required function. Additional discussion of FSI's is contained in Section 4.5.

System. A group of subsystems connected so as to operate together to accomplish a tactical function, e.g. Guided Missile System, Propulsion System etc.

Subsystem. A group of equipment connected so as to operate together to perform one or more functions, e.g. launching subsystems, boiler subsystem etc.

Set. A unit or units and necessary assemblies, subassemblies and basic parts connected or associated together to perform an operational function or functions. Typical examples are: search radar set, sound measuring set, radio transmitting set.

Group. A collection of units, assemblies or subassemblies which is a subdivision of a set or system, but which is not capable of performing a complete operational function. Typical examples are antenna group, indicator group.

Unit. A major building block for a set or system, consisting of a combination of basic parts, subassemblies and assemblies packaged together as a physically independent entity. Typical examples are radio receiver, radio transmitter, electronic power supply, antenna.

Equipment. Components and assemblies connected or associated to perform a specific function.

Component. An assembly or combination of parts, subassemblies and assemblies mounted together normally capable of independent operation in a variety of situations.

Assembly. A number of parts or subassemblies or any combination thereof joined together to perform a specific function and capable of disassembly. The distinction between assembly and subassembly is determined by the individual application.

Subassembly. Two or more parts which form a portion of an assembly or a component replaceable as a whole but having a part or parts which are individually replaceable.

Part. One piece of two or more pieces joined together which are not normally subject to disassembly without destruction or impairment of designed use.

For brevity in the remainder of this manual all elements of the hierarchy below the subsystem and above the part level will be described as equipments/components unless otherwise indicated.

As discussed in Chapter 2 (Ships) and Chapter 3 (Systems) the contractor should structure the hardware tree from top to bottom and assign an LSACN to each element of the system above the piece part level. If the mechanized Logistic Support Analysis Record (LSAR) is to be used, the LSACN is restricted to 11 alphanumeric characters. Instructions for use of the mechanized LSAR, recommended coding schemes, and record formats are contained in US Navy/Marine Corps Guide to Logistics Support Analysis (DRAFT) MIL-HDBK-XXX (NAVY). In addition if provisioning parts lists are to be generated from the LSAR the last two digits must be reserved for identification of the piece parts within the lowest level of the hierarchy.

Since in some cases there may be more than one way to structure a system, the contractor must obtain approval from the project manager on the content and structure of the FBD before proceeding with the analysis.

For ship acquisitions the highest level represents the end item (ship) and is not usually shown on the FBD, and levels 1-4 are structured in accordance with the Ship Work Authorization Boundary (SWAB) as described in NAVSEA 0900-LP-098-G010. Section 2.3 contains detailed information on assigning LSACNs for ship acquisitions.

#### 4.2 Partitioning for Maintenance Task Identification and Analysis

A critical milestone in the LSA process is the determination of how the Maintenance Task Identification (MTI) process is to be structured. The goal is to partition the application undergoing LSA into the minimum number of units for which maintenance tasks can be effectively identified.

The basis for partitioning are the FBDs. The first step is to determine the "first maintenance analysis level", i.e., the highest indenture level at which requirements analysis can usefully be performed. For ship acquisitions the highest levels, Ship Group, and Sub-group are usually too general to be considered maintenance significant and are not specifically addressed through engineering analysis. On the other hand, the next two levels, System and Sub-system, are almost always functionally significant and by convention are designated to undergo MTI&A.

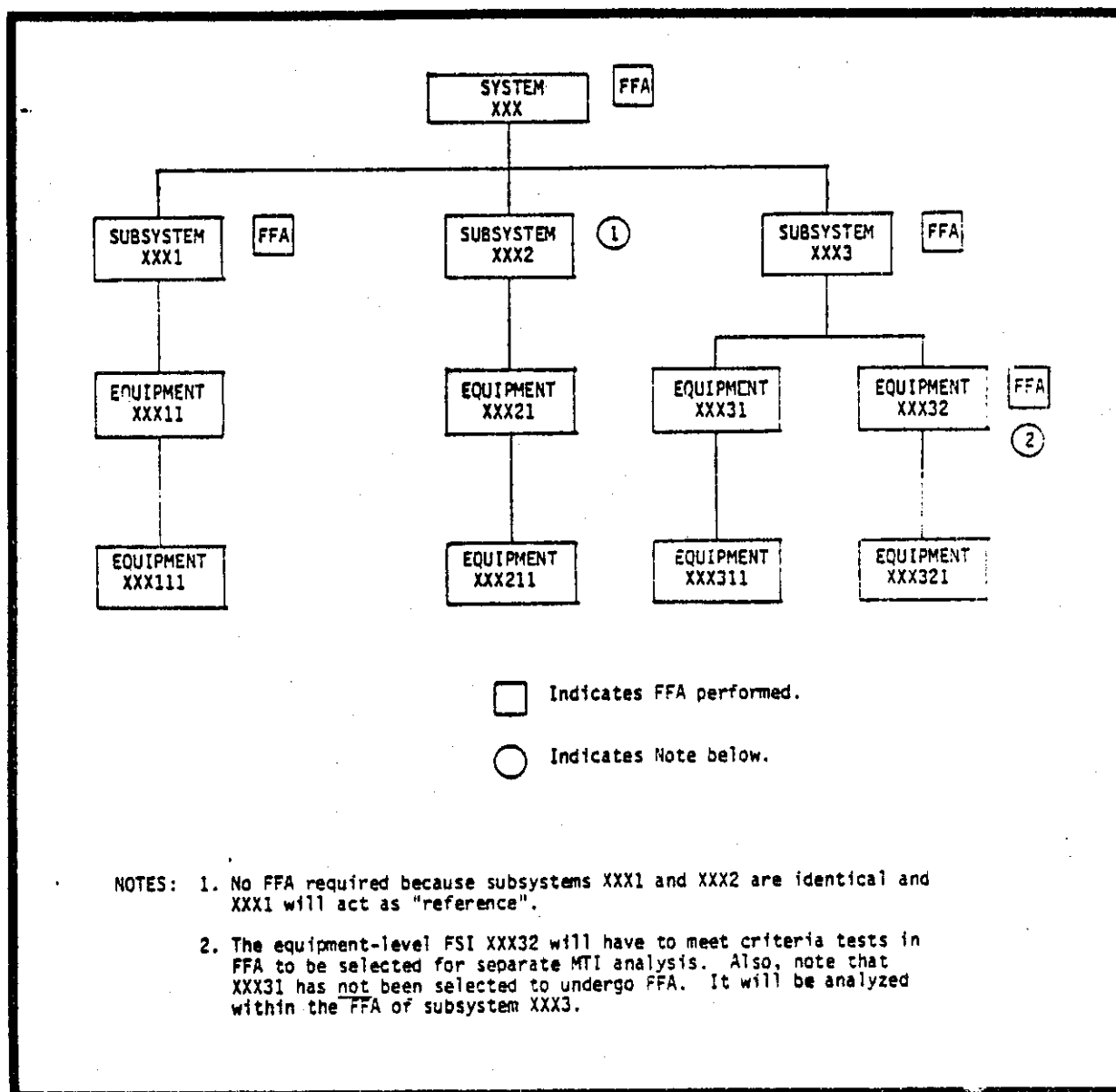
The task of determining whether all the equipments/components within a subsystem can be adequately considered by an MTI analysis at the subsystem level or whether the subsystem should be further partitioned for analysis purposes is a challenging one. There is no rigorous, simple procedure. The analyst must review the block diagrams and first conduct Functional Failure Analyses (FFA) at the system and subsystem levels to determine whether all significant failure modes and related maintenance tasks can be identified at those levels. Further breakdown is generally desirable when a subsystem:

- o provides many different functions;
- o provides certain functions that are exceptionally critical to the safe and effective operation of the system and ship;
- o contains equipments that are shared with other systems.

If the analyst determines that further breakdown is desirable, a Functional Failure Analysis (FFA) is conducted below the sub-system level using the Additional FSI Selection Worksheet both to identify the functions performed at the level and to test the appropriateness of the selection. "Hybrid" solutions are permitted, e.g., not all items at a lower indenture need be selected. Also, in cases where there are candidate items which are identical in both form and function, only one should be analyzed since it can act as a "reference" item, with the MTI results applied to the identical items.

Figure 4-1 shows a hypothetical system partitioned for Functional Failure Analysis.

Figure 4-1  
SAMPLE BREAKDOWN OF A SYSTEM FOR FFA ANALYSIS



### 4.3 Acquisition and Review of Technical Data

The availability of required information and data will be the principal constraint in scheduling and completing LSAs. The purpose of this step is to acquire detailed technical information, drawings, etc. on the system/equipments to be analyzed, as well as any available test or in service data. Valuable insight can be obtained by reviewing the maintenance and operating histories of identical or similar systems already in service in the fleet.

The following information applicable to the system/equipment being analyzed are useful in the analysis:

#### o Technical Data

- Ships drawings;
- Design specifications;
- Assembly drawings;
- System schematics;
- Operating and maintenance instructions for the item;
- Technical manuals for the item.

#### o Historical Data

- APLs and LAPLs for same or similar items;
- Previous LSA;
- 3M data;
- CASREP summaries;
- Operating instructions for similar items;
- Technical manuals for similar items;
- PMS documentation.

Often not all sources will be available for each item and the contractors information requests to the government and other sources should reflect the scope of the analysis to be conducted as determined by the System and Equipment Classification Process (4.4). Also by integrating the PMS and FOMIS (for ship acquisitions) with the LSA, the same data will serve multiple purposes.

Applicable data is to be recorded on the LSA Data Collection Worksheet (Figure 4-2). A worksheet will be prepared for each repairable component of the system/ subsystem identified in the FBD. Detailed worksheet instructions are contained in Appendix B. This worksheet will be a major audit tool of the LSA Review Team.

Figure 4-2  
DATA COLLECTION WORKSHEET

1. LSACN 561101		2. NOMENCLATURE Port Hydraulic Pump Assembly		3. SHIP CLASS	
4. TECHNICAL DATA  Litton Dwg # 7734A-5 Specification # 4423-62A Parts List 561AC CASREP Report SUP 4400-28-108-4 Illustrated Parts Breakdown 561ACD				5. EQUIPMENT CATEGORY NUMBER <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 4 <input type="checkbox"/> 2 <input type="checkbox"/> 5 <input type="checkbox"/> 3 <input type="checkbox"/> 6	
				6. MANUFACTURER Litton Industries Inc.	
				7. MANUFACTURER FSCM 4522	
				8. MER. MODEL/PART NUMBER CG-99/05-1432/81	
				9. QUANTITY 1	
				10. EIC TL 01440	
				11. CDC GV	
				12. APL/AEL/APL 011-012	
				13. CURRENT SMER CODE NONE	
				14. DRAWING REFERENCE LT-05-1432-AF2	
				15. TECHNICAL MANUAL REF. NONE	
				16. TPS REFERENCE NONE	
				17. MIP NONE	
				18. WORK CENTER MMØ2	
				19. LOCATION 4-176-0-5	
20. MTBF 1-1		21. MTR 10		22. USAGE FACTOR .25	
23. REFERENCE LSACN 561104		24. MLC 3		25. CM ANALYSIS REQUIRED <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
26. PREPARED BY DATE		27. REVIEWED BY DATE		28. APPROVED BY DATE	
				29. REVISION DATE	
				30. SERIAL NUMBER	
				PAGE OF	

#### 4.4 System and Equipment Classification for Ship Acquisitions

This step identifies which ship systems/subsystems will receive LSA-II corrective maintenance analysis. The classification procedure is outlined in Chapter 2 and is also contained in the instructions for completing LSA Data Collection Worksheets (Appendix B).

This classification is not required for system/equipment acquisitions. For system acquisitions all items on the approved LSA candidate list which meet the criteria of Chapter 3 will receive LSA-II corrective maintenance analysis.

#### 4.5 Functional Failure Analysis (FFA)

Functional Failure Analysis (FFA) is the process used to define and describe the functions, system interfaces, and the functional failures of Functionally Significant Items (FSIs). An FFA is required for every FSI partitioned for separate analysis (i.e., every system/subsystem and all lower level components identified on Additional FSI Selection Worksheets.)

The FFA provides a baseline for detailed analysis of the maintenance requirements of systems, subsystems, and equipments. The FFA is performed to determine and document:

- o The definition of the specific functions of the FSI.
- o The definition of the interfaces of the FSI with other branches of the FBD.
- o All functional failures of the FSI.

Proper performance of an FFA requires a clear understanding of the concepts of function, system interface and functional failure:

- o Functions. Simply defined, a function is something the FSI does, in terms of its purpose in being. Functions are the "why" of an FSI. Functions may be active or passive, visible or hidden. "Active" functions require some form of measurable activity by the FSI, such as the transmission of modulated electro-magnetic energy (as in radio or radar transmissions) or the provision of motive force to a propeller shaft. "Passive" functions are those which require no measurable activity by the FSI (in fact, "activity" generally characterizes the failure of a passive function). An example of a passive function is the fluid-containing function of a boiler feedwater system. Note that a leak (activity) would be a failure of this function. "visible" functions are those readily apparent to the crew during normal ship's operations; "hidden"

functions are those which are not readily apparent. Examples of the latter are self-protection features and emergency alarm functions. In a combat ship, many systems are used infrequently; their functions, then, may all be "hidden". In Functional Failure Analysis, all functions of an FSI, active or passive, visible or hidden, must be determined and documented.

- o System Interfaces. FSIs often receive inputs from other systems, and provide outputs to other systems. System interfaces are often critical functions of the FSI, yet are easily overlooked and may vary widely among different configurations of the same basic FSI. By convention, input interfaces to an FSI are assumed given (present without failure) and are listed separately; output interfaces of an FSI are considered functions and are listed with other functions of the FSI.
  
- o Functional Failures. A functional failure exists when an FSI ceases to provide a required function. The definition of what constitutes a failure is of prime importance. Whenever a failure is defined by some level of performance, condition, or dimension, the appropriate standards must be stated to provide the basis for establishing whether a failure has occurred. Where applicable, these definitions of failures are required to be stated in terms of system parameters or performance standards. When defining failures of functions provided by redundant FSIs, the failure should be clearly defined as failure of all the redundant items.

As part of the FFA, the analyst indicates functions which are directly related to the performance of primary ship missions or crew safety.

Any functional failures which would result in a safety hazard are flagged. The FFA Worksheet is shown in Figure 4-3. When analysis below the subsystem level is required it is documented on the Additional FSI Selection Worksheet (Figure 4-4).

Figure 4-3  
FFA WORKSHEET

1. SWAB NUMBER 5611	2. NOMENCLATURE Electro-Hydraulic Steering Subsystem	3. SHIP CLASS	SM OF
4. PREPARED BY DATE	5. REVIEWED BY DATE	6. APPROVED BY DATE	7. REVISION DATE
8. SOURCES OF INFORMATION Drawing LT-05-1432AF2 NAVSHIPS Plan No. CG-99-518-2435317 NAUSEA 0901-481-002 CASREP Report SUP 4404.28-100-4			
9. DESCRIPTION (Add additional sheet, if necessary)  The Electro-Hydraulic Steering Subsystem consists of the port and starboard pump assemblies, distribution valve, service tank and filters, Redundancy - port and starboard pump assemblies Protective Devices - see pump assembly FFA (LSACN 561101) Safety Features - see pump assembly FFA (LSACN 561101) ( Details of each component are described in individual FFAs )			
10. FUNCTIONS AND OUT INTERFACES 1.0 Provides hydraulic power and control to activate ships directional control surfaces ( Functions of each component are described in individual FFAs )			
11. SYSTEM IN INTERFACES IN: 230 volt 3 phase power to pump motors LSACN 56110103 and 56110103 bridge control signals from ship control console LSACN 4381 OUT: (1) variable hydraulic power to position rudder LSACN 5621			
12. FUNCTIONAL FAILURES 1.1 Ship Control System does not operate 1.2 Ship Control System does not operate as specified ( Functional failures of each component are described in individual FFAs )			
			13. SERIAL NUMBER

Figure 4-4

## ADDITIONAL FUNCTIONALLY SIGNIFICANT ITEMS SELECTION

1. SWAB NUMBER 561101	2. NOMENCLATURE FSI CANDIDATE Port Hydraulic Pump Assembly	3. SHIP CLASS	SH OF
4. PREPARED BY DATE	5. REVIEWED BY DATE	6. APPROVED BY DATE	7. REVISION DATE
8. DESCRIPTION The positive displacement, axial piston, pump assembly develops hydraulic pressure in response to bridge or local control units. To position the rudder through the distribution valve and rudder ram assembly pump assembly consists of a pump, pump motor, and a differential control assembly is actuated remotely at the helm through the rotary hydraulic power unit or locally through a direct truck wheel. The direction and pressure of the hydraulic fluid flow to the distribution valve is controlled by changing pump stroke through changing position of pump yoke. Yoke position is controlled by a control piston which, in turn, is controlled by the servo and control circuit of the rotary hydraulic power unit, or by the truck wheel. Low pressure side of the pump has a relief valve set at 350 psi; high pressure side has a relief valve set at 2800 psi. Replenishment line has a relief valve set at 140 psi. Gauges are provided for pressure indication. Pump stroke indicated by neon pointer.		9. LOCATION 41-176-0-6	
11. FUNCTIONS: 1.0 Provides variable and reversible delivery of hydraulic fluid through the distribution valve to the rudder ram assembly, in proportional response to control inputs and rudder position feedback. 2.0 Provides hydraulic fluid from service tank to replenish main system. 3.0 Provides system self-protection from excessive hydraulic pressure. 4.0 Contains hydraulic fluid.  ARE ANY OF THESE FUNCTIONS NECESSARY FOR SAFETY, MOBILITY, OR MISSION?		10. QTY 1	11A. IMPACT? (Y/N) Y
12. FUNCTIONAL FAILURES 1.1 Inability to provide hydraulic fluid pressure to rudder ram assembly 1.2 Inability to vary or reverse fluid pressure to rudder ram assembly 1.3 Inability to modulate hydraulic pressure in response to control and feedback inputs 2.1 Inability to replenish main system with hydraulic fluid. 3.1 Pressure in LP side of system exceeds 350 psi 3.2 Pressure in HP side of system exceeds 2800 psi 3.3 Pressure in Replenishment line exceeds 140 psi 4.1 Leaks hydraulic fluid DO ANY OF THESE FAILURES HAVE A DIRECT ADVERSE IMPACT ON SAFETY?		12A. IMPACT? (Y/N) Y	
13. RELIABILITY  IS THE ESTIMATED CORRECTIVE MAINTENANCE RATE GREATER THAN 1 PER YEAR?		13A. IMPACT? (Y/N) Y	
14. COST  IS THIS ITEM'S PURCHASE COST GREATER THAN \$5000?		14A. IMPACT? (Y/N) Y	
15. MASTER FSI INDEX TRANSFER? (Y/N) Y		16. SERIAL NUMBER	

ADDITIONAL FUNCTIONALLY SIGNIFICANT ITEMS SELECTION  
OPNAV 4790117 (ED 142)

#### 4.6 Determining the Mission Essentiality Code (MEC)

The "mission essentiality" of an FSI refers to its functional importance to the mission(s) of the ship and the safety of the crew. The ship's primary and secondary mission areas are specified in the Top Level Requirement and are drawn from the CNO statement of Required Operational Capabilities of the ship. MECs and their meanings are displayed in Table 4-1.

MECs will be assigned to every FSI on the SBDI. To determine the appropriate MEC assignment, a top-down approach, along the SBDI branches, is used. The Acquisition Manager will assist the Contractor in assigning MECs for Groups and Sub-groups. A MEC is then assigned to each successive lower-level component FSI based on the MEC of the FSI immediately above it and on its functional importance to that next higher FSI. Generally, the MEC assigned to an FSI can be no higher numerically than the MEC assigned to next higher-level FSI. Once all FSIs have been assigned MECs an individual MEC at any level will relate the functional importance of its FSI directly to the missions of the ship.

Two exception procedures are provided:

- o Safety. If the functions or functional failures of an FSI are found to have a direct, adverse impact on the safety of the crew (i.e., pose a direct threat to life and limb), MEC "5" will be assigned to that FSI regardless of the numerical MEC values at higher indenture levels. FSIs at indenture levels lower than the coded "5" will themselves again be coded in relation to their functional importance to the missions of the ship.
- o Redundancy. Some degree of redundancy may have been designed into the system. This level of redundancy was created to provide a level of reliability to the system, based on the reliability of the redundant items in the system. When identifying redundancy it should be noted that redundancy does not really exist unless the function in question is completely available from alternate sources. Systems which can operate at only reduced capability or capacity after failure of some items within the system do not exhibit redundancy.

If a pair, or set, of FSIs are found to be redundant, a MEC will be determined as above, but the next lower MEC will be assigned to each of the redundant FSIs.

#### 4.6.1 Assigning Depth of Analysis

Once a MEC has been assigned to systems and subsystems, the depth of analysis, i.e., the percentage of expected failure events to undergo detailed planning, shall be assigned. This depth coding ensures that the analytic effort is weighted toward systems which contribute to the missions or safety of the ship. The depth of analysis, as related to MEC, is:

<u>MEC</u>	<u>DEPTH (% of Failure Events)</u>
5 and 4	90%
3 and 2	75%
1	50%

MEC assignments are recorded on the LSA Data Collection Worksheets.

TABLE 4-1  
MISSION ESSENTIALITY CODES[1]

MISSION  
 ESSENTIALITY  
CODE (MEC)

IMPACT ON MISSIONS AND SAFETY

- |   |   |
|---|---|
| 1 | Failure of the FSI does not directly impact the ship's ability to perform its primary missions, result in the loss of a secondary mission area, or impact crew safety.  |
| 2 | Failure of the FSI results in only a minor degradation of the ship's ability to perform its primary missions, but may result in the loss of a secondary mission area; there is no impact on safety.   |
| 3 | Failure of the FSI results in a severe <u>degradation</u> in one or more primary mission areas, but does not impact safety.   |
| 4 | Failure of the FSI results in the <u>loss</u> of one or more primary mission areas, but does not impact safety.   |
| 5 | Failure of the FSI results in a safety hazard to the ship's crew or others. (A safety hazard is a condition which could result in direct physical harm to a person. Fire-fighting systems, alarm systems, and other emergency systems are MEC 5 type item.) |

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[1] MEC definitions and numerical codes are compatible with the MEC assignments used by the supply system to determine stockage levels for wholesale and retail inventories.

## 5. MAINTENANCE TASK IDENTIFICATION

The key to development of a successful maintenance plan for the application undergoing LSA is careful Maintenance Task Identification and Analysis (MTI&A). A complete MTI&A identifies the preventive, corrective, and servicing maintenance tasks needed to maintain the application in adequate material condition and determines the resources (skill, manhours, parts, special tools and equipment) needed to perform each maintenance task). Figure 5-1 provides a flow diagram of the process.

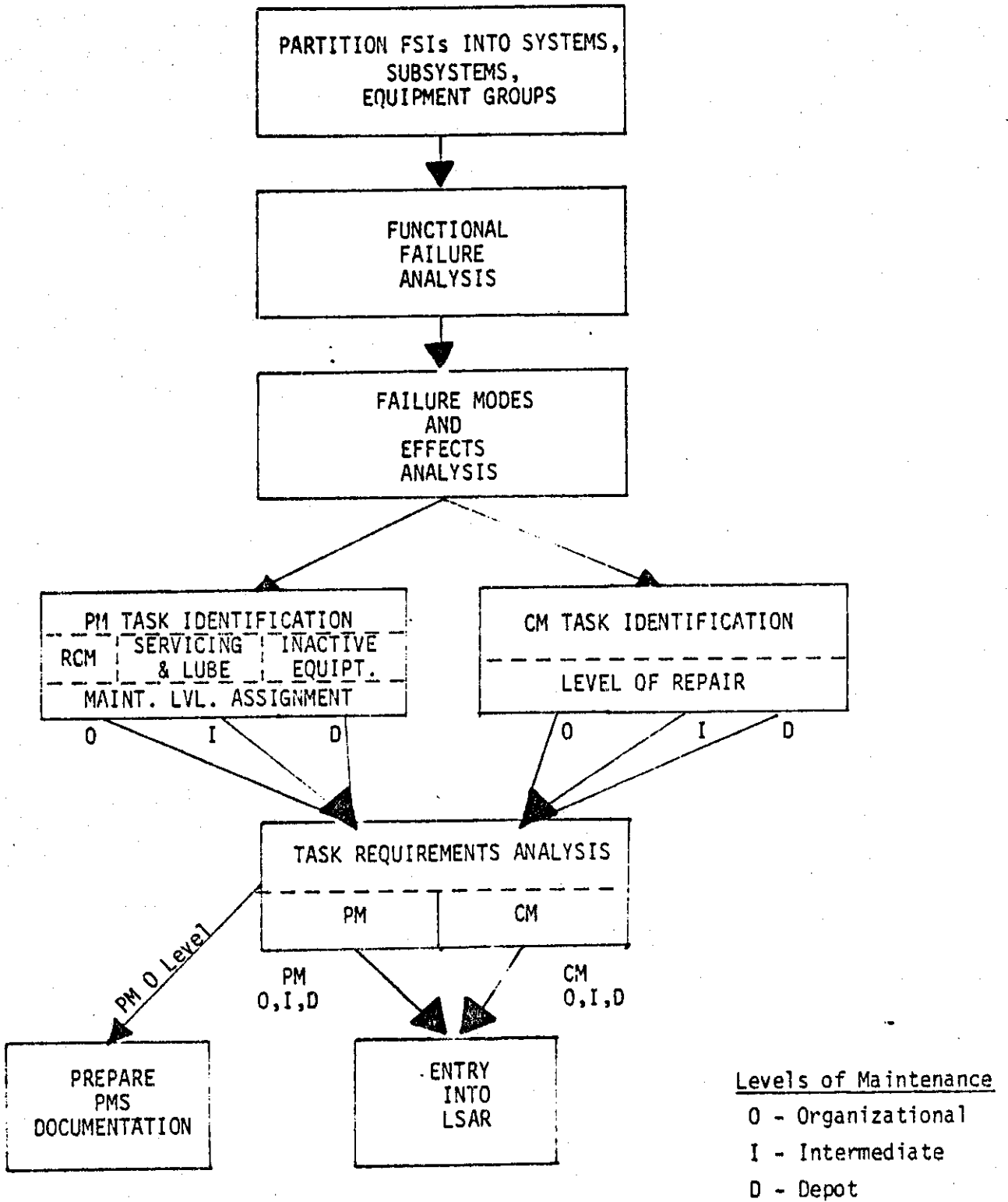
This chapter covers the Maintenance Task Identification (MTI) portion of the process; resource determination is covered in the following chapter (Chapter 6). Task identification consists of the following steps:

- o Failure Modes and Effects Analysis (FMEA) (5.1)
- o Failure Mode Selection for Corrective Maintenance Analysis (5.2)
- o Corrective Maintenance (CM) Task Identification (5.3)
- o Planned Maintenance (PM) Task Identification (5.4)
- o Servicing and Lubrication Analysis (5.5)
- o Inactive Equipment Maintenance (IEM) Analysis (5.6)

The review of technical and usage data and the FMEA form the basis for determining required maintenance tasks. RCM logic is used to identify what preventive maintenance tasks would be worthwhile and effective. Corrective maintenance tasks are developed for critical failure modes identified in the FMEA, and level-of-repair analysis is conducted for all equipment/components. The Servicing and Lubrication Analysis identifies routine consumable replacement tasks, and the IEM Analysis identifies tasks for protecting equipment which will be inactive for an extended period.

An analysis is conducted on each system/subsystem. All FSIs are included in the analysis.

Figure 5-1  
MAINTENANCE TASK IDENTIFICATION & ANALYSIS (MTI&A)



## 5.1 Failure Modes and Effects Analysis

The purpose of the LSA FMEA is to identify the specific conditions that are the causes of functional failures. The FMEA identifies the failure modes, whose impact requires consideration in identifying the maintenance tasks to be performed at each maintenance level. The identification of failure modes is based on those functional failures identified by the FFA (Section 4.5).

The FMEA must identify all the dominant failure modes, which must be considered in the development of the preventive maintenance tasks using Reliability Centered Maintenance. In addition, if the system is to undergo corrective maintenance task analysis, the FMEA must identify high frequency failure events down to the level defined by the MEC of the system/subsystem, i.e., for MEC 1 - 50%; MEC 2 and 3 - 75%; MEC 4 and 5 - 90%.

The FMEA analysis tasks include:

- o Listing of functions and functional failures identified in the Functional Failure Analysis.
- o Determination of failure modes (a "way an item may fail") for each functional failure.
- o Evaluation of the impact of each failure mode in terms of extent to which the function is lost or of the potential safety hazard. This is the "failure effect".

To expedite the FMEA, the failure modes of each branch of the SBDI or EBDI will be reviewed from the bottom up. Specifically, the analyst will identify the lowest level where a functional failure analysis was performed. That FSI will undergo the steps of the FMEA outlined above. Then, the next higher FSI of the same branch will be reviewed for failure modes not defined at the lower level. This process will continue to the highest level FSI requiring analysis, where any failure modes not revealed previously, i.e., those probably resulting from the interfacing of the system's component items, will be analyzed.

Results of the FMEA are recorded on an FMEA Worksheet (Figure 5-2). Detailed instructions for completing the worksheet are contained in Appendix B.

Figure 5-2  
FMEA WORKSHEET

1. SWAB NUMBER 56 1101		2. NOMENCLATURE Port Hydraulic Pump Assembly		3. SHIP CLASS		SH OF	
4. PREPARED BY		5. REVIEWED BY		6. APPROVED BY		7. REVISION	
DATE		DATE		DATE		DATE	
8. FUNCTION(S)	9. FUNCTIONAL FAILURES	10. DOMINANT FAILURE MODES		11. FAILURE EFFECTS: a. LOCAL b. SUBSYSTEM c. SYSTEM		12. TRANS-FER (Y/N)	
1.0	1.1 Inability to provide hydraulic fluid pressure	1.1a Leaking seals	A. Total Failure B. Loss of H. I. C. None		Yes		
		1.1b Motor failure - worn brushes	A. " " B. " " C. "		Yes		
		1.1c Motor failure - bearings	A. " " B. " " C. "		Yes		
		1.1d Controller failure - burnt contacts	A. " " B. " " C. "		Yes		
		1.2 Inability to vary or reverse flow pressure	1.2a Pump control valve failure	A. " " B. " " C. "	No		
			1.2b Differential control unit failure	A. " " B. " " C. "	No		
2.0	1.3 Inability to modulate hydraulic pressure	1.3a Line stop valve failure	A. Must use local control	" " B. " " C. "	Yes		
		1.3b Follow up shaft failure	A. Pressure pulses	" " B. " " C. "	No		
		2.1a Replenishing check valve failure	A. Total Failure	" " B. " " C. "	Yes		

13. SERIAL NUMBER

## 5.2 Failure Mode Selection for Corrective Maintenance Analysis [1]

To this point in the process the analyst has been concerned with functional failures, i.e., the loss of a capability of a system that is a specific requirement of the design. During FMEA the analyst identified the dominant (highest frequency) failure modes, the specific conditions that are the most likely causes of the functional failures. To minimize the effort however the analysis was conducted at the highest level of the hierarchy at which the function can be isolated.

In order to develop corrective maintenance tasks the functional failures and their dominant failure modes must be identified to the specific equipment/component of the system where the malfunction takes place. In addition, to limit the depth of analysis in a consistent manner, all identified failure modes for the system or subsystem must be considered together while prioritizing and selecting the corrective maintenance tasks which will receive detailed task analysis and maintenance planning.

If the analysis has been performed at the subsystem level the analyst first, enters all equipment/components of the subsystem and their LSACNs on the Corrective Maintenance Failure Mode Selection Worksheet (Figure 5-3). He then relates the failure modes identified in the FMEA to the equipment or component involved. Each failure mode must be isolated to a single component (no multiple failure events) and should be described to the level of detail required to develop a single maintenance task for each failure mode. Where more than one FMEA was required to analyze the subsystem, all the failure modes for the subsystem will be identified on the subsystem worksheet.

After the failure modes have been identified to the involved component the analyst will add to the worksheet, the component population, reliability and operational (usage factor) information from the applicable Data Collection Worksheets.

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[1] This task is performed for all systems meeting the tailoring requirements of Chapter 2 (ship acquisitions) and Chapter 3 (system/equipment acquisition).

Figure 5-3  
CORRECTIVE MAINTENANCE FAILURE MODE SELECTION

1. LSACH 5611		2. NOMENCLATURE Electro-Hydraulic Steering Subsystem										
4. EQUIPMENT	5. UNIT FAILURE RATE	6. USAGE FACTOR	7. ADJUSTED FAILURE RATE	8. QUANTITY PER SUBSYSTEM	9. SUBSYSTEM FAILURE RATE	3. DOMINANT FAILURE MODES	10. UNIT MODE FAILURE RATE	11. ADJUSTED MODE FAILURE RATE	12. % OF TOTAL FAILURE RATE	13.a. RANK	13.b. CUMULATIVE SUBSYSTEM FAILURE RATE	14. SELECT
Rotary Hydraulic Power Unit 56110101	.76	.25	.19	2	.38	1.3.2 Line Stop Valve Fail	.18	.36	.11	4	.64	✓
Truck Wheel 56110102	10.0	.001	.01	2	.02	—						
Hydraulic Pump 56110102	.8	.25	.2	2	.4	1.1.6 Leaking Seals	.17	.38	.12	3	.50	✓
Motor 56110103	2.0	.25	.5	2	1.0	1.1.6 Worn Brushes 1.1.2 Bearing Failure	.25 .15	.50 .30	.16 .10	2 5	.46 .79	✓ ✓
Motor Controller 56110201	.4	.25	.1	2	.2	1.1.2 Burnt Contacts	.09	.18	.06	6	.85	✓
Distribution Valve 561102	.6	.25	.15	1	.15	5.1.1 Valve Failure	.15	.15	.05	7	.90	✓
Service Tank 561103	1.0	1.0	1.0	1	1.0	6.1.1 Clogged Filters	.95	.95	.30	1	.30	✓
Total System Failures					<u>3.15</u>							
15. PREPARED BY	16. REVIEWED BY		17. APPROVED BY		18. REVISION		19. SERIAL NUMBER					

### 5.3 Corrective Maintenance Task Identification

Corrective Maintenance (CM) Task Identification involves two analyses:

- o Level of Repair. Each equipment/component of the FSI under analysis is assigned a corrective maintenance concept (repair-in-place or remove-and-replace) and a level of repair.
- o Task Identification. A specific maintenance task is developed for each failure mode selected.

#### 5.3.1 Level of Repair

The Level of Repair Analysis (LORA) is recorded on the LORA Worksheet (Figure 5-4). After listing the components of the subsystem, the analyst evaluates the most cost-effective method for restoring the function(s) provided by each component, when failure occurs. Consideration must be given to Top Level Requirements, and the overall Maintenance Concept of the application undergoing analysis, as well as the physical design of the component being analyzed. A logic chart (Figure 5-5) is provided to assist in the evaluation.

The analyst must also consider the Source, Maintenance, and Recoverability (SM&R) Code if one has previously been assigned to the item. Generally, the maintenance concept identified by the existing SM&R code should not be modified unless there are overriding operational or economic advantages.

In cases where a remove-and-replace repair concept is recommended for the component and it does not have a Navy assigned SM&R code, a preliminary economic LORA must be conducted.

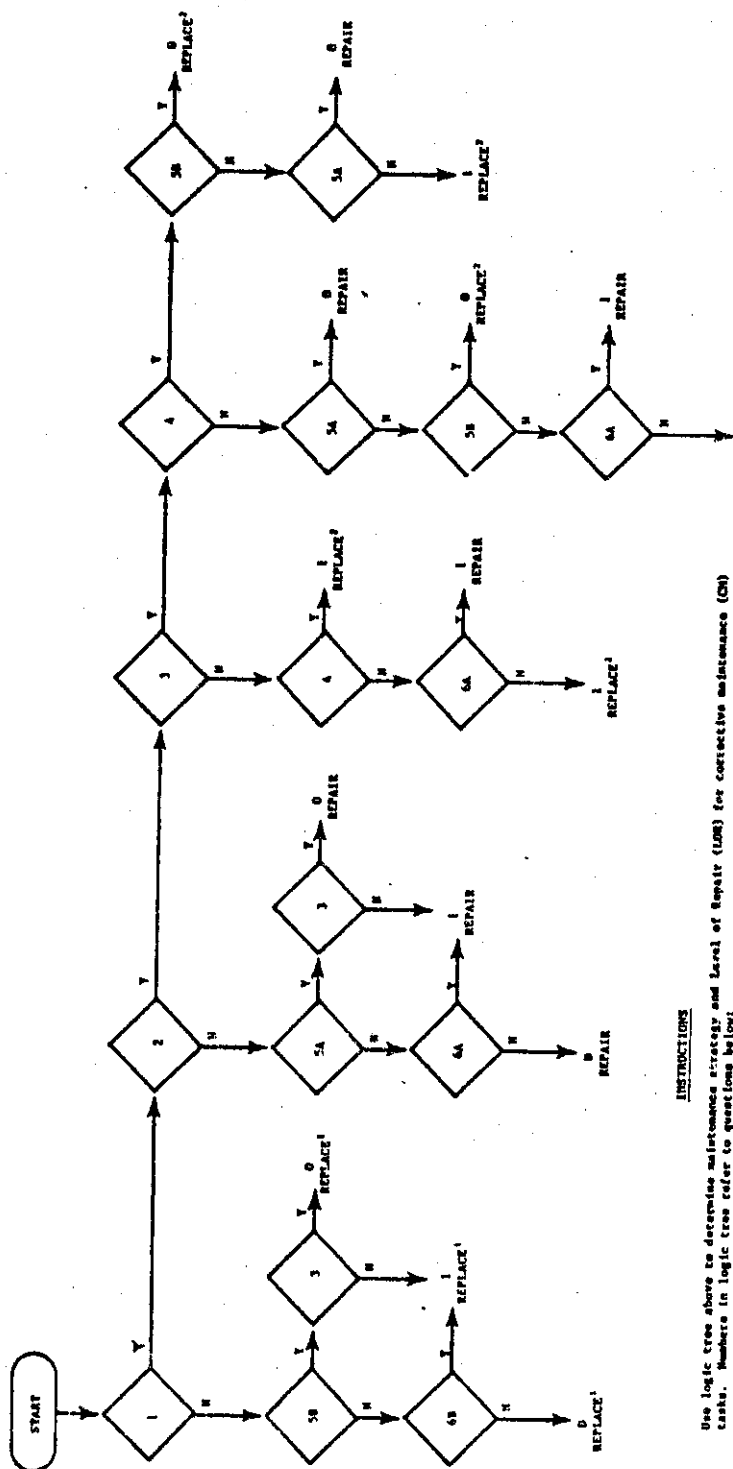
The preliminary economic LORA will consist of the following two steps:

- o Use the NAVSEA Level III LORA model to determine if the component should be initially managed as a consumable or a repairable.

**Figure 5-4**  
**LEVEL OF REPAIR ANALYSIS WORKSHEET**  
**(LORA Worksheet)**

1. SUBSYSTEM LSACH 5611		2. NOMENCLATURE Electro-Hydraulic Steering Subsystem														
3. EQUIPMENT		4. EXISTING SM&R CODE	5. ON NON-ECON LOR								6. ON Logic Questions		6. ECON LORA	7. REV SM&R	8. REMARKS	
			1	2	3	4	5a	5b	6a	6b	Result					
Rotary Hydraulic Power Unit 56110101			Y	N	Y		Y						O Repair		PA66D	
Trick Wheel 56110102		PA66D	Y	N	Y		Y						O Repair			
Hydraulic Pump 56110102			N					N		Y			I Replace	F.L.R.	PA66D	
Motor 56110103		PA66D	Y	N	Y		Y						O Repair			
Motor Controller 56110101		PA66E	Y	N	Y		Y						O Repair			
Distribution Valve 561102			Y	N	Y		Y						O Repair	F.L.R.	PA22D	
Service Tank 561103			Y	N	Y		Y						O Repair	F.L.R.	PA22D	
9. PREPARED BY		10. REVIEWED BY		11. APPROVED BY			12. REVISION			13. SERIAL NUMBER						
DATE		DATE		DATE			DATE			PAGE _____ OF _____						

Figure 5-5  
LORA LOGIC CHART



**INSTRUCTIONS**

Use logic tree above to determine maintenance strategy and Level of Repair (LOR) for corrective maintenance (CM) tasks. Numbers in logic tree refer to questions below:

1. Is the design of the item such that repair is feasible (Y/N)?
2. Are the item physical characteristics and installation such that a "remove/replace" strategy is feasible (Y/N)?
3. Is the item essential to the mission or safety of the ship (Essentially Codes 2, 3, 4, 5) (Y/N)?
4. Does replace require significantly less manhours and/or skills than repair (Y/N)?
5. Can the repair/replacement and post repair testing be accomplished at sea with the skills, facilities, support and test equipment which can reasonably be placed aboard ship?  
 5A Repair (Y/N)  
 5B Replace (Y/N)?
6. Can the item be repaired/replaced without the use of unusual and expensive equipments or facilities and/or highly specialized skills and experience?  
 6A Repaired (Y/N)  
 6B Replaced (Y/N)

**NOTES**

1. Removed unit is discarded.
2. Economic LOR analysis required to determine level of repair for removed unit.

- o For those components recommended for management as consumables use the procedures of section VIII of the Level III Users Manual to determine if the item is PTD worthy.

Detailed instructions for completing the LORA Worksheet are contained in Appendix B.

### 5.3.2 CM Task Identification

The Corrective Maintenance Task Worksheet (Figure 5-6) is used in this analysis. Each failure mode selected in the FMEA is recorded and related to specific equipment failures. An appropriate corrective action is identified based on the cause of the failure and the SM&R coding per item. Also, an estimate is made of how frequently the maintenance task will have to be performed.

Detailed instructions for the CM Task Worksheet are contained in Appendix B.

### 5.4 Planned Maintenance (PM) Task Identification

Planned maintenance tasks will be determined in accordance with MIL-P-24534 using the Reliability-Centered Maintenance (RCM) concept. This approach looks at system level failures and the impact of these failures, rather than the traditional equipment oriented view, to identify applicable and effective preventive maintenance task (see Table 5-1). RCM analysis will be conducted on those dominant failure modes identified in the FMEA. Calibration and alignment are considered preventive maintenance tasks and should be identified during the RCM analysis.

Although all Servicing and Lubrication (S&L) tasks could be determined using RCM logic, a simpler procedure, described in Section 5.5, is adequate for identifying routine S&L tasks. RCM analysis shall only consider special S&L tasks that do not have an obvious benefit.

**Figure 5-6**  
**CORRECTIVE MAINTENANCE TASK WORKSHEET**  
 (CM Worksheet)

1. LSACH 5611		2. NOMENCLATURE Electro-Hydraulic Steering Subsystem		6. TASK FREQUENCY	7. TASK CODE
3. FAILURE MODES		4. EQUIPMENT		5. TASK DESCRIPTION	
		A. LSACH	B. Nomenclature		
1.3a		56110101	Rotary Hydraulic Power Unit	3.2	CM-1
1.1		56110102	Hydraulic Pump	3.2	CM-2
1.1c		56110103	Motor	2.6	CM-3
1.1d		56110104	Motor Controller	1.5	CM-4
5.1		561102	Distribution valve	1.3	CM-5
6.1		561103	Service tank	8.3	CM-6
8. PREPARED BY		9. REVIEWED BY		10. APPROVED BY	
DATE		DATE		DATE	
				11. REVISION	
				12. SERIAL NUMBER	
				PAGE _____ OF _____	

Table 5-1  
TASK APPLICABILITY AND EFFECTIVENESS CRITERIA

TASK	APPLICABILITY	EFFECTIVENESS
<p>Time-Directed</p> <p>Scheduled Rework (RW)</p> <p>Scheduled Life Limit (LL)</p>	<p>Probability of failure must increase at an identifiable age. A large proportion of units must survive to that age.</p> <p>For safe-life items: Probability of failure below life limit must be zero.</p> <p>For economic-life items: Probability of failure must increase at an identifiable age. A large proportion of units must survive to that age.</p>	<p>For critical failures: The task must reduce the risk of failure to an acceptable level.</p> <p>For all other failures: The task must be cost-effective.</p> <p>A safe-life limit must reduce the risk of failure to an acceptable level.</p> <p>An economic-life limit must be cost-effective.</p>
<p>Condition-Directed (CD)</p>	<p>Reduced failure resistance for a specific failure mode must be detectable. Rate of change in failure resistance must be reasonably predictable.</p>	<p>For critical failures: The task must reduce the risk of failure to an acceptable level.</p> <p>For all other failures: The task must be cost-effective.</p>
<p>Failure Finding (FF)</p>	<p>Occurrence of functional failure must not be evident to the operating crew during performance of their normal duties.</p>	<p>The task must increase availability of the affected function to an acceptable level.</p>

#### 5.4.1 RCM Analysis

The key element in RCM analysis is application of structured decision logic in the form of a decision tree (Figure 5-7) consisting of a series of YES/NO questions that serve to identify the applicable and effective preventive maintenance tasks that should be performed. Functions whose failure would result directly in a safety hazard to the crew require either an effective preventive task or consideration of redesign of the item. Non-safety-related functions whose failure would affect the operational capability of the ship receive preventive maintenance if an effective, reasonable task can be found. Non-safety and non-mission-related functions are assigned tasks only when the tasks result in substantial economic savings (usually through avoidance of catastrophic failure).

Either preventive or failure finding tasks are also required to ensure acceptable availability of off-line functions. Off-line functions are of two kinds, hidden functions that protect against the impact of multiple failures, and those which relate to military mission systems not used frequently enough to provide confidence that they will be available when required.

The RCM Logic Tree Analysis Worksheet (Figure 5-8) records this process and is explained in Appendix B.

#### 5.4.2 Determination of Maintenance Interval

There are no practicable mathematical methods for selecting the "right" interval for a preventive maintenance task. When there is a threat to safety, and the associated failure is time-related, a conservative approach based on past experience is required to ensure a very high level of effectiveness.

The periodicity of a task for a non-safety related failure mode requires a careful evaluation of the impact of failure, the effectiveness of the task, and the resources required to perform the task. Generally, failures which have little impact on the ship's missions and which require significant resources should have tasks assigned as infrequently as possible. It should also be remembered that in most maintenance tasks, a risk exists that failure will be



Figure 5-8  
RCM LOGIC TREE ANALYSIS WORKSHEET

1. SWAB NUMBER		2. NOMENCLATURE		3. SHIP CLASS		SH OF		
561101		Port Hydraulic Pump Assembly						
4. PREPARED BY		5. REVIEWED BY		6. APPROVED BY		7. REVISION		
DATE		DATE		DATE		DATE		
8. FUNCTIONAL FAILURE/ FAILURE MODE	9. CRITICALITY ANALYSIS		10. CRITICALITY CLASS		11. PM TASK?		12. FAILURE FAILURE TASK?	
	(1)	(2)	(A)	(B)	(C)	(D)	(E)	(F)
13. REDESIGN? SERIAL NO.		14. TASK DESCRIPTIONS OR DESIGN CHANGES		15. PERIODICITY		16. SERIAL NUMBER		
1.1a	Y	N	C	N	N	N		
1.1b	Y	N	C	Y	N	N		
1.1c	Y	N	C	N	N	N		
1.1d	Y	N	C	N	N	N		
1.3a	Y	N	C	N	N	N		
2.1a	Y	N	C	N	N	N		
				PM-1 Inspect brush length, replace when less than 3/4"		Q		

LOGIC TREE ANALYSIS  
OPNAV OP0120812787

induced through improper performance of the task. Thus, selection of any periodic tasks means that the analyst believes, after careful consideration of the available information, that the user will be better off by performing the task than by not performing it.

#### 5.4.3 Safety-Related Design Change Request

A Safety-Related Design Change Request must be prepared for each safety-related functional failure for which no effective preventive maintenance task exists. Such functional failures are identified during RCM Logic Tree Analysis.

For ship acquisitions it is imperative that each recommendation be prepared and forwarded to the shipbuilder's LSA Coordinator as quickly as possible, since the ship design and ship construction schedule could be affected.

#### 5.5 Servicing and Lubrication Analysis

The LSA Servicing and Lubrication Analysis is a simple, common sense evaluation of existing requirements to establish performance of the specific task at specific periodicities. The current periodicities are frequently based only on manufacturer's recommendations and may be excessive. The goal is to determine the tasks that really have benefit and determine the periodicity at which the benefits and resources to perform the tasks are optimized.

The analysis begins with the listing of all current servicing and lubrication tasks on the Servicing and Lubrication Worksheet (Figure 5-9). The primary sources of these tasks will be relevant Maintenance Requirement Cards (MRCs) or technical manuals. Also included will be any servicing and lubrication tasks developed during RCM analysis. These tasks are then evaluated using the following considerations:

- Is the task and frequency appropriate, considering the specific application and usage factor of the item?

Figure 5-9  
SERVICING AND LUBRICATION WORKSHEET

1. SWAB NUMBER	2. NOMENCLATURE		3. SHIP CLASS	BH OF		
	4. PREPARED BY	5. REVIEWED BY			6. APPROVED BY	7. REVISION
8. ITEM AND TASK DESCRIPTION	9. LOCATION	10. QUANTITY	11. PREVIOUS PERIODICITY	12. MATERIAL SPECIFICATION	13. ANALYSIS DECISION	14. EXPLANATION
Motor / 5610103 Lubricate bearings. MRC J-16 D1-R 5L-1		2	500 hours	Grease: MIL-G-81332 Grease: MIL-G-2164	CP	Periodically excessive - change to Q MIL-G-81332 sufficient for all bearings
Motor / 5610107 Grease entire length of flex coupling MRC J-16 D1-d 5L-2		2	Q	Grease: MIL-G-81332	NC	
Motor Controller / 561010301 Use paint brush and vacuum cleaner to remove foreign matter MRC J-16 D2-A 5L-3		2	Q	None	OM	Controller housing sealed

15. SERIAL NUMBER

SERVICING AND LUBRICATION ANALYSIS (OPNAV FORM 1) (11-76)

- o Is the location of the item such that the operating environment is more or less severe than that assumed by the manufacturer?
- o Can the recommended method be improved?
- o Can an approved alternative material be used? When practical, common periodicity and materials should be established so that several items can be serviced or lubricated at once, and the number of different materials required can be minimized.

Step by step instructions for completing the LSA Servicing and Lubrication Worksheet are contained in Appendix B.

#### 5.6 Inactive Equipment Maintenance Analysis

The purpose of Inactive Equipment Maintenance (IEM) analysis is to identify tasks which should be performed when a system/subsystem is to be temporarily inactivated for 30 days or longer. Four types of tasks may be identified:

- o Lay-up Maintenance Tasks - to prepare the system or subsystem for the inactive period.
- o Periodic Maintenance Tasks - protective actions to be taken at intervals during the inactive period.
- o Start-Up Maintenance Tasks - to prepare the system or subsystem to become operable.
- o Operability Test - to ensure operability of the system or subsystem at the end of the inactive period.

This information provides a basis to generate new detailed task procedures and material requirements or to identify the source of appropriate existing procedures for system level MIPs.

The analysis utilizes the IEM Worksheet (Figure 5-10). The goal is to determine the most cost effective tasks to protect equipment from degradation. It is therefore important to consider those dominant system and subsystem failure modes that are a direct result of the environment during the inactive period. The analyst must examine not only equipment internal workings, but also external surfaces, attachments, connecting lines, piping and valves. The tasks selected should be straightforward, such as:

- o Remove equipment and place in protected area.
- o Lubricate and cover exposed areas.
- o Remove fluids and seal intake ports.
- o Operate periodically in local control.
- o Remove from power source.
- o Rotate assemblies periodically.

Before conducting the analysis, the analyst should review existing PMS, technical manuals or manufacturer's maintenance data. Appendix B provides detailed instructions for completing the Inactive Equipment Maintenance Worksheet.

Figure 5-10  
INACTIVE EQUIPMENT MAINTENANCE (IEM) WORKSHEET

1. LSACN 561101		2. NOMENCLATURE Port Hydraulic Pump Assembly		7. TASK CODE
4. DEGRADATION	3. EQUIPMENT	5. IEM TASKS	6. PERIODICITY	
Corrosion	Motor / 56110103	1. Place cardboard between motor brushes and commutator 2. Remove cardboard	LU	IM-1
Hidden Damage	Hydraulic Pump Assembly / 561101	1. Topp-off hydraulic fluid 2. Visually inspect unit before start-up 3. Monitor unit operation using bridge control 4. Remove and hydrostatically test relief valves, and replace (if inactive period greater than 12 months)	SU	IM-2
			LU	IM-3
			SU	IM-4
			OT	IM-5
			OT	IM-6

8. PREPARED BY	9. REVIEWED BY	10. APPROVED BY	11. REVISION	12. SERIAL NUMBERS
DATE	DATE	DATE	DATE	PAGE _____ OF _____

## 6. MAINTENANCE TASK REQUIREMENTS DEFINITION

The purpose of the task definition process is to identify the logistic resource requirements (parts, materials, tools, test equipment, manpower, and skills) needed to perform the PM and CM tasks identified in Chapter 5. This information forms the basis of the Maintenance Plan and PMS for the item undergoing LSA and is used to verify that adequate logistic resources will be acquired and positioned to support the item when it is deployed.

The definition process begins with generation of a Maintenance Task Index (Section 6.1) which lists maintenance tasks identified in the MTI process described in Chapter 5. Each task listed on the index is then analyzed to identify the specific resources required to accomplish it (Task Requirements Definition, Section 6.2). In cases where an identified resource (excluding spare parts) levies a substantial new requirement on the logistic support system (such as a new NEC) which has not been identified during LSA-I, a Special Requirements Justification must be prepared (Section 6.3). Finally, a Task Definition Form may be required for preventive maintenance and for servicing and lubrication tasks to be performed at the organizational level (Task Definition Form, Section 6.4).

### 6.1 Maintenance Task Index

A Maintenance Task Index, similar to that shown in Figure 6-1, shall be prepared for each system/subsystem. The index shall segment the tasks identified for that system/subsystem both by level of application and by task type; i.e., tasks which apply to the entire system/subsystem are listed first, then lower level tasks through the equipment level, i.e., hierarchically, as in the SBDI or EBDI LSACN Index.

Within each level, tasks should be listed in the following order:

- o Preventive Maintenance Tasks.
- o Servicing and Lubrication tasks.
- o IEM tasks.
- o Corrective Maintenance tasks.

Figure 6-1  
SAMPLE MAINTENANCE TASK INDEX

DATE: 5/7/81  
APPLICATION: CG-99

SYSTEM/SUBSYSTEM/EQUIPMENT:

ICN: 561101

NOMENCLATURE: Port Hydraulic Pump Assembly

ICN	APPLICABLE FSIS NOMENCLATURE	SMER	TASK CODE	TASKS		FREQUENCY
				DESCRIPTION		
561101	Port Hydraulic Pump Assembly	PADDL	IM-3	Top-off hydraulic fluid		LU
			IM-4	Visually inspect unit before start-up		SU
			IM-5	Monitor unit operation using bridge control		OT
			IM-6	Hydrostatic test of relief valves		OT
5611010101	Port Rotary Hydraulic Power Unit	PA6DD	CM-3	Overhaul IAW technical manual		80
56110103	Motor	PA6DD	PM-1	Inspect brushes		S
			PM-2	Tighten flex coupling flanges		S
			SL-1	Lubricate motor bearings		W
			SL-2	Grease flex coupling		Q
			IM-1	Place cardboard between brushes and commutator		LU
			CM-1	Reinstall or replace flex coupling		140
			CM-2	Replace brushes		80

The Maintenance Task Index may be computer generated when an automated LSAR is used. Table 6-1 relates index data requirements to MTI worksheets.

## 6.2 Task Requirement Definition

A Task Requirements Worksheet (Figure 6-2) is prepared for each task identified on the Maintenance Task Index. There are six major types of information which must be provided:

- o Level of Maintenance. There are three questions concerning the level of maintenance that should perform the task:
  1. Could the ship's crew perform the task? The purpose of this question is to identify whether the ship's crew has the skills, materials, tools, and equipment to perform the task.
  2. Should the task be performed in-place, in the ship shop or off-ship. If the task is not to be performed in-place, the LSA analyst must determine if removal routes have been established which will accommodate the equipment.
  3. What is the most appropriate level of maintenance? If the task frequency and criticality is such that the safety and mission capability of the ship would be jeopardized during an extended at-sea period, then the task must be assigned to the organizational level. If the task frequency or criticality permits performance by off-ship resources, a decision must be made on what level is most appropriate. (Corrective Maintenance tasks are assigned to the level indicated by the equipment/component SM&R

TABLE 6-1  
SOURCE DATA FOR MAINTENANCE TASK INDEX

MAINTENANCE TASK INDEX DATA ELEMENT	RELATED WORKSHEET & BLOCKS
<u>System/Subsystem/Major Equipment</u>	
LCN	FMEA, Block 1
Nomenclature	FMEA, Block 2
<u>Applicable Equipment Component</u>	
LCN	RCM, Block 1 S&L, Block 8 IEM, Block 8 CM, Block 4A
Nomenclature	RCM, Block 2 S&L, Block 8 IEM, Block 3 CM, Block 4B
<u>Tasks</u>	
Task Code	RCM, Block 14 S&L, Block 8 IEM, Block 7 CM, Block 7
Description	RCM, Block 14 S&L, Block 8 IEM, Block 7 CM, Block 7
Periodicity	RCM, Block 15 S&L, Block 11 or 13 IEM, Block 6 *CM, Block 6
SM&R	LORA, Block 4 or 7

\* must be converted

coding, unless the specific task is beyond that level's capability.)[1]

- o Skills -- Manhours. The question: "Who must do this task and can he/she do this task with existing skills and knowledge?" is answered by the minimum number of persons required to perform this task by rate and rating and the manhours for each. If a specific NEC is required, it is added to the appropriate rate. The total of all ratings manhours and the total elapsed time is also recorded.
- o Materials & Parts. Here is answered the question: "What materials, lubricants, or parts must be provided to accomplish this task?"
- o Special Tools. This answers the question: "What special tools are needed?" (Special tools are hand or power tools not routinely provided in a ship's AEL).
- o Test Equipment. Answered is the question: "What mechanical, electronic, or electric test equipment is used in performing the task?" Also indicated is whether the test equipment is currently used by the Navy.

Detailed instructions for completing the Task Requirements Worksheet are contained in Appendix B.

### 6.3 Special Requirements Justification

Each "special" requirement identified in the Task Requirements Definition process must be justified using a Special Requirements Justification Worksheet (Figure 6-3). Special requirements are defined as follows:

---

[1] For complex equipments an economic LORA should be conducted in accordance with MIL-STD-1390 B (Navy) for all components of the equipment as part of the task requirements analysis in order to finalize SM&R coding assignments.

Figure 6-2  
TASK REQUIREMENTS WORKSHEET

1. LSACN 5611010101		2. NOMENCLATURE Rotary Hydraulic Power Unit			3. SHIP CLASS						
4. TASK CODE CM-5		5. TASK DESCRIPTION Overhaul IAW technical manual			6. PERIODICITY 3.75 M						
7. TASK SUMMARY (include Facilities Requirements): Accomplish class "C" overhaul <input type="checkbox"/> Spec. Fac. in accordance with NSTM 00741-2P47					10. SKILLS						
					a. NO.	b. RATE/RATING	c. NEC	d. M/H			
					1	EM1	0123	7.0			
					1	EM3	0123	12.0			
					1	MM1	2002	8.0			
8. SHIP'S CREW <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				9. LOR <input type="checkbox"/> 0 <input type="checkbox"/> I <input type="checkbox"/> D		11. TOTAL M/H 27.0		12. ELAPSED TIME 19.5			
13. MATERIALS & PARTS											
NUMBER	QUANTITY	U/M	DESCRIPTION	SPECIAL							
4522-0714312	1	set	hydraulic seals								
4522-9318765	1	ea	shaft bearing								
NSN 5950-00-178	1	set	synchro gear set								
14. SPECIAL TOOLS						15. TEST EQUIPMENT					
NUMBER	DESCRIPTION	SPECIAL > 5500				SCAT/IDENT NO.	DESCRIPTION	SPECIAL			
None						4020/4522-0TS-003	Synchro Signal Generator	X			
16. PREPARED BY:			17. REVIEWED BY:			18. APPROVED BY:			19. REVISION		20. SERIAL NO.

- o Facilities. Any structure, industrial equipment, or services (such as sand-blasting) which are generally not available at the maintenance level at which the task is to be performed. Special facilities already identified and approved in the Maintenance Concept for the item undergoing LSA do not need to be justified.
- o Materials. Special materials are defined as lubricants, piping, gasket material, etc., not currently available through the Navy supply system.
- o Skills. Special skills are defined as a requirement for a new NEC that has not previously been identified in the Navy Training Plan (NTP) for the end item undergoing LSA. During LSA II it is more likely that the analysts will identify changes required to existing curricula rather than an entirely new NEC.
- o Tools. Special tools are any hand or power tools which are not currently carried by the Navy supply system and/or have a unit cost over \$500.
- o Test Equipment. Special electric or electronic test equipment or accessories are those not listed in NAVSEA ST000-AA-IDX-010/PEETE. Special mechanical test equipment is defined as not being available through the Navy system and/or having a unit cost over \$500.

Justification includes a detailed description of the special requirement and an explanation of why it is needed in lieu of existing Navy support resources. Physical descriptive data should also be provided for tools, materials, and test equipment. Detailed instructions are provided in Appendix B.

#### 6.4 Task Definition Form

A Task Definition Form must be prepared for all organizational level preventive maintenance and for servicing and lubrication tasks for which there are no applicable, current Maintenance Requirement Cards (MRCs). Timing of preparation of the form will be established in conjunction with NAVSEA 05L for each LSA program.

Figure 6-3

SPECIAL TASK REQUIREMENTS JUSTIFICATION WORKSHEET

		<p>A. REQUIREMENTS TYPE:</p> <p><input type="checkbox"/> FACILITIES    <input checked="" type="checkbox"/> TEST EQUIP.</p> <p><input type="checkbox"/> SKILLS/NEE    <input type="checkbox"/> TOOLS</p> <p><input type="checkbox"/> MATERIALS</p>		
1. LSACN 5611010101	2. NOMENCLATURE Pent Rotary Hydraulic Power Unit	3. SHIP CLASS		
<p>4. SPECIAL REQUIREMENT DESCRIPTION AND FUNCTION</p> <p>Synchro Signal Generator (SSG) 4522-ETS-0003: SSG is self programmed to randomly test the synchro receiver in the Rotary Hydraulic Power unit for speed and accuracy in response to (simulated) helm wheel inputs. Input Power: 120 v. 3 phase 400 cycle regulated. Full test cycle ensures synchro receiver operation within ±2% of design speed and position accuracy of 2.5°.</p>				<p>5. TASK CODES</p> <p>CM-1</p>
<p>6. EXPLANATION AND JUSTIFICATION</p> <p>Test points and built-in test circuitry of synchro receiver are only compatible with 4522-ETS-0003 SSG</p>				
BLOCKS 7-11 APPLICABLE TO TEST EQUIPMENT, TOOLS, AND MATERIALS ONLY				
7. QUANTITY 1	8. UI Ea	9. UNIT COST \$ 32,000	10. DIMENSIONS (L/W/H) (FT) 1.4 / 1.6 / 1.6	11. WEIGHT (LBS) 47.0
12. PREPARED BY:	13. REVIEWED BY:	14. APPROVED BY:	15. REVISION	16. SERIAL NUMBER

Most of the information needed is generated through the analyses described previously (see Table 6-1). However, the following additional requirements analysis is required:

- o Task Description. In some cases it may be desirable to combine two or more tasks on one form, if they are closely and sequentially related.
- o Warnings and Cautions. Warnings and cautions which should be observed in performing the task will be determined. A warning applies to a potential danger to personnel; a caution applies to potential damage to equipment.
- o Procedure. A step-by-step description of how the task is to be performed is required.

Detailed instructions for the Task Definition Form preparation are contained in MIL-P-24534 (Navy).

## 7. COMPLETION OF THE MRP PROCESS

Once analysis is completed, the Analyst must consolidate output products prior to submitting ILS documentation to the Navy. This chapter describes some of the output products and other uses of the analysis.

### 7.1 Standardization of Requirements

Task requirements determination included the identification of tools, materials, manpower, skills and test equipments needed to perform each task. The analyst, concerned only with the task at hand, may specify items which, with slight modifications, could be shared among a much larger family of tasks.

For example, two equipments in a ship compartment may require voltage measurements of 1-10 volts and 100-150 volts, respectively. Two different Multimeters may have been specified in the task analysis. However, a single meter of appropriate tolerance could be used to meet both requirements.

The Contractor should review and standardize requirements in the following areas:

- o Servicing and Lubrication. Review all servicing and lubrication requirements and consolidate the lubricant and consumable requirements. Standard Navy items shall be used whenever possible.
- o Support and Test Equipment. Review all requirements for support and test equipment and consolidate requirements whenever possible. Standard Navy test equipment shall be used whenever possible.

### 7.2 Maintenance Plan

The Maintenance Plan for systems undergoing LSA is one of the major outputs of the MRP process and will be used by the ship, Type Commander, and PERA (Planning and Engineering for Repairs and Alterations). The Maintenance Plan summarizes the overall maintenance concept for the application undergoing LSA

and shows how the maintenance concept will be carried out. It lists the maintenance tasks identified in the MRP process, the levels of maintenance at which they are to be performed, and the resources required to perform them.

A typical plan will contain the following sections:

- o Introduction, including maintenance concept;
- o Functional Block Diagrams and LSACN Index;
- o Listing of PM and S&L tasks by level, periodicity, and workcenter or SWBS;
- o Listing of IEM tasks by level, periodicity, and workcenter or SWBS;
- o Listing of CM tasks by level and workcenter or SWBS;
- o Listing of all tasks by LSACN;
- o Listing of resource requirements by task code.

### 7.3 Planned Maintenance Subsystem

After the proposed organizational level PM tasks have been approved by the LSA Review Team, the Contractor shall prepare Maintenance Index Pages (MIPs). Specific guidance should be provided concerning the LSACN level at which Task Definition Forms (section 6.4) shall be assembled into MIPs.

#### 7.3.1 Submission of PMS

Each completed set of MIPs and TDFs covering a system shall be submitted to the Navy accompanied by the following documentation:

- o Covering title sheet identifying the system analyzed, the maintenance requirement development activity and the contract number under which the development was accomplished.
- o Applicable portions of the SBDI.
- o Applicable MRP documentation, including:
  - a. FSI Data Worksheets
  - b. Functional Failure Analysis Worksheets
  - c. Failure Modes and Effects Analysis Worksheets
  - d. RCM Decision Logic Tree Analysis Worksheets
  - e. Servicing and Lubrication Task Worksheets
  - f. Inactive Equipment Maintenance Worksheets
  - g. Maintenance Task Index
  - h. Task Requirements Worksheets

#### 7.4 Validation of the Preliminary Ships Manning Document (PSMD)

By the start of LSA II, many important manpower decisions have been made and documented in the PSMD. This document developed by the Navy Manpower and Material Centers, Atlantic and Pacific with NAVSEA 03 (Manning Branch) and SHAPM input incorporates the Required Operational Capabilities and Top Level Requirements, determined during the Conceptual Design Phase, into a preliminary manning document. It lists minimum manpower requirements by rate, rating, and NEC for different watch conditions. Initial manpower estimates to perform preventive and corrective maintenance actions are also included. Workload requirements are broken down into five categories: Preventive, Corrective, and Facilities Maintenance, Own-Unit Support and Customer Support (repair services to other ships).

Although the PSMD is a planning document and changes are made throughout the ship acquisition cycle, major increases in overall crew size can require significant redesign of the physical ship structure. The upper bound on manpower (without redesign) is the number of crew accommodations.

The PSMD manhour estimates for PM, by individual equipment, are derived from 3M data if the equipment is operational or there is comparable equipment in other ships. Estimates are sought from the manufacturer for new equipment. CM manhour estimates are determined as a multiple of PM manhours. The current factors are 1.0 hour CM for 2 hours PM for most HM&E equipment and 1.0 hour CM for 1 hour PM for most electronic equipment.

Other factors such as Facilities Maintenance and Own Unit Support are determined by various industrial engineering, statistical sampling and job study techniques.

During LSA II, estimates of both PM and CM workload in the PSMD should be validated/updated. Since PM requirements will be developed using RCM, the new PM estimates will probably be lower than the initial estimates in cases where the initial estimates were based upon the critical examination method for PM packages for similar equipment. Since a full PMS package will be developed, the total PM workload can be computed by summing all the PM manhours in the LSAR. For CM manhour estimates the following estimation technique will be used.

#### 7.4.1 Estimation of CM Workload

In order to estimate the total CM workload for system/subsystems undergoing analysis the individual task estimates must be extrapolated using the depth of analysis parameter applied to the subsystem. During Functional Failure Analysis each subsystem was assigned a Mission Essentiality Code (MEC) and a required depth of analysis, i.e.:

<u>MEC</u>	<u>DEPTH OF ANALYSIS</u> (% Cum Failure Rate)
5 and 4	90%
3 and 2	75%
1	50%

As a result, the CM workload represented by the set of CM Task Requirements Worksheets do not represent the total expected workload. In order to estimate the total CM workload for the subsystem, the following rules will be applied:

- o For each worksheet compute the annual workload identified by the task (the worksheet identifies the periodicity of each task as well as task workload).
- o Aggregate the workload by repair level and skill (Rate/Rating and NEC).
- o Apply to each aggregation the applicable depth parameter in order to estimate the total requirement e.g.,

$$\begin{array}{l} \text{Total Annual Manhours} \\ \text{for the subsystem} \\ \text{(all levels)} \end{array} = \frac{\text{Total Annual Manhours (all worksheets)}}{\text{Depth Factor expressed} \\ \text{as a Decimal.}}$$

$$\begin{array}{l} \text{Total Annual Manhours} \\ \text{"0" level, for a} \\ \text{specific skill (all worksheets)} \end{array} = \frac{\text{Total Annual Manhours, "0" level, for the NEC,}}{\text{Depth Factor (Decimal)}}$$

### 7.5 Navy Training Plan (NTP)

As with Ships Manning, many important training decisions have been made prior to the start of LSA II since "an approved NTP is required at least four years in advance of planned fleet introduction.[1] Consideration will have already been given to identification of new course requirements resulting from the introduction of new systems and equipment; shipbuilder training to be provided to lead ship operator and maintenance personnel; feasibility of the use

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[1] OPNAVINST 1500.8 SERIES SUBJ: NAVY TRAINING PLANNING PROCESS IN SUPPORT OF NEW DEVELOPMENTS.

of Land Based Test Sites for crew hands on training, etc. LSA II analysis will provide input to course curricula requirements identified in task and skills analyses and can also ensure that last minute design changes made during construction are analyzed to identify the impact on training material or course content. Due to the long lead times and tight constraints on the acquisition of training resources, these inputs should be provided to the training community on as "as identified" basis and not await the completion of the full LSA package.

## 7.6 Provisioning

Provisioning is the process of identifying, cataloging and buying initial supply support for the ship's equipments. It begins with the Contractor providing Provisioning Technical Documentation (PTD) to the Provisioning Activity (normally SPCC) and results in the stowing of required materials in the ship's storerooms as well as the prepositioning of required materials at the intermediate and depot level maintenance sites.

PTD comprises various types of provisioning parts lists (PPLs) plus drawings, photographs, wiring diagrams, and other supplementary descriptive data.

### 7.6.1 Provisioning Requirements Statement

LSA II provisioning will be in accordance with a NAVSEA Provisioning Requirements Statement (PRS), which implements:

- o MIL-STD-1552 "Provisioning Technical Documentation",
- o MIL-STD-1561 "Provisioning Procedures", and the
- o NAVSEA/NAVSUP "Program Support Agreement" of August 1977.

The PRS procedures should facilitate timely, effective supply support at a reasonable cost by specifying the use of existing data where possible in determining shipboard stock levels. The following rules are currently used at SPCC in determining replacement rates for repair parts.

- o Items with National Stock Numbers (NSNs) having established demand/3M usage data are assigned a historical replacement rate (Best Replacement Factor).
- o Items having no NSN but similar to those listed in a Lead Allowance Parts List (LAPL) are assigned Technical Replacement Factors (TRFs) from the LAPL.
- o Application Replacement Factors (ARFs) (an expected failure rate of an item based on testing/analysis) are provided by the Contractor when a BRF or TRF is not available.

The PRS should highlight the following areas, which should also be stressed in the LSA Plan:

- o Provisioning Parts Lists (PPLs) shall be detailed and complete. They should list all replaceable parts, not merely those expected to fail.
- o Equipments containing items that have long procurement lead times shall have PTD submitted early in the LSA process.
- o The Contractor will identify a point of contact for each Vendor providing equipment and/or PTD with whom analysts at the Provisioning Activity can discuss technical issues.

#### 7.6.2 LSA II Provisioning Interfaces

During development and submission of PTD, the primary interface requirements between provisioning and other MRP branches are that:

- o PTD submission are reviewed by the LSA analyst and are assigned applicable LSA Control Numbers (LSACNs).

- o All LSA information corresponding to FOMIS data elements are entered into FOMIS, citing the applicable LCN and FOMIS Access Number.
- o PPLs are compared with equipment Technical Manuals to verify that part numbers and manufacturers are correct.

As major segments of the PTD and the LSA are completed, Provisioning Review Conferences should be held between SPCC, the LSA Contractor, and the Acquisition Manager to determine that:

- o Stock levels for those items having BRFs or TRFs support the maintenance tasks identified in the LSA.
- o Material for PMS and safety requirements are included in ship-board inventories.
- o Assignment of or changes to SM&R Codes are made.
- o The impact of Intermediate and Depot Level requirements on Tender Load Lists (TLLs) and Operational Support Inventories (OSIs) are identified.
- o Increases in requirements that may affect Navy/DLA wholesale system planning are identified.

### 7.6.3 Quality Control of Provisioning and Allowance Lists

LSA II procedures do not require that the LSAR contain all replaceable parts in an equipment. However, the Planned Maintenance Task Identification worksheets contain all materials required for PM, and the Corrective Maintenance Task Identification identifies the spares and repair parts required for high frequency critical CM actions. The parts and material identified in the LSA II analyses should first be compared to the Provisioning Technical Documentation to validate that the parts have been identified and that the Source Maintenance and Recoverability (SM&R) Code is consistent with the equipment

maintenance plan. As allowance quantities are computed, they should also be compared to the Task Requirements worksheets,[1] i.e., when COSALs and load lists are generated, they should be checked to ensure that the required material will be available at the appropriate echelon. If parts required to support a significant number of critical repairs do not appear on the allowance (this can be the case with large complex equipments provisioned using FLSIP allowance policies), consideration should be given to the use of alternative stocking policies such as the Availability Centered Inventory Rule (ACIR).

### 7.7 Technical Documentation

Technical documentation provides detailed descriptions of the operation, construction, and characteristics of a system or equipment. It provides the maintainer with the information needed to undertake maintenance actions. A major goal of the LSA process is to provide the ship with complete technical documentation, both to support the Maintenance Plan at all three levels of maintenance and to allow emergency repairs to be undertaken anywhere in the world (utilizing local industrial facilities when required).

There are four basic types of technical documentation:

- o System Technical Manuals describe systems (equipment grouped to provide specific functions) and include required drawings, fault logic charts, etc.
- o Equipment Technical Manuals describe specific equipments and detail their construction, operation, and maintenance.

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[1] The alternative to checking allowance quantities on COSALs is to compare the estimated replacement rates for parts from the task analyses to the Best Replacement Factors (BRFs) or Technical Replacement Factors (TRF) used by SPCC in allowance computations. If this alternative is used, arrangements must be made with SPCC to obtain BRF/TRF data since it is not usually made available to the shipbuilder or other contractors.

- o Repair Manuals are based on System or Equipment Technical Manuals, but focus on how routine maintenance tasks should be performed and are in a pocket-sized format.
- o Technical Repair Standards (TRSs) are step-by-step instructions developed for the use of industrial activities in the overhaul of complex systems and equipments.

System and Equipment Technical Manuals are the most critical elements of technical documentation since they provide the basic information needed by skilled personnel to undertake rare or unexpected maintenance actions, as well as routine tasks. The Repair Manuals are a more convenient reference for undertaking routine tasks and provide a useful text for initial personnel training. TRSs are valuable when complex items are expected to require frequent overhaul.

Technical documentation shall be prepared in accordance with the Technical Manual Contract Requirements (TMCR).

#### 7.7.1 LSA II/Technical Documentation Interfaces

Technical documentation preparation interacts with other branches of the MRP process as follows:

- o System Technical Manual requirements will be determined based on the results of the partitioning process (Chapter 4).
- o Equipment and System Technical Manuals (if available) provide valuable technical information for identifying maintenance task requirements.
- o Repair Manuals should be validated to ensure that they cover the tasks documented in the MTI&A.

- o TRSs should be developed if the frequency of system failures requiring overhaul indicates a requirement for Technical Repair Standards.
- o Part number references should be validated in all manuals against the applicable PPLs.

### 7.8 Reliability, Maintainability, and Availability Estimation

Reliability, Maintainability, and Availability (RMA) must be an important consideration throughout the MRP process. Reliability is the measure of an item's susceptibility to failure and can be expressed as the Mean Time Between Failure (MTBF). Maintainability refers to the ease with which failures can be corrected and can be expressed as Mean Time to Repair (MTTR). Operational Availability ( $A_o$ ) is the ratio of the time a system or equipment is in operable condition over the total time examined and is usually expressed as a percentage. Total time is made up of the operable time, time undergoing repairs, and logistic delay time associated with initiating the repair and/or acquiring needed materials:

$$A_o (\%) = \frac{\text{Up-Time}}{\text{Up-time} + \text{Repair Time} + \text{Delay Time}} \times 100$$

RMA goals are established during LSA I. MRP (LSA II) plays a critical role in ensuring that these goals will be met. The inherent reliability and maintainability of systems and equipments are a function of their design, construction, and installation and are not affected by MRP decisions. However, actual reliability can be degraded by unnecessary preventive maintenance, poor maintenance documentation, or inadequately trained personnel. Maintainability can also be affected adversely by these factors as well as through inadequate provision of special tools, test equipment, and facilities.

While reliability and maintainability are affected solely by the quality of the logistic support elements developed in MRP, operational availability is also affected by the time needed to assemble the skills, tools, parts, etc.,

required for repair of a failure. The average time required is referred to as the Mean Logistics Delay Time (MLDT), and the  $A_0$  for an item can be projected using the equation:

$$A_0 (\%) = \frac{MTBF[1]}{MTBF + MTTR + MLDT}$$

Level of repair and provisioning decisions in the MRP process determine MLDT and thus directly impact  $A_0$ . Obviously, there is a dramatic difference between MLDT of a repair action in which all the required support elements are aboard ship (a few hours) and the MLDT of a repair action for which one or more necessary elements are located ashore (hundreds of hours). Logic has been built into the MRP process to select the appropriate level of repair and to ensure logistic elements are integrated, i.e., that all resources needed to perform a maintenance action are available at the appropriate level.

When each system has undergone MRP, the resulting data shall be used to compute the system's projected  $A_0$  goal. Shortfalls may occur due to design deficiencies (lower than expected MTBF) or due to unsatisfactory MLDT.

When a shortfall occurs, it is usually difficult, time consuming, and expensive to attempt to substantially improve MTBF. Therefore, when possible first emphasis should be placed on improving  $A_0$  by reducing MLDT. This may be accomplished through changes in the repair strategies of key items in the system and related changes to support resources. In some cases, extraordinary support measures may be justified.

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[1] MTBF should be in calendar time rather than operating time. Weapon systems and other equipments which have low overall usage, but which may be operated intensively for extended periods to accomplish certain missions, should have their operating MTBF adjusted to reflect operating time during that mission period.

### 7.8.1 Ao Review

As discussed in the previous section, the results of the LSA shall be used in verifying established  $A_0$  goals. The computation shall utilize a reliability model of each system through the equipment level.[1] The operating time MTBFs and USAGE factors needed to convert to calendar time MTBFs may be taken directly from the LSAR.

Any changes required in maintenance strategy or supporting resources due to the  $A_0$  review shall be fully documented and entered into the LSAR and the Maintenance Plans.

### 7.8.2 MTTR

MTTR for each equipment in the system/subsystem will be determined as follows:

- o If one or more CM tasks were analyzed for the item, the MTTR will be the average elapsed time for those tasks, weighted by their expected frequencies (if only a single task was identified, the MTTR is simply the elapsed time of that task).
- o When no CM tasks were analyzed for the item, a default MTTR will be used (for example, 4 hours).

### 7.8.3 MLDT

MLDT for each equipment will be computed in accordance with its SM&R code:

- o Organizational Level. MLDT will be computed based on supply effectiveness and delay default values provided in NAVMATINST 3000.2.

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[1] See OD39223, Maintainability Engineering Handbook for procedures for developing RM&A models.

- o Intermediate and Depot Level. The following estimates will be used for Mean Down Time for equipment which is normally repaired at the I or D level.

MEC	EQUIPMENT REPAIR LEVEL	
	I	D
1	1/2 the mean time between IMAVs	1/2 the mean time between SRAs
2 or 3	30 days	30 days
4 or 5	20 days	20 days

The estimates for MEC 2 through 5 are derived from current averages of equipment down time when I or D level repair is required as reported by CASREPs.

**APPENDIX A**

**GLOSSARY**

## APPENDIX A

GLOSSARYA

AEL	Allowance Equipage List
Ao	Operational Availability
APL	Allowance Parts List
ARF	Application Replacement Factor
ATE	Automatic Test Equipment

B

BITE	Built-In Test Equipment
BRF	Best Replacement Factor
BT	Boiler Technician

C

CASREP	Casualty Report
CD	Condition-Directed
CDC	Component Dictionary Code
CFE	Contractor-Furnished Equipment
CM	Corrective Maintenance
CMP	Class Maintenance Plan
CNO	Chief of Naval Operations
COSAL	Consolidated Shipboard Allowance List
CP	Change Procedure
CUM % MTBF	Cumulative Percent of Mean Time Between Failure

D

DCA	Damage Control Assistant
DEN	Data Element Number
DLA	Defense Logistics Agency
D-Level	Depot Maintenance Level
DS	Data Systems Technician

E

EBDI	Equipment Block Diagram and Index
EDP	Electronic Data Processing
EIC	Equipment Identification Code
EM	Electronic Module
EMO	Electronics Maintenance Officer
ENG	Chief Engineer/Engineering Officer

F

FBD	Functional Block Diagram
FF	Failure Finding
FFA	Functional Failure Analysis
FFT	Failure Finding Task
FMEA	Failure Modes and Effects Analysis
FRS	FOMIS Requirements Statement
FSCM	Federal Supply Code for Manufacturers
FSI	Functionally Significant Item

G

GFE	Government Furnished Equipment
GFI	Government Furnished Information
GPETE	General Purpose Electronic Test Equipment

H

HM&E	Hull, Mechanical, and Electrical
------	----------------------------------

I

IEM	Inactive Equipment Maintenance
I Level	Intermediate Maintenance Level
ILS	Integrated Logistics Support
IM	Intermediate Maintenance
IMA	Intermediate Maintenance Activity
IMAV	Intermediate Maintenance Availability

L

LAPL	Lead Allowance Parts List
LSACN	LSA Control Number
LL	Life Limit
LORA	Level of Repair Analysis
LSA	Logistic Support Analysis
LSA I	Logistic Support Analysis, Phase I
LSA II	Logistic Support Analysis, Phase II
LSA III	Logistic Support Analysis, Phase III
LSAR	Logistic Support Analysis Record
LU	Lay-Up

M

MEA	Maintenance Engineering Analysis
MEC	Mission Essentiality Code
M/H	Manhours
MIP	Maintenance Index Page
MLDT	Mean Logistics Delay Time
MMM (3M)	Maintenance and Material Management
MP	Maintenance Plan
MRC	Maintenance Requirements Card
MRP	Maintenance Requirements Planning
MTBF	Mean Time Between Failures
MTBFc	Mean Time Between Failures in Calendar Hours
MTI	Maintenance Task Identification
MTI&A	Maintenance Task Identification and Analysis
MTTR	Mean Time To Repair

N

NAVMAT	Naval Material Command
NAVSEA	Naval Sea Systems Command
NAVSEACENPAC	Naval Sea Support Center, Pacific
NAVSEASYS COM	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NC	No Change
NEC	Navy Enlisted Classification
NSN	National Stock Number
NSWSES	Naval Ship Weapon Systems Engineering Station
NTP	Navy Training Plan

O

O Level	Organizational Maintenance Level
OP	Ordnance Publications
OSI	Operational Support Inventory
OT	Operational Test

P

PCB/EM	Printed Circuit Board/Electronic Module
PERA	Planning and Evaluation of Repairs and Alterations (Office of)
PM	Preventive Maintenance/Planned Maintenance
PMS	Planned Maintenance Subsystem
PNTTP	Preliminary Navy Training Plan
PPL	Provisioning Parts List
PRS	Provisioning Requirements Statement
PSMD	Preliminary Ship Manpower Document
PTD	Provisioning Technical Documentation

Q

QCMM	Quarterly Corrective Maintenance Manhours
QTF	Quarterly Task Frequency
QTM	Quarterly Task Manhours

R

R	Situation Requirement
RCM	Reliability-Centered Maintenance
RCMREF	RCM Reference Number
ROH	Regular Overhaul
RW	Rework

S

S	Semiannual
SBDI	Ship Block Diagram and Index
SCAT	Sub-Category
SHAPM	Ship Acquisition Project Manager
S&L	Service and Lubrication
SMD	Ship Manpower Document
SM&R	Source, Maintenance, and Recoverability
SPCC	Ship's Parts Control Center
SPEC	Specification
SPETE	Special Purpose Electronics Test Equipment
SRA	Ship Repair Availability
SSDI	Ship Systems Definition and Index
S&TE	Support and Test Equipment
SU	Start-Up
SWAB	Ship Work Authorization Boundary
SWBS	Ship Work Breakdown Structure

T

TD	Time Directed
TLL	Tender Load List
TM	Technical Manual
TMCR	Technical Manual Contract Requirement
TPS	Test Program Set
TRF	Technical Replacement Factor

U

U	Unscheduled
UI	Unit of Issue
UIC	Unit Identification Code
U/M	Unit of Measure

APPENDIX B

**LSA WORKSHEETS**

## APPENDIX B

**B.1 LSACN Index for Ship Acquisitions**

For ship acquisitions the LSACN Index defines the ship/system hierarchy and provides a common reference number for both provisioning and maintenance requirements planning activities. A common numbering system is established at the outset of the process to enable the maintenance planners to access provisioning data and vice-versa. The Functional Block Diagrams described in Chapter 4 together with the LSACN Index form the Ship Block Diagram and Index (SBDI).

For ship acquisitions the LSACN Index initiates both the FOMIS and MRP processes. A source document for the Index is either the Ship System Diagram and Index (SSDI) or the Ship Systems Staging Diagram (SSSD). These documents should detail the structure of the ship's systems down to the APL worthy level. Every APL for the ship will then cross-reference to an LSACN. The LSACN Index, Figure B-1, shall be filled out in accordance with the following convention: Data Element Number (DEN) and Title is followed by a parenthesis, indicating the number of characters and the character-type:

- o (2, N) ... 2 numeric characters.
- o (1, A) ... 1 alphabetic character.
- o (14, AN) ... 14 alpha-numeric characters.

**BLOCK 1 - FOMIS HEADER INFORMATION.** The following entries are required for all FOMIS submissions:

DEN A002, UIC (6, AN). The ship's Unit Identification Code as assigned in Volume 2 (Chapter 5) of the Navy Comptroller Manual, preceded by a constant "R".

DEN E134, TRANSACTION ORIGINATOR CODE (1, A). A constant "C" for Contractor. (For other codes see MIL-STD-1626.)

DEN E165 and E211, CARD CODES (2, N and 2, A). A constant "10 AA" when entering LSACNs. (For other codes, see MIL-STD-1626.)

DEN E033, TRANSACTION CODE (1, A). A constant "A" for adding a new card to the FOMIS file. (See MIL-STD-1626 for delete and change codes.)

BLOCK 2 - SERIAL NUMBER. Enter the serial number of the document.

BLOCK 3 - PREPARED BY. Enter the preparer's name and the date.

BLOCK 4 - REVIEWED BY. Enter the reviewer's name and the date of review.

BLOCK 5 - APPROVED BY. Reserved for Navy use. Contractor leave blank.

BLOCK 6 - DEN E212, LSACN (11, AN). MIL-STD-1626 identifies this data element as the "Local Control Number, to be used by the Contractor". In the LSA process, the Contractor will use this element to record the LSA Control Number for each item in the SSDI, as detailed in Appendix A.

BLOCK 7 - DEN E001, NOMENCLATURE (48, AN). The nomenclature of each block indicated on the FBD.

BLOCK 8 - DEN E205, QUANTITY (4, N). Enter the quantity of items that are identical to this LSACN.

BLOCK 9 - DEN C003Y, MISSION ESSENTIALITY (1, N). THIS COLUMN WILL BE VACANT IN THE PRELIMINARY SBDI. When the essentiality has been determined, as described in Section 4.6, it will be entered in the final SBDI and -- when approved by the SHAPM -- added to the FOMIS record. THE ESTABLISHMENT OF THE FOMIS RECORD WILL NOT BE DELAYED PENDING THE DETERMINATION/APPROVAL OF ESSENTIALITY.

BLOCK 10 - ACCESS NUMBER. Enter the FOMIS Access Number in accordance with MIL-STD-1626.

Figure B-1  
LSACN INDEX

<u>FOMIS DEN</u>	<u>ITEM</u>	<u>ENTRY</u>
A002	UIC	_____
E134	Originator	C
E165 & E211	Card Control	IOAA
E033	Transaction Code	A

2. SERIAL NUMBER
3. PREPARED BY _____ DATE _____
4. REVIEWED BY _____ DATE _____
5. APPROVED BY _____ DATE _____

(6) <u>LSACN</u> FOMIS DEN E212	(7) <u>NOMENCLATURE</u> FOMIS DEN E001	(8) <u>QUANTITY</u> FOMIS DEN E205	(9) <u>MEC</u> FOMIS DEN C0034	(10) <u>ACCESS NUMBER</u> FOMIS DEN E133

## 8.2 Master Systems and Subsystems Index

The RCM approach requires that maintenance analysis begin at the system and subsystem level. A master index is developed to facilitate mutually exclusive and exhaustive development assignments. For ship acquisitions this index is primarily based on the Ship Work Breakdown Structure (SWAB). The Master Systems and Subsystems Index (Figure B-2) is to be completed as follows:

a. BLOCK 1 - SWAB GROUP NUMBER. Enter the Major Functional Group Number (a 3 digit number containing 2 zeroes) and the associated nomenclature, e.g., 100 - Hull Structure group, 200 - Propulsion Plant group, etc.

b. BLOCK 2 - GROUP NOMENCLATURE. Enter the nomenclature for the Swab Group in block 1.

c. BLOCK 3 - SHIP CLASS. Enter the ship class and the hull number on which the analysis is based.

d. BLOCK 4 - PREPARED BY. Enter Analyst's name and date.

d. BLOCK 5 - REVIEWED BY. Enter first level reviewer's name and date.

e. BLOCK 6 - APPROVED BY. Reserved for PMS Coordinating Activity approval signature.

f. BLOCK 7 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with the revised information.

g. BLOCK 8 - SWAB SUBGROUP/SYSTEM/SUBSYSTEM NUMBER. Enter a number identifying each subdivision through subsystem (SWAB). If the SWAB number cannot uniquely identify a Subsystem, add the additional indenture levels to the SWAB number and use this LSACN throughout the analysis.

h. BLOCK 9 - SUBGROUP/SYSTEM/SUBSYSTEM NOMENCLATURE. Enter the nomenclature of each LSACN IN BLOCK 8.

**Figure B-2**  
**MASTER SYSTEMS AND SUBSYSTEMS INDEX**

1. SWAB GROUP NUMBER	2. GROUP NOMENCLATURE	3. SHIP CLASS	SH OF
4. PREPARED BY DATE	5. REVIEWED BY DATE	6. APPROVED BY DATE	7. REVISION DATE
8. SWAB SUBGROUP/SYSTEM/SUBSYSTEM NUMBER	9. SUBGROUP/SYSTEM/SUBSYSTEM NOMENCLATURE		
10. SERIAL NUMBER			

i. BLOCK 10 - SERIAL NUMBER. Enter a serial number for this form as follows:

- (1) Segment 1 - Developing organization abbreviation followed by a slant (/).
- (2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).
- (3) Segment 3 - "31" to indicate the Master Systems and Subsystems Index, followed by a slant (/).
- (4) Segment 4 - Enter the highest indenture level LSACN for the development group assigned (if an entire group is assigned, this number is a Functional Group LSACN with 2 zeros, e.g., 100, 200, ...).

### B.3 Data Collection Worksheet

The Data Collection Worksheet, Figure B-3, will be completed by the LSA Analyst to record both essential sources of data for each LSACN and certain data elements that are peculiar to each LSACN. This sheet will then become a "cover sheet" for the analysis to follow on the LSACN. If available the Provisioning Data Cover Page (Figure B-3A) will be a useful source of information. In addition this document will aid the LSA Review Team in verifying the accuracy of the Data Collection Worksheet. Data Collection Worksheets should be grouped together by subsystem. In other words one Data Collection Worksheet for the subsystem LSACN and one Data Collection Worksheet for each LSACN within the subsystem.

BLOCK 1 - LSACN. Enter the LSACN of the subsystem, or within the subsystem from block 6 of the LSACN Index.

BLOCK 2 - NOMENCLATURE. Enter the noun name corresponding to the LSACN in block 1 from the LSACN Index block 7.

**BLOCK 3 - SHIP CLASS.** Enter the ship class or platform application if applicable.

**BLOCK 4 - TECHNICAL DATA.** List the technical documentation describing the LSACN.

Such data will include but not be limited to:

- o Design specifications
- o Assembly drawings and system schematics
- o Technical manuals
- o Operating and maintenance instructions
- o Historical reports such as CASREP, 3M previous LSA data, etc.

**BLOCK 5 - EQUIPMENT CATEGORY NUMBER.** Check corresponding block on worksheet from Equipment Category Matrix.

	<u>STANDARD</u>	<u>MOD</u>	<u>NEW</u>
Complex	3	2	1
Simple	6	5	4

The identification of standard, modified standard, or new is made by the shipbuilder during the provisioning process. Electronic systems, weapons and sensors are all considered complex. HM&E equipment may be considered either simple or complex. The "simple" classification is for HM&E that has been or will be provisioned using a Lead Allowance Parts List (LAPL). All other HM&E equipments will be considered complex.

**BLOCK 6 - MANUFACTURER.** Enter name of item manufacturer (or prime contractor) of the LSACN.

**BLOCK 7 - MFR. FSCM (Manufacturer's Federal Supply Code for Manufacturers).** Enter the item manufacturer's FSCM. FSCM codes are published in the Federal Cataloging Handbook, H4 series.

BLOCK 8 - MFR. MODEL/PART NUMBER. Enter the model, part or other identification number used by the manufacturer to identify the item.

BLOCK 9 - QUANTITY. Enter quantity from LSACN Index block 8.

BLOCK 10 - EIC (Equipment Identification Code). When a direct correlation exists between the item nomenclature in Block 2 and that of an EIC in MSOD 4790.2E-2579, enter the appropriate four-character EIC. The Supervisor of Shipbuilding will provide assistance when a direct correlation does not exist.

BLOCK 11 - CDC (Component Dictionary Code). Enter the appropriate two character alpha-numeric code used to categorize, generically, each LSACN. Codes are listed in Component Dictionary Codes (CDC), Naval Sea Systems Command, 6 September 1979; Vol 1 - Basic Listing; Vol 2 Hull, Mechanical and Electrical (HM&E) Equipment; Vol 3 - Electronic Equipment; Vol 4 - Ordnance Equipment.

BLOCK 12 - APL/AEL/LAPL (Allowance Parts List/Allowance Equipage List/Lead APL). For a standard or GFE item, enter the APL or AEL number assigned by the Navy. For a new or modified Hull, Mechanical, or Electrical (HM&E) item, enter the LAPL number. Otherwise, enter "NONE".

BLOCK 13 - CURRENT SM&R CODE (Source, Maintenance, and Recoverability Code). If an APL or AEL was identified in Block 12, enter the SM&R code currently assigned by Navy. Otherwise, enter "NONE".

BLOCK 14 - DRAWING REFERENCE. Enter the drawing number which shows the LSACN. Preferably, the number should be the NAVSEA drawing number rather than the manufacturer's.

BLOCK 15 - TECHNICAL MANUAL REFERENCE. Enter identification number of technical manual, if known.

BLOCK 16 - TPS (Test Program Set) REFERENCE. If a TPS exists, enter TPS identification number. Otherwise enter "NONE". (TPS information may be obtained from NSWSES, Code 5300, Port Hueneme, California.)

BLOCK 17 - MIP (Maintenance Index Page). If an APL or AEL was identified in Block 12, enter MIP number. Otherwise, enter "NONE".

BLOCK 18 - WORK CENTER. Enter four character alpha-numeric code indicating the work center to which the item will be assigned. Work Center information will be supplied by the acquisition manager.

BLOCK 19 - LOCATION. Enter the location (DECK-FRAME-ATHWARTSHIPS-LOCATION-COMPARTMENT USE format) of the item.

BLOCK 20 - MTBF. Enter the Mean Time Between Failure in thousands of operating hours. This figure must be in operating time, e.g., if there is 2500 operating hours between failures enter 2.5.

BLOCK 21 - MTTR. Enter the Mean Time to Repair. Measured in elapsed time (clock hours) for corrective maintenance.

BLOCK 22 - USAGE FACTOR. This value accounts for two operating variables. It includes the percentage of total time, in which the subsystem operates and the percentage of time an equipment operates within the subsystem. For example, if the subsystem operates during only 10 percent of calendar time, the factor is .1. If an equipment within the same subsystem operates only 5 percent of the time that the subsystem operates, a factor would be  $.1 \times .05 = .005$ . This factor is essential to convert a rate which assumes constant individual operation, to a subsystem failure rate that recognizes subsystem operation.

BLOCK 23 - REFERENCE LSACN. This block is used to prevent repetitious analysis of redundant hardware items. For example, if an equipment is made up of four components that are identical, analysis need only be conducted on one component, whose LSACN shall be called the "reference LSACN". The remaining three equipments shall refer to this set of documentation.

BLOCK 24 - MEC (Mission Essentiality Code). Enter the MEC code for the item. This will be determined after the Functional Failure Analysis (FFA), Section 4.6.

BLOCK 25 - CM ANALYSIS REQUIRED. Check appropriate block. A corrective maintenance analysis is required for equipments with category numbers 1, 2 or 3 (if a problem equipment).

BLOCK 26 - PREPARED BY. Enter name of worksheet preparer and date.

BLOCK 27 - REVIEWED BY. Enter name of worksheet reviewer and date.

BLOCK 28 - APPROVED BY. Leave blank (reserved for Navy use).

BLOCK 29 - REVISION. Enter "ORIGINAL", or "A", "B", "C", etc. sequentially and date. Place a vertical black bar in the right hand margin in line with revised information.

BLOCK 30 - SERIAL NUMBER. Enter serial number. Also, enter worksheet page numbers.

Figure B-3  
DATA COLLECTION WORKSHEET

1. LSACN		2. NOMENCLATURE		3. SHIP CLASS	
4. TECHNICAL DATA		5. EQUIPMENT CATEGORY NUMBER <input type="checkbox"/> 1 <input type="checkbox"/> 4 <input type="checkbox"/> 2 <input type="checkbox"/> 5 <input type="checkbox"/> 3 <input type="checkbox"/> 6		6. MANUFACTURER	
		7. MANUFACTURER FSCM		9. QUANTITY	
		8. MFR. MODEL/PART NUMBER		11. CDC	
		10. EIC		13. CURRENT SM&R CODE	
		12. APL/AEL/LAPL		15. TECHNICAL MANUAL REF.	
		14. DRAWING REFERENCE		17. MIP	
		16. TPS REFERENCE		19. LOCATION	
		18. WORK CENTER		24. MEC	
20. MTBF		22. USAGE FACTOR		25. CM ANALYSIS REQUIRED <input type="checkbox"/> YES <input type="checkbox"/> NO	
21. MTR		23. REFERENCE LSACN		30. SERIAL NUMBER	
26. PREPARED BY		27. REVIEWED BY		29. REVISION	
DATE	DATE	DATE	DATE	PAGE	OF



#### B.4 Functional Failure Analysis (FFA) Worksheet

The purpose of the FFA Worksheet (figure B-4) is to document sufficient information to lead the analyst to potential sources of functional failures. At least one FFA will be required for each system. If the system is simple, this will usually suffice. If the system contains several subsystems that are relatively complex, a FFA on each subsystem should be accomplished. This is in addition to a system FFA.

The overall intent is to document the System (or subsystem) characteristics so that maintenance tasks can be developed.

a. BLOCK 1 - SWAB NUMBER. Duplicate the entries in Block 8 of the Master Systems and Subsystems Index form.

a. BLOCK 2 - NOMENCLATURE. Enter the nomenclature used on the Master Systems and Subsystems Index form, Block 8, for the selected system or subsystem.

b. BLOCK 3 - SHIP CLASS. Duplicate the entries on the Master Systems and Subsystems Index form, Block 3.

c. BLOCK 4 - PREPARED BY, BLOCK 5 - REVIEWED BY, BLOCK 6 - APPROVED BY, BLOCK 6 - REVISION. See instructions for the Master Systems and Subsystems Index.

d. BLOCK 7 - REVISION. Enter "ORIGINAL", or "A", "B", "C", etc. sequentially and date: Place a vertical black bar in the right hand margin in line with the revised information.

e. BLOCK 8 - SOURCES OF INFORMATION. Enter the drawing, manual, document, and report numbers and titles of reference material actually used in this analysis.

f. BLOCK 9 - DESCRIPTION. Referring to the block diagram prepared previously enter a brief physical and functional description of the subdivision, focusing on what the hardware is and what it does, oriented toward maintenance needs. Specifically identify redundancy, protective devices, safety features, and fail safe/unsafe features. Specifically identify Built-In-Test-Equipment, (BITE), meters, gauges, and condition indicators in terms of what they indicate about the system and to whom.

g. BLOCK 10 - FUNCTIONS AND OUT INTERFACES. Enter a description of all functions of the system including self protective features, and co-functions. States minimum operational function parameters or performance standards if appropriate. Number functions sequentially 1, 2, 3, etc.

h. BLOCK 11 - SYSTEM IN INTERFACES. Enter sources of input and their critical values; specify the LSACN for each source.

i. BLOCK 12 - FUNCTIONAL FAILURES. Enter the definition of what constitutes failure for each function listed in Block 10 and output interface listed in Block 11. There may be several functional failures for each function; all functional failures must be identified. Number each functional failure 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, etc. to correspond to the function number in Block 10 and any output interface number in Block 11.

j. BLOCK 13 - SERIAL. Enter a four segment serial number as follows:

(1) Segment 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "33" indicating the FFA form, followed by a slant.

(4) Segment 4 - LSACN Number from Block 7.

Figure B-4  
FFA WORKSHEET

1. SWAB NUMBER	2. NOMENCLATURE	3. SHIP CLASS	SH	CF
4. PREPARED BY	5. REVIEWED BY	6. APPROVED BY	7. REVISION	
DATE	DATE	DATE	DATE	
8. SOURCES OF INFORMATION				
9. DESCRIPTION (Add additional sheet, if necessary)				
10. FUNCTIONS AND OUT INTERFACES				
11. SYSTEM IN INTERFACES				
12. FUNCTIONAL FAILURES				
				13. SERIAL NUMBER

### B.5 Additional Functionally Significant Item (FSI) Selection

All systems and subsystems on the Master Systems and Subsystems Index are FSIs. The purpose of the Additional FSI selection form (figure B-5) is to allow the analyst to select additional FSIs for analyses at lower indenture levels such as at the equipment level. Additional FSIs may be chosen for further analysis because of their importance and/or complexity.

- a. BLOCK 1 - SWAB NUMBER. Enter the LSACN for the FSI candidate.
- b. BLOCK 2 - NOMENCLATURE FSI CANDIDATE. Enter the appropriate nomenclature of the FSI candidate.
- c. BLOCK 3 - SHIP CLASS. Duplicate the entries of the Master Systems and Subsystem Index form, Block 3.
- c. BLOCK 4 - PREPARED BY, BLOCK 5a- REVIEWED BY, BLOCK 6 - APPROVED BY, AND BLOCK 7 - REVISION/DATE. See instructions for Master Systems and Subsystems Index.
- d. BLOCK 8 - DESCRIPTION. Enter a brief functional description of this item keyed to its maintenance needs and provisions for maintenance. Specifically identify redundancies, interface, BITE, and indicators including what they show about the system, to whom, and operator/watch title, responsibilities, and condition of manning the station.
- e. BLOCK 9 - LOCATION. For ship acquisitions enter the compartment numbers of the spaces where this item is located.
- f. BLOCK 10 - QUANTITY. Enter the number of these items installed in this system.
- g. BLOCK 11 - FUNCTION(S). Enter definitions of all of the functions of this item. Number these functions 1, 2, 3, etc. Under the "Impact" column, Block 11A., enter a "yes" or "no" in answer to the question, "Are any of these functions necessary for safety, mobility, or mission?"

h. BLOCK 12 - FUNCTIONAL FAILURES. Enter the definitions of failure of each of the functions listed in Block 10. Number each 1.1., 1.2, 1.3, 2.1, 2.2, 2.3, etc. corresponding to the appropriate function. Under the "Impact" column, Block 12A., enter a "yes," or "no" in answer to the question, "Do any of these failures have a direct adverse impact on safety?"

i. BLOCK 13 - RELIABILITY. Under the "Impact" column, Block 13A., enter a "yes" or "no" in answer to the question, "Is the estimated corrective maintenance rate per item greater than 1 per year?"

j. BLOCK 14 - COST. Under the "Impact" column, Block 14A., enter a "yes" or "no" in answer to the question, "Is this item's purchase cost greater than \$5,000?"

k. BLOCK 15 - MASTER FSI INDEX TRANSFER. If there is a "yes" in the "Impact" column for any block (10-13), enter "Yes."

l. BLOCK 16 - SERIAL NUMBER. Enter the segment serial number as follows:

(1) Segment 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "34," indicating the FSI Selection form followed by a slant (/).

(4) Segment 4 - LSACN from Block 1.

Figure B-5

ADDITIONAL FUNCTIONALLY SIGNIFICANT ITEMS SELECTION

1. SWAB NUMBER	2. NOMENCLATURE FSI CANDIDATE		3. SHIP CLASS	SH	OF
4. PREPARED BY		5. REVIEWED BY	6. APPROVED BY	7. REVISION	
DATE		DATE	DATE	DATE	
8. DESCRIPTION				9. LOCATION	
				10. QTY	
11. FUNCTIONS				11A. IMPACT? (Y/N)	
ARE ANY OF THESE FUNCTIONS NECESSARY FOR SAFETY, MOBILITY, OR MISSION?					
12. FUNCTIONAL FAILURES				12A. IMPACT? (Y/N)	
DO ANY OF THESE FAILURES HAVE A DIRECT ADVERSE IMPACT ON SAFETY?					
13. RELIABILITY				13A. IMPACT? (Y/N)	
IS THE ESTIMATED CORRECTIVE MAINTENANCE RATE GREATER THAN 1 PER YEAR?					
14. COST				14A. IMPACT? (Y/N)	
IS THIS ITEM'S PURCHASE COST GREATER THAN \$5000?					
15. MASTER FSI INDEX TRANSFER? (Y/N)			16. SERIAL NUMBER		

## B.6 Functionally Significant Items (FSI) Index

The FSI Index (figure B-6) centrally lists in hierarchical order all FSIs in the system. A Failure Modes and Effects Analysis will be accomplished for each FSI on this index.

- a. BLOCK 1 - SYSTEM/SUBSYSTEM SWAB NUMBER. Enter the highest level LSACN number to be covered by the index.
- b. BLOCK 2 - SYSTEM/SUBSYSTEM NOMENCLATURE - Enter the nomenclature corresponding to the SWAB Number in Block 1.
- c. BLOCK 3 - SHIP CLASS. Enter the ship class and hull number to which the analysis applies.
- d. BLOCK 4 - PREPARED BY, BLOCK 5 - REVIEWED BY, BLOCK 6 - APPROVED BY BLOCK 7 - REVISION/DATE. See instructions for Master Systems and Subsystem Index form.
- e. BLOCK 8 - SWAB NUMBER. Duplicate the entry on the FFA form, Block 1, or Additional FSI Selection form Block 1, as applicable.
- f. BLOCK 9 - NOMENCLATURE. Duplicate the entry on the FFA form, Block 2, or Additional FSI Selection form, Block 2.
- j. BLOCK 10 - LOCATION. Duplicate the entry on the Data Collection Worksheet, Block 19.
- h. BLOCK 11 - SERIAL NUMBER. Enter a four segment serial number as follows:
  - (1) Segment 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "35," indicating the FSI Index form, followed by a slant (/).

(4) Segment 4 - LSACN from block 1.

Figure B-6  
FUNCTIONALLY SIGNIFICANT ITEMS INDEX

1. SYS/SUBSYS SWAB NUMBER		2. SYSTEM/SUBSYSTEM NOMENCLATURE		3. SHIP CLASS	SH OF
4. PREPARED BY DATE		5. REVIEWED BY DATE	6. APPROVED BY DATE	7. REVISION DATE	
8. SWAB NUMBER	9. NOMENCLATURE			10. LOCATION	
11. SERIAL NUMBER					

### B.7 Failure Modes and Effects Analysis (FMEA) Worksheet

The FMEA Worksheet, figure B-7, is used to record dominant failure modes and to determine the effects of each failure. The specific failure modes will drive both the RCM logic process for preventive maintenance and the corrective maintenance analysis. Each FSI on the FSI Index requires an FMEA. It is recommended that the lowest level FSI of a particular system or subsystem be analyzed first. This should minimize unnecessary duplication of failure modes on multiple levels. In other words the analyst should conduct the analysis "bottom-up".

- a. BLOCK 1 SWAB NUMBER - Duplicate entries used on the FSI Index, Block 8 for the selected system or subsystem.
- b. BLOCK 2 - NOMENCLATURE. Duplicate corresponding nomenclature from FSI Index from Block 8.
- c. BLOCK 3 - SHIP CLASS. Duplicate entries from FFA form Block 2.
- d. BLOCK 4 - PREPARED BY, BLOCK 5 - REVIEWED BY, BLOCK 6 - APPROVED BY, BLOCK 7 - REVISION DATE. See instructions for Master Systems and Subsystems Index form.
- e. BLOCK 8 - FUNCTION(S). Enter the numbers of the functions listed in FFA form, Block 10, or the FSI Selection form, Block 10.
- f. BLOCK 9 - FUNCTIONAL FAILURES. Duplicate entries from FFA form, Block 12, or Additional FSI Selection Form Block 11, as applicable.
- g. BLOCK 10 - DOMINANT FAILURE MODES. Enter the dominant failure modes for each functional failure. Number each failure mode sequentially 1:1.a, 1.1.b, 1.2.b, etc. to correspond to the appropriate functional failure and function. Failure modes should be identified at the level at which the analysis is made. If there are no dominant failure modes, enter "NONE".

g. BLOCK 11 - FAILURE EFFECTS (LOCAL, SUBSYSTEM, SYSTEM). Enter the details of the effects of each failure mode on the item (FSI) where the failure mode occurs, and at subsystem and system level, if appropriate, and the end effect. If the failure mode has no effect on a particular level, enter "NONE" in the appropriate column. If the particulars of the effects are such that a safety hazard or reduction in mission capability results, so indicate in clear phrases such as:

"Safety hazard to operators"

" Safety hazard to personnel in vicinity"

"Partial loss of capability to detect and track surface contacts with radar"

"Total loss of mobility capability" etc.

If the details of the effects are such that only a redundant item is lost, so indicate using the phrase, "Loss of Redundancy."

h. BLOCK 12 - TRANSFER? Y/N. Enter "YES" if the failure mode is so important that further analysis should take place. If the failure mode has insignificant effects or it is only remotely likely to occur, enter "NO" and provide rationale for this decision on clearly labeled backup sheets. When considering failure modes of redundant items, it is the likelihood of failure of all the redundant items which must be considered. The PMS Coordinating Activity will particularly scrutinize this area in the review process.

i. BLOCK 13 - SERIAL NUMBER. Enter a four segment serial number as follows:

(1) 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "36," indicating the FMEA form followed by a slant (/).

(4) Segment 4 - LSACN number for the item for Block 7 of the FSI Index for the item.

## Figure B-7 FAILURE MODES AND EFFECTS ANALYSIS

1. SWAB NUMBER		2. NOMENCLATURE				3. SHIP CLASS		SM OF	
4. PREPARED BY			5. REVIEWED BY		6. APPROVED BY		7. REVISION		
DATE			DATE		DATE		DATE		
8. FUNCTION(S)	9. FUNCTIONAL FAILURES		10. DOMINANT FAILURE MODES			11. FAILURE EFFECTS: a. LOCAL b. SUBSYSTEM c. SYSTEM			12. TRANSFER? (Y/N)
						13. SERIAL NUMBER			

B.8 RCM Logic Tree Analysis Worksheet

The process for identifying preventive maintenance tasks uses a decision logic tree, figure 5-5. The RCM Logic Tree Analysis worksheet, figure B-8 is used to record the results of the decision logic analysis. Only those functional failure modes with a "yes" in block 11 of the FMEA form will be processed using the RCM decision logic.

a. BLOCK 1 - SWAB NUMBER. Duplicate the entry on the FSI Index Form, Block 1 (start new sheets for each item).

B. BLOCK 2 NOMENCLATURE. Enter the nomenclature corresponding to the SWAB Number in Block 1.

b. BLOCK 3 - SHIP CLASS. Duplicate the entry on the FSI Index Form, Block 2.

c. BLOCK 4 - PREPARED BY, BLOCK 5a REVIEWED BY, BLOCK 6 APPROVED BY, BLOCK 7, REVISION/DATE. See instructions for the Master Systems and Subsystem Index.

d. BLOCK 8 - FUNCTIONAL FAILURE/FAILURE MODE. Enter a functional failure and its related failure mode receiving a "yes" in Block 12 of the FEMA; number each as numbered in the FMEA.

e. BLOCK 9 - CRITICALITY ANALYSIS. Enter Y or N to signify a yes or no answer to each of the first three questions. The possible alternatives are:

Question			Assign Criticality Class
1	2	3	
Y	Y	N/A	A
Y	N	Y	B
Y	N	N	C
N	N/A	N/A	D

f. BLOCK 10 - CRITICALITY CLASS. Enter A, B, C or D based on the answers in Block 8. These letters identify the four main branches of the logic tree as follows:

A - Operating safety; B - Operating capability; C - Other regular functions; D - Hidden or infrequent functions.

g. BLOCK 11 - PREVENTIVE TASK? Enter a Y or N to signify a YES or NO answer to questions 4, 5, 6 or 7 in the RCM logic tree. If the Criticality Class for this failure is A, the task must be able to reduce the risk to an acceptable level; cost is not a consideration. If no task is available, a Safety-Related Design Change Form (11ND NAVSEACENPAC 4790/40) must be submitted to the PMS Coordinating Activity.

h. BLOCK 12 - FAILURE FINDING TASK? Enter Y or N signifying a YES or NO answer to question 9 in the logic tree.

h. BLOCK 13 - REDESIGN SERIAL NO. Enter the serial number of the Safety-Related Design Change form if one was required for this failure.

i. BLOCK 14 - TASK DESCRIPTION OR DESIGN CHANGES. Enter a brief description of the applicable and effective tasks or design change related to this failure. Assign a task code to each task. Tasks should be numbered sequentially, with the letters "PM" prefacing each number (PM-1, PM-2,....). For each tasks or design change list the applicable equipment/component by LSACN and nomenclature.

j. BLOCK 15 - PERIODICITY. Enter the periodicity for accomplishment of task in Block 13. Use periodicities specified in table B-1.

k. BLOCK 16 - SERIAL NUMBER. Enter a four segment serial number as follows:

(1) Segment 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "37" to indicate the RCM Decision Logic Tree Analysis form, followed by a slant (/).

(4) Segment 4 - LSACN from Block 1.

TABLE B-1  
MAINTENANCE PERIODICITY CODES

a. Calendar Periodicity

D - Daily

W - Weekly

M - Monthly

Q - Quarterly

S - Semiannually

A - Annually

18M - Each 18 Months

24M - Each 24 Months

30M - Each 30 Months

36M - Each 36 Months

48M - Each 48 Months

60M - Each 60 Months

C - Cycle (once during the period between consecutive scheduled Regular overhaul, ROH. It shall be prescribed only when it is not possible to use the 18M to 60M periodicities.

b. Non-Calendar Periodicity

R - Situation Requirement

U - Unscheduled (corrective)

c. Inactive Equipment Maintenance

LU - Lay-Up Maintenance

PM - Periodic Maintenance

SU - Start-Up Maintenance

OT - Operational Test



## B.9 Corrective Maintenance (CM) Failure Mode Selection

The CM Failure Mode Selection worksheet (figure B-9) provides an important link between the FMEA (Section B.7) and the Corrective Maintenance Task Analysis (Section B.11). Since all CM tasks ultimately involve equipment components, the dominant failure modes determined during the FMEA must be associated with the corresponding equipment/component [1]. The end result of this analysis is a list of failure modes that will undergo further analysis to determine maintenance requirements. One CM Failure mode Selection worksheet is prepared for each subsystem and will contain all identified dominant failure modes. To amplify, failure modes determined through analysis of equipments, (that are FSIs within the subsystem,) must be included.

BLOCK 1 - LSACN. Enter the system or subsystem LSACN.

BLOCK 2 - NOMENCLATURE. Enter nomenclature corresponding to LSACN in block 1.

BLOCK 3 - DOMINANT FAILURE MODES. Transfer all failure modes from the block 9, that have a yes in block 11, of the subsystem's FMEA form(s). The failure modes should be matched to, and recorded opposite the equipments listed in block 3.

BLOCK 4 - EQUIPMENT. Enter the equipment/component nomenclature and LSACN for all elements of the subsystem described in block 1. This information is available from the Data Collection worksheet(s) for the particular subsystem.

BLOCK 5 - UNIT FAILURE RATE. Enter the inverse of the equipment MTBF from block 20 of the Data Collection worksheet.

BLOCK 6 - USAGE FACTOR. Enter usage factor from block 22 of the Data Collection Worksheet.

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[1] In complex systems, it is possible that an FMEA will be completed on an equipment or component. This will be documented by an Additional FSI Selection Worksheet.

BLOCK 7 - ADJUSTED FAILURE RATE. Multiply block 5 times block 6, enter result.

BLOCK 8 - QUANTITY PER SUBSYSTEM. Enter the number of equipments per subsystem.

BLOCK 9 - SUBSYSTEM FAILURE RATE. Multiply block 7 times block 8, enter result.

BLOCK 10 - UNIT MODE FAILURE RATE. Estimate the failure rate of each failure mode for each equipment/component. The entered value must be in the same units and be less than or equal to the Adjusted Failure Rate (block 7), of the equipment/component.

BLOCK 11 - ADJUSTED MODE FAILURE RATE. Multiply block 8 times block 10, enter result.

BLOCK 12 - % OF TOTAL SUBSYSTEM FAILURE RATE. Enter the percentage for each failure mode calculated as follows.

$$\% \text{ of Total Subsystem Failure Rate} = \frac{\text{Adjusted Mode Failure Rate (block 11)}}{\sum \text{Subsystem Failure Rates (block 9)}}$$

BLOCK 13 - COLUMN A. RANK AND COLUMN B. CUMULATIVE SUBSYSTEM FAILURE RATE. Enter a 1 in column (a) opposite the failure mode with the highest percentage in block 12. Enter this percentage from block 12 into column b. next, enter a 2 opposite the second highest percentage in block 12, and add this percentage to the previous percentage. Continue the ranking and summing process until the cumulative percentage reaches (equals or exceeds) the limit set for analysis, based on the MEC of the subsystem.

BLOCK 14 - SELECT. Place a mark opposite any ranked failure modes?

BLOCK 15 - PREPARED BY. Enter name, address, and signature of preparer; enter date.

BLOCK 16 - REVIEWED BY. Enter name, address and signature of reviewer; enter date.

BLOCK 17 - APPROVED BY. Leave Blank (for Navy use only).

BLOCK 18 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with the revised information.

BLOCK 19 - SERIAL NUMBER. Enter serial number (optional). Also, enter page numbers.



## B.10 Level of Repair Analysis

The purpose of the level of repair analysis is to verify the repair strategy of each equipment within a subsystem. The purpose of analysis is to establish, verify or revise an equipment/component SM&R code. A level of repair worksheet, figure B-10 will be prepared for each subsystem and the repair analysis will consider all equipment/components in the subsystem.

BLOCK 1 - SUBSYSTEM LSACN. Transfer from block 1 of CM Failure Mode Selection worksheet.

BLOCK 2 - NOMENCLATURE. Transfer from block 2 of CM Failure Mode Selection Worksheet.

BLOCK 3 - EQUIPMENT. Enter the LSACN and nomenclature of all equipment listed in block 3 of the CM Failure Mode Selection Worksheet.

BLOCK 4 - EXISTING SM&R CODE. Transfer code from the block 17 of the Data Collection worksheet if an SM&R for the specific equipment/component code has been assigned. Enter code opposite the corresponding equipment/component in block 3.

BLOCK 5 - CM NON-ECONOMIC LOR. Using the logic chart shown in figure B-10, determine the applicable CM Maintenance Strategy for each equipment/component. When going through the logic indicate the answer (Y/N) in the appropriate space. Also record the result (1 replace, 0 repair, etc). If the existing SM&R code (block 4) agrees with the LOR analysis, enter the code in block 7 and proceed to the next equipment.

COLUMN 6 - ECONOMIC LORA. If the MAINTENANCE STRATEGY (Column 6) indicated a REPLACE action, conduct a preliminary economic LORA using the NAVSEA Level III LORA model to determine what action should be taken concerning the removed unit. Enter the result: DLR (Depot Level Repairable), FLR (Fleet Level Repairable) or C (Consumable).

COLUMN 7 - REVISED SM&R. Develop an SM&R Code in accordance with OPNAVINST 4410.2, based on the Maintenance Strategy (Column 5) and Economic LORA (Column 6).

COLUMN 8 - REMARKS. Optional.

BLOCK 9 - PREPARED BY. Enter name, address, and signature of preparer; enter date.

BLOCK 10 - REVIEWED BY. Enter name, address and signature of reviewer; enter date.

BLOCK 11 - APPROVED BY. Leave blank (for Navy use only).

BLOCK 12 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially an date. Place a vertical black bar in the right hand margin in line with the revised information.

BLOCK 13 - SERIAL NUMBER. Enter serial number (optional). Also, enter page numbers.



### B.11 LSA Corrective Maintenance Task Worksheet

The LSA Corrective Maintenance Task Worksheet, Figure B-11, is used in identifying the maintenance tasks required to correct the dominant failure modes selected in Section B.9. A worksheet(s) will be completed for each subsystem.

BLOCK 1 - LSACN. Enter from Block 1 of the Corrective Maintenance Failure Mode Selection Worksheet.

BLOCK 2 - NOMENCLATURE. Enter from Block 2 of Corrective Maintenance Failure Mode Selection Worksheet.

BLOCK 3 - FAILURE MODES. Enter serially the number assigned to failure modes (for example, 1.1.a, 1.1.b, 1.2a, 2.1a) receiving a "check" in Block 14 of the Corrective Maintenance Failure Mode Selection Worksheet for the specific subsystem.

BLOCK 4 - EQUIPMENT. Transfer the equipment/component and LSACN from Block 4 of the Corrective Maintenance Failure Mode Selection Worksheet.

BLOCK 5 - TASK DESCRIPTION. For each equipment identified in Block 4, enter a brief description of the appropriate repair action required. If the same task has already been described for the same equipment in repair of another failure mode, enter "See Task" and the applicable TASK CODE from Block 7.

BLOCK 6 - TASK FREQUENCY. Enter the estimated task frequency per annum. This value will equal the Adjusted Mode Failure rate (Block 11) for the specific failure mode recorded or the CM Task Selection Worksheet multiplied by 8.76.

BLOCK 7 - TASK CODE. Serially number each task, preceding each number with "CM" (if the same task was identified earlier and assigned a code, use that code):

Sample codes: CM-1, CM-2, ... CM-999

BLOCK 8 - PREPARED BY. Enter name of worksheet preparer.

BLOCK 9 - REVIEWED BY. Enter name of worksheet reviewer.

BLOCK 10 - APPROVED BY. Leave blank (reserved for Navy use).

BLOCK 11 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with revised information.

BLOCK 12 - SERIAL NUMBER. Enter serial number (optional). Also, enter worksheet page numbers.

Figure B-11  
CORRECTIVE MAINTENANCE (CM) TASK WORKSHEET

1. LSACN		2. NOMENCLATURE				
3. FAILURE MODES	4. EQUIPMENT		5. TASK DESCRIPTION	6. TASK FREQUENCY	7. TASK CODE	
	A. LSACN	B. Nomenclature				
8. PREPARED BY	9. REVIEWED BY	10. APPROVED BY	11. REVISION	12. SERIAL NUMBER		
DATE	DATE	DATE	DATE	PAGE	OF	

## B.12 Servicing and Lubrication Analysis Worksheet

The Servicing and Lubrication Analysis Worksheet, Figure B-12, is used to identify preventive maintenance tasks that consist of the routine replacement of consumables, such as grease, oil filters, hydraulic fluid, coolants, etc. Some of these tasks may have already been identified during the previous RCM analysis. In the preparation of this document, it is important to consider manufacturer's recommendations. The preparer must also seek to specify the use of common materials and sensible periodicities. The document shall be prepared as follows:

- a. BLOCK 1 - SWAB NUMBER. Enter the LSACN of the system under analysis as defined on the Master Systems and Subsystems Index, Block 7.
- b. BLOCK 2 - NOMENCLATURE. Enter the nomenclature of the system under analysis from Block 8 of the Master Systems and Subsystems Index.
- c. BLOCK 3 - SHIP CLASS. Duplicate the entries from Block 2 of the Master System and Subsystems Index.
- d. BLOCK 4 - PREPARED BY, BLOCK 5 - REVIEWED BY, BLOCK 6 - APPROVED BY, BLOCK 7 - REVISION/DATE. See instructions for the Master Systems and Subsystems Index.
- e. BLOCK 8 - ITEM AND TASK DESCRIPTION. Enter the nomenclature and LSACN of each item and beneath that the description of each servicing and lubrication task pertinent to that item including MRC SYSCOM Control Number where appropriate. Assign a task code to each task. Tasks should be numbered sequentially, with the letters "SL" prefacing each number (SL-1, SL-2,....).
- f. BLOCK 9 - LOCATION. Enter the compartment number(s) where the item(s) upon which the task is performed is located.
- g. BLOCK 10 - QUANTITY. Enter the quantity of the items upon which the task is performed that are installed in the system under analysis.

h. BLOCK 11 - PREVIOUS PERIODICITY. Enter the most recently used periodicity for this task on this or similar items. If this is a new item, enter the manufacturer's recommendation.

i. BLOCK 12 - MATERIAL SPECIFICATION. Enter the specification/symbols of any material used (oil, grease, fluid, etc.)

j. BLOCK 13 - ANALYSIS DECISION. Enter action taken by analysis; NC-no change, OM-omit, CM-change material, CP-change procedures; and the revised periodicity, if appropriate.

k. BLOCK 14 - EXPLANATION. Enter rationale and justification for the analysis decisions in Block 13; outline revised procedures, and specify new materials as appropriate.

l. BLOCK 15 - SERIAL NUMBER. Enter a four segment serial number as follows:

(1) Segment 1 - Developing organization abbreviation followed by a slant (/).

(2) Segment 2 - For contractor developers, enter the development authorization number; for other development activities, assign a development number followed by a slant (/).

(3) Segment 3 - "32," indicating the Servicing and Lubricating Analysis form followed by a slant (/).

(4) Segment 4 - LSACN form Block 1



### B.13 Inactive Equipment Maintenance (IEM) Analysis Worksheet

The IEM analysis shall provide the basis for determining the maintenance requirements to be performed when an equipment is temporarily inactivated for 30 days or longer. The maintenance requirements shall prepare the equipment for the inactive period (Lay-Up Maintenance); protect the equipment during the inactive period (Periodic Maintenance); prepare equipment to become operable (Start-Up Maintenance); and ensure the equipment is completely operable at the end of the inactive period (Operational Test).

The Inactive Equipment Maintenance Worksheet, Figure B-13 will be used to conduct analysis at the Subsystem level.

BLOCK 1 - LSACN. Enter the system or subsystem LSACN.

BLOCK 2 - NOMENCLATURE. Enter system or subsystem nomenclature corresponding to block 1.

COLUMN 3 - EQUIPMENT. List equipments and LSACNs within the subsystem from block 3 at the CM Failure Mode Selection worksheet.

COLUMN 4 - DEGRADATION. List types of degradation which will occur if the equipment is not operated for periods exceeding 30 days (up to 18 months). Ignore routine preservation (i.e., painting).

COLUMN 5 - IEM TASKS. Determine whether there are one or more applicable and cost-effective tasks which will protect the equipment listed in Column 4. Consider actions at the beginning of the inactive period (lay up tasks) or periodic maintenance tasks. Also, determine what maintenance tasks are required to activate equipment that has been idle for a prolonged period. Consideration must be given the actions taken to lay-up the equipment to ensure procedures are provided to restore it to the original condition. Provide start-up maintenance where necessary and specify what tests are required to determine the operability of the equipment.

COLUMN 6 - PERIODICITY. List the IEM periodicity, Lay-Up Maintenance (LU), Periodic Maintenance (PM), Start-Up Maintenance (SU), or Operational Test (OT) for each task in column 6. For periodic maintenance, identify the periodicity of performance required by adding a code to the PM indicator, for example, PM(W), PM(M) (See Table D-1 for periodicity codes).

COLUMN 7 - TASK CODE. Assign a task code to each task. Tasks should be numbered sequentially, with the letters "IM" prefacing each number (IM-1, IM-2 ... IM-999).

BLOCK 8 - PREPARED BY. Enter name, address, date and signature of worksheet preparer.

BLOCK 9 - REVIEWED BY. Enter name, address, and signature of worksheet reviewer.

BLOCK 10 - APPROVED BY. Leave blank (reserved for Navy use).

BLOCK 11 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with revised information.

BLOCK 12 - SERIAL NUMBER. Enter serial number (optional). Also, enter worksheet page numbers.

Figure B-13  
INACTIVE EQUIPMENT MAINTENANCE (IEM) WORKSHEET

1. LSACN		2. NOMENCLATURE		7. TASK CODE	
4. DEGRADATION		3. EQUIPMENT		6. PERIODICITY	
		5. IEM TASKS			
8. PREPARED BY DATE		9. REVIEWED BY DATE		10. APPROVED BY DATE	
		11. REVISION DATE		12. SERIAL NUMBERS PAGE OF	

## B.14 Task Requirements

The Task Requirements worksheet, figure B-14 is used to list maintenance resource requirements. One worksheet will be completed for every maintenance task identified in the Analyses (CM, PM, IEM and servicing and lubrication).

BLOCK 1 - LSACN. Enter the equipment LSACN. PM analysis: Logic Tree Analysis, block 1; CM analysis: CM Task Worksheet, block 4A; S&L analysis: Servicing and Lubrication Analysis, block 8; IEM analysis: IEM Task Worksheet, block 8.

BLOCK 2 - NOMENCLATURE. Enter corresponding nomenclature. PM analysis: Logic Tree Analysis, block 2; CM analysis: CM Task Worksheet, block 4B; S&L analysis: Servicing and Lubrication Analysis, block 8; IEM analysis: IEM Task Worksheet, block 3.

BLOCK 3 - SHIP CLASS. Enter as required.

BLOCK 4 - TASK CODE. Enter appropriate task code. PM analysis: Logic Tree Analysis, block 14, CM analysis: CM Task Worksheet, block 7, S&L analysis: Servicing and Lubrication Analysis, block 8; IEM analysis: IEM Task Worksheet, block 7.

BLOCK 5 - TASK DESCRIPTION. Enter individual task description; PM analysis: RCM Logic Tree Analysis block 14; CM analysis: CM Task Worksheet block 5; S&L analysis: Servicing and Lubrication Analysis, block 8 IEM analysis; IEM worksheet block 5.

BLOCK 6 - PERIODICITY. Enter periodicity; PM analysis: Logic Tree Analysis block 15; CM analysis: CM Task worksheet block 6[1]; S&L analysis: Servicing and Lubrication Analysis, Block 11 or 13; IEM analysis: IEM Task Worksheet block 6.

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[1] For CM periodicity =  $\frac{1}{\text{frequency (Block 6)}} \times 12$

BLOCK 7 - TASK SUMMARY. If Task Description (Block 5) does not adequately convey what must be done, briefly summarize the action to be taken. (Note: if an existing MRC applies to the task to be performed, indicate MRC number.) indicate any unusual access problems. Identify any special facilities or industrial equipment required, and check the "Special Facilities" block if such are required. Describe any test requirements needed on completion of the action.

BLOCK 8 - SHIP'S CREW. Check "yes" or "no" to indicate whether the ship's crew will have the skills, materials, tools, and equipment to perform the tasks described. If the crew is not considered capable, briefly explain why.

BLOCK 9 - LEVEL OF REPAIR (LOR). Check "O", "I" or "D" to indicate the level at which the task should be performed. Figure 5-5 provides logic for PM tasks; the SM&R code shall be used in determining the appropriate level of CM tasks.

BLOCK 10 - SKILLS. Enter the number of persons needed to perform the maintenance requirement, by rate/rating and NEC, and the time required by each one. If a new NEC is considered necessary, a Special Requirements Worksheet shall be completed (Section B.15).

COLUMNS A, B, and C - No. of Men, Rate/Rating, and NEC

Entries should be made as follows:

- a. If a commissioned officer or warrant officer should be present or available for a specific task indicated in a maintenance procedure, the officer's billet title (DCA, EMO, ENG, etc.) should be entered in Column B.
- b. List the rates and ratings in Column B, based on respective qualification factors in the Manual of Qualifications for Advancement in Rating, NAVPERS 18068C. If a special skill is required, also enter the Navy Enlisted Classification (NEC) in Column C. NECs are listed in Section II, NAVPERS 18068D.
- c. In cases where more than one rating is required, they shall be listed after the officers in alphabetical order, descending by rate within each rating category: for example, Eng. Off., BT1, BT2, DS2, MM1, MM2.

d. Enter the number of personnel of each rate/rating required in Column A. When two or more persons of the same rate are required and their time requirements are not equal, then each person shall be listed separately. When additional personnel are required because of safety regulations, the rate and number of such personnel shall also be included.

COLUMN D - M/H (Manhours). Manhours converted to hours and tenths of an hour shall be entered in Column D. When a commissioned officer or warrant officer is required, no manhours shall be assigned. The time entered shall indicate the manhours required for each rate/ rating/NEC listed in Columns C and D. When two or more persons of the same rate are indicated in Column A, the entry in the manhours column will be a summation of their required time. When two or more persons of the same rate are required and their time requirements are not equal, then each person shall be listed separately. Equipment warm-up time of 30 minutes, or less, shall be included in the assigned manhours. Warm-up times in excess of 30 minutes shall not be included unless the maintainer is required for constant observance. "Make ready" or "put away" time shall not be included in this block.

BLOCK 11 - TOTAL M/H. Enter the sum of the manhours listed in Column 10d.

BLOCK 12 - ELAPSED TIME. Enter the total elapsed time required for this task, including applicable warm-up.

BLOCK 13 - MATERIALS AND PARTS. List any materials, lubricants, or parts required to perform the task. Indicate identification number, quantity required, related unit-of measure (U/M), and description. Use manufacturer's FSCM and part number for spare parts. Use Military, Federal, or Navy specification numbers for materials and lubricants where applicable; otherwise use an NSN. When a commercial specification must be used, provide the manufacturer's number and check the "Special" column.

BLOCK 14 - SPECIAL TOOLS. List special tools required to perform the task. Provide manufacturer's FSCM, part number, and description. Use the "Special" column to indicate any special tool that is expected to cost over \$500 per unit.

BLOCK 15 - TEST EQUIPMENT. List test equipment required. Electronic/electrical test equipment should be selected from MIL-STD-1364E (NAVY) or NAVSEA ST000-AA-IDX-0101 PEETE.

BLOCK 16 - PREPARED BY. Enter name, address, and signature of preparer; enter date.

BLOCK 17 - REVIEWED BY. Enter name, address, and signature of reviewer; enter date.

BLOCK 18 - APPROVED BY. Leave blank (reserved for Navy use).

BLOCK 19 - REVISION. Enter "ORIGINAL," "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with the revised information.

BLOCK 20 - SERIAL NUMBER. Enter serial number (optional).

**Figure B-14**  
**TASK REQUIREMENTS WORKSHEET**

1. LSACN		2. NOMENCLATURE			3. SHIP CLASS		
4. TASK CODE		5. TASK DESCRIPTION			6. PERIODICITY		
7. TASK SUMMARY (include Facilities Requirements): <input type="checkbox"/> Spec. Fac.				10. SKILLS			
				a. NO.	b. RATE/ RATING	c. NEC	d. M/H
8. SHIP'S CREW <input type="checkbox"/> YES <input type="checkbox"/> NO				9. LGR <input type="checkbox"/> O <input type="checkbox"/> I <input type="checkbox"/> D		11. TOTAL M/H	12. ELAPSED TIME
13. MATERIALS & PARTS							
NUMBER	QUANTITY	U/M	DESCRIPTION	SPECIAL			
14. SPECIAL TOOLS				15. TEST EQUIPMENT			
NUMBER	DESCRIPTION	SPECIAL > \$500		SCAT/IDENT NO.	DESCRIPTION	SPECIAL	
16. PREPARED BY:		17. REVIEWED BY:		18. APPROVED BY:		19. REVISION	20. SERIAL NO.

### B.15 Special Requirements Justification Worksheet

A Special Requirement Justification Worksheet (Figure B-15) must be prepared for each special requirement identified during the task definition process. Special requirements include personnel skills, facilities, support and test equipment, and materials for which the analyst determines the current Navy inventory or standards are inadequate for proper completion of the task. Special tools, whose unit cost is over \$500, should also be included.

Only one Special Requirements Justification Worksheet should be prepared for each unique special requirement. If a particular special requirement exists for more than one task, multiple Task Codes should be entered in Block 5 of the Special Worksheet describing the requirement.

Complete each Special Worksheet as follows:

BLOCK A - REQUIREMENTS TYPE. Check which type of special requirement (Facilities, Skills, NEC, Support and TEST Equipment (S&TE), Tools, or Materials) is to be described in Block 4.

BLOCK 1 - LSACN. Duplicate Block 1, from appropriate Task Requirements Worksheet.

BLOCK 2 - NOMENCLATURE. Duplicate Block 2, from appropriate Task Requirements Worksheet.

BLOCK 3 - SHIP CLASS. Enter as required.

BLOCK 4 - SPECIAL REQUIREMENT DESCRIPTION AND FUNCTION. Enter a detailed description of the special requirement. Include a brief description of its function. Enter manufacturer data if applicable. If skill/NEC, briefly outline training required. If S&TE, provide specific information on the range, type, and tolerances of inputs and outputs.

BLOCK 5 - TASK CODES. List the Task Codes (Block 3, Task Requirements Worksheet) for the tasks in which the special requirement is needed.

BLOCK 6 - EXPLANATION AND JUSTIFICATION. Briefly explain why the special requirement exists. Describe the potential impact on equipment functions if the special requirement is not available. Describe why standard/existing resources cannot be utilized.

NOTE: Skip to Block 12 if Special Requirement is Facilities or Skills/NEC.

BLOCK 7 - QUANTITY. Enter the maximum quantity or number of items needed for a single task.

BLOCK 8 - UNIT OF ISSUE (UI). Enter appropriate unit of issue (S&TE and Tools are normally "EA"). Note that Quantity (Block 7) should be measured in this unit of issue.

BLOCK 9 - UNIT COST. Enter the estimated cost per unit.

BLOCK 10 - DIMENSIONS. Enter the approximate dimensions per unit in feet and tenths of feet (format is Length/Width/Height).

BLOCK 11 - WEIGHT. Enter the approximate weight per unit in pounds

BLOCK 12 - PREPARED BY. Enter name, address, and signature of preparer, plus date.

BLOCK 13 - REVIEWED BY. Enter name, address, and signature of reviewer, plus date.

BLOCK 14 - APPROVED BY. Leave blank. (Reserved for Navy use.)

BLOCK 15 - REVISION. Enter "ORIGINAL," or "A," "B," "C," etc. sequentially and date. Place a vertical black bar in the right hand margin in line with the revised information.

BLOCK 16 - SERIAL NUMBER. Enter serial number (optional).

**Figure B-15**  
**SPECIAL TASK REQUIREMENTS JUSTIFICATION**

A. REQUIREMENTS TYPE: <input type="checkbox"/> FACILITIES <input type="checkbox"/> TEST EQUIP. <input type="checkbox"/> SKILLS/NEE <input type="checkbox"/> TOOLS <input type="checkbox"/> MATERIALS				
1. LSACN	2. NOMENCLATURE	3. SHIP CLASS		
4. SPECIAL REQUIREMENT DESCRIPTION AND FUNCTION				5. TASK CODES
6. EXPLANATION AND JUSTIFICATION				
BLOCKS 7-11 APPLICABLE TO TEST EQUIPMENT, TOOLS, AND MATERIALS ONLY				
7. QUANTITY	8. UI	9. UNIT COST	10. DIMENSIONS (L/W/H) (FT)	11. WEIGHT (LBS)
12. PREPARED BY:	13. REVIEWED BY:	14. APPROVED BY:	15. REVISION	16. SERIAL NUMBER

**APPENDIX C**

**INSTRUCTIONS FOR THE USE OF  
MECHANIZED LSAR**

APPENDIX CInstructions for the Use of Mechanized LSARC.1 Purpose

The worksheets and procedures specified by this manual were designed to guide the analyst through the sequential analysis steps involved in determining maintenance requirements in a systematic and efficient manner. In addition they provide the government LSA Review Team with a documented audit trail which can be used to validate logistic requirements and identify the source data used to determine those requirements.

The mechanized LSAR, however, provides an efficient medium for the storage and use of the data produced by the various LSA tasks. This appendix provides a cross reference between the data generated by the LSA-II process and the applicable Data Element Numbers (DENs) of the mechanized LSAR. There is no requirement to transcribe the results of the LSA-II analysis to the mechanized LSAR unless the Statement of Work specifies that the LSAR and government furnished software will be used to satisfy various contract data requirements, e.g., PTD, Technical Manuals, support and test equipment lists etc.

C.2 Data Cross Reference

During some procurements it may be required that a number of the Data Sheets developed by NAVWESA be completed. To aid in the data transcribing effort, and to prevent unnecessary duplication of analysis, the following list by individual NAVWESA data card is provided. Its purpose is to serve as a cross reference between data developed from LSA-II analysis and NAVWESA data requirements. If any data translation or change in definition is required, this is also indicated. Data elements definitions that do not exactly match those generated by LSA-II analysis are indicated by an asterisk.

Data Sheet A: Operations & Maintenance Requirements

Information required to complete this data sheet is normally provided by the government and should be available prior to Full Scale Development and the commencement of LSA-II analysis.

**Data Sheet B: Item Reliability (R) Maintainability (M) Characteristics**

Card B01 - duplicates Card A01

Card B02 - duplicates Card A02

- Card B03A1B - duplicates Card A03A/B

Card B04

1. Maintainability Considerations - not used in LSA-II analysis
2. Maintenance Concept Impact - not used in LSA-II analysis.
- 3.A. Mean Time Between Failures - Data Collection Block 20
- B. Mean Time To Repair - Data Collection Block 21
- C. Mean Time Between Maintenance Actions - Task Requirements Block

5

Card B06A/B

- A. Logic Results - not used - RCM logic different
- B. Disposition - not used in LSA-II analysis
- C. Task Analysis Documentation - not used in LSA-II analysis

Card B07A/B

1. Item function - FFA Block 10

Card B08A/B

- \* 1. Qualitative Maintainability Requirements - FFA Block 9, LSA-II analysis includes item description.

Card B09A/B

1. Maintenance Concept not used in LSA-II analysis

Card B0A/B

1. Remarks/Recommendations/Justification - not used in LSA-II analysis

Data Sheet C: Task Analysis Summary

Card C01

1. LSACN - Task Requirements - Block 1
2. End Item Acronym data - not used in LSA-II analysis
3. Service Designation code - not used in LSA-II analysis
4. FSCM - Data Collection Block 7
5. Alternative Action Code - not used in LSA-II analysis
6. Revision Code - not used in LSA-II analysis
7. Data Sheet States Code - not used in LSA-II analysis
8. Drawing Classification - not used in LSA-II analysis
9. Serial Number Effectivity - not used in LSA-II analysis
10. Date - not used in analysis

Card C02

1. Item Name - all data sheets except MSSSI, FFA, FSI index, RCM Logic, Special Task Requirements
2. Item Designation Code - Data Collection Worksheet Block 8, or Task Requirements Block 14.
3. Conversion Factor - CM Failure Mode Selection Block 6, and Data Collection Block 22.

Card C03A/B

1. Manufacturer Part Number - Data Collection Block 8
2. FSCM - Data Collection Block 14
3. Drawing Number - Data Collection Block 14
4. FSCM - Data Collection Block 14

Card C04A-I

1. Task Code (Data Chain) - not used in LSA-II analysis
2. Task Frequency - RCM logic Block 14, CM Task Block 6, S&L Analysis Block 8, IEM Block 6.

## Data Sheet C: Task Analysis Summary (Continued)

3. Measurement Base Code - not used in LSA-II analysis
4. Elapsed Time - Task Requirements Block 11 (only predicted)
5. Pilot Rework/Overhaul Candidate - not used in LSA-II analysis
6. Skill Level Code - not used in LSA-II analysis
7. Skill Speciality Code - Task Requirements Block 9c.
8. Skill Speciality Evaluation Code - not used in LSA-II analysis
- \* 9. Number of Men per Task - Task Requirements Block 9a. (this block does not sum total)
10. Manhours - Task Requirements Block 10. (only predicted)
11. Requirements For - not used in LSA-II analysis

## Data Sheet D: Maintenance Operator Task Analysis

## Card D01

1. LSACN - Task Requirements Block 1
- \* 2. Task Code - RCM Logic Block 13, CM Task Block 7 S&L Block 8, IEM Block 7.
3. End Item Acronym - not used in LSA-II analysis
4. Service Designation Code - not used in LSA-II analysis
5. FSCM - Data Collection Block 7
6. Alternative Action Code - not used in LSA-II analysis
7. Revision Code - not used in LSA-II analysis
8. Data Sheet Status - not used in LSA-II analysis
9. Drawing Classification - not used in LSA-II analysis
10. Serial Number Effectivity - not used in LSA-II analysis
11. Date - not used in LSA-II analysis

## Card D02

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2
3. Item Name - Same as C02 1
4. Type, Model, Series - Same as C02 2
5. Conversion Factor - Same as C02 3

## Card D03A/B

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2
3. MFR. Part Number - Same as C03A/B 1
4. LRNC - not used in LSA-II analysis
5. FSCM - Same as D01 5.
6. Drawing Number - Same as C03A 3
7. LRNC - not used in LSA-II analysis
8. FSCM - same as C03A/B 4

## Data Sheet D: Maintenance Operator Task Analysis (CONTINUED)

## Card D04

1. LSACN - Task Requirements Blocks
2. Task Code - Same as D01 2,
3. Task Identification - not used in LSA-II analysis.

## Card D05A-P

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2
3. Safety Hazard Level Code - not used in LSA-II analysis
4. Sequential Task Description - RCM Logic Block 13, CM Task Block 5, S&L Block 8, IEM Block 5.

## Card D06A-H (Data Sheet D1)

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2
3. Safety Hazard Level Code - not used in LSA-II analysis
- \* 4. Work Area - Data Collection Block 19 (LSA-II analysis may require more than the allocated 4 digits)
5. Sequence Line Number - not used in LSA-II analysis
6. Skill Speciality Code - Task Requirements Block 9.c.
- \* 7. Man-Hours - Task Requirements Block 9.d. (LSA-II analysis consistent with MIL-P-24534 (Navy))
8. Elapsed Time - Task Requirements Block 11

## Card D07A-H (Data Sheet D1)

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2
3. Manufacturer Part Number - Task Requirements Block 12
4. Item Category Code - not used in LSA-II analysis
5. Item Name - Task Requirements Block 12
6. Quantity Per Task - Task Requirements Block 12

Data Sheet D: Maintenance Operator Task Analysis (CONTINUED)

Card D08A

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2  
A-H Skill Speciality Code - Task Requirements Block 9c.

Card D08B

1. LSACN - Task Requirements Block 1
2. Task Code - Same as D01 2.  
A-H Manhours - Task Requirements Block 9d  
I Total Elapsed Time - Task Requirements Block 11.

**Data Sheet E: Support and Test Equipment or Training Description and Justification**

**Card E01 - Same as Card C01**

**Card E02**

1. LSACN - Same as card E01
2. Item Name - Same as card C02
3. Item Designation Code - Task Requirements Block 14
4. Conversion Factor - not used in LSA-II analysis

**Card E03A/B**

1. LSACN - Same as card E01
2. Manufacturer Part Number - Task Requirements Block 14
3. LRNC - not used in LSA-II analysis
4. FSCM - Task Requirements Block 14
5. Drawing Number - not used in LSA-II analysis
6. LRNC - not used in LSA-II analysis
7. FSCM - not used in LSA-II analysis

**Card E04 (used for Special Requirements only)**

1. LSACN - Special Task Requirements Block 1
2. Type of Item Code - not used for LSA-II analysis
3. Operating Dimension and Weight-Special Task Blocks 9 and 10
4. Storage Dimensions and Weight - not used in LSA-II analysis

**Card E05 - (used for special Requirements only)**

1. LSACN - Special Task Requirements - Block 1
2. Procurement Concept Code - not used in LSA-II analysis
- \* 3. Unit Cost (Non Recurring) - Special Task Requirements Block 8 (LSA-II makes no distinction between Non Recurring and Recurring costs)
4. UPM - Not used in analysis
- \* 5. Unit Cost (Recurring) - Special Task Requirements Block 8 (LSA-II makes no distinction between Non Recurring and Recurring costs)
6. UPM - Not used in LSA-II analysis

Data Sheet E: Support and Test Equipment or Training Description and Justification (CONTINUED)

- \* 7. Total Quantity Required - Special Task Requirements Block 6 (LSA-II assumes total quantity and on a per task basis)
- 8. Extended Unit Price - not used in LSA-II analysis
- 9. Support Equipment Grouping Identification Number - not used in LSA-II analysis

Card E06A/B

- 1. LSACN - same as Card 501
- 2 -4 LSACN and Task Code - same as cards D05A-P

Card E07A - not used in LSA-II analysis

Card E07B - not used in LSA-II analysis

Card E07C - not used in LSA-II analysis

Card E08 (Special Requirements only)

- 1. LSACN - Special Task Requirements Block 1
- 2. Justification - Special Task Requirements Block 5

Card E09 (Special Requirements only)

- 1. LSACN - Special Task Requirements Block 1
- 2. Description and Function - Special Task Requirements Block 3

Card E10 - not used in LSA-II analysis

Card E11 - not used in LSA-II analysis

Card E12 - not used in LSA-II analysis

**Data Sheet F: Facility Description and Justification**

**Card F01 - Same as card C01**

**- Card F02 - not used in LSA-II analysis**

**Card F03A/B - Task Requirements Block 6**

**Card F04A/B - Cards F10A/B - not used in LSA-II analysis**

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Data Sheet G: Skill Evaluation and Justification

- Not used in LSA-II analysis

## Data Sheet H: Supply Support Requirements

## Card H01A

1. Manufacturer Part Number - same as D07A-H
2. Reference Number Category - not used in LSA-II analysis
3. Reference Number Format code - not used in LSA-II analysis
4. FSCM - same as D03A Block 8
5. Item Name - Same as D02 Block 3
6. Item Category Code - not used in LSA-II analysis
7. Quantity per End Item - not used in LSA-II analysis
8. Type of Item Code - not used in LSA-II analysis
9. Essentiality Code - Data Collection Block 24
10. Shelf Life Code - not used in LSA-II analysis
11. Production Lead time - not used in LSA-II analysis
12. Unit of Measure Code - not used in LSA-II analysis
- \* 13. Total Quantity Required - Task Requirements Block 12 (LSA-II assumes total quantity on a per task basis)
14. Service Description Code - not used in LSA-II analysis
15. Date - not used in LSA-II analysis

Cards H01B - H04C - not used in LSA-II analysis

## Card H05

1. Manufacturer Part Number - Same as Card D07A-H
2. LSACN - same as card D01
3. SMR - LORA Block 7
4. Failure Factor I - not used in LSA-II analysis
5. Failure Factor II - not used in LSA-II analysis
6. Failure Factor III - not used in LSA-II analysis
7. Identification Code - not used in LSA-II analysis
8. Quantity per Assembly - Task Requirements Block 12
9. Remarks - not used in LSA-II analysis

Cards H06 - H010 and H020 - not used in LSA-II analysis

Data Sheet J: Automatic Testing Equipment Requirement/Test Program Set  
Description - not used in LSA-II analysis

Card I01 - I03A/B - not used in LSA-II analysis

Card I04

1. LSACN - same as card C01
2. Item Name - same as card C02
3. Automatic Test Equipment Identification - Data Collection Block 16

Cards I05A - I10 - not used in LSA-II analysis