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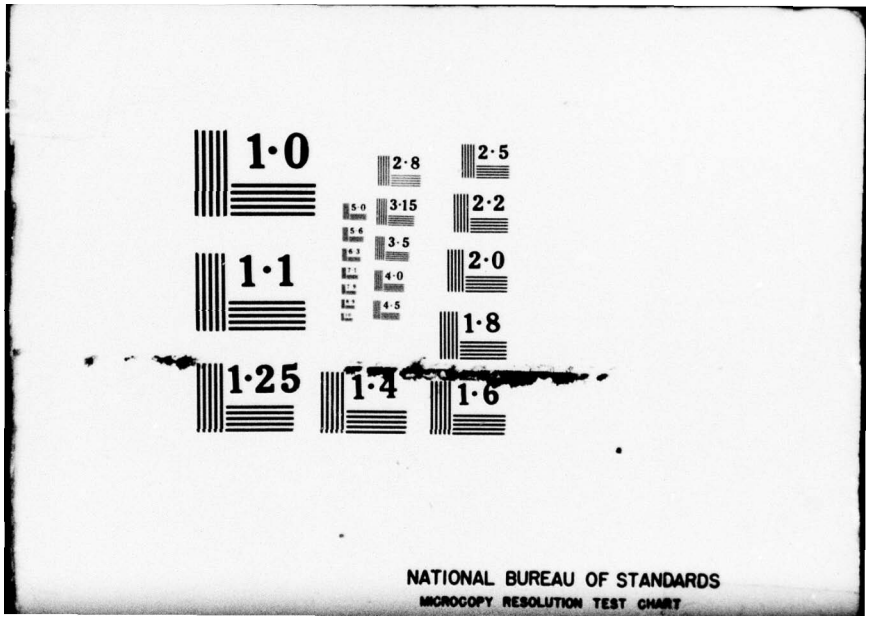
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Publication 626-32-4-1502

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CATALOG OF TECHNIQUES SUPPORTING SHIP MAINTENANCE MANAGEMENT

June 1976

Prepared as an Internal
Research and Development Project

Work Order 0626-32

ARINC RESEARCH CORPORATION

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 626-32-4-1502	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) CATALOG OF TECHNIQUES SUPPORTING SHIP MAINTENANCE MANAGEMENT		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER 626-32-4-1502
7. AUTHOR(s) Neil J. Scarlett		8. CONTRACT OR GRANT NUMBER(s) No Contract No. Internal R&D Project
9. PERFORMING ORGANIZATION NAME AND ADDRESS ARINC Research Corp. 2551 Riva Road Annapolis, Maryland 21401		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS 12 134p.		12. REPORT DATE June 1976 13. NUMBER OF PAGES 90
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

UNCLASSIFIED/UNLIMITED

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

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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

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UNCLASSIFIED

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Publication 626-32-4-1502

ABSTRACT

Techniques relating to the management of ship maintenance programs are cataloged on the basis of their characteristics and applications. Brief descriptions are given of each technique, together with references to other documents providing greater detail.

ABBREVIATIONS

AAW	–	Antiair Warfare
APL	–	Allowance Parts List
ASW	–	Antisubmarine Warfare
CASREPT	–	Casualty Report
CER	–	Cost-Estimating Relationships
CID	–	Component Identification (Number)
CINCPACFLT	–	Commander-In-Chief, U.S. Pacific Fleet
CLMDP	–	CAPTOR Logistics Management Data Program
COMSERVPAC	–	Commander Service Force, Pacific
COSAL	–	Coordinated Shipboard Allowance List
CPIC	–	Coastal Patrol & Interdiction Craft
CSMP	–	Current Ship's Maintenance Project
ECP	–	Engineering Change Proposals
EIC	–	Equipment Identification Code
EMC	–	Electromagnetic Compatibility
EMI	–	Electromagnetic Interference
EOC	–	Extended Operating Cycle
FARADA	–	Failure Rate Data Bank (Exchange Program)
FAST	–	Fast Automatic Shuttle Transfer
FY	–	Fiscal Year
HERF	–	Hazards of Electromagnetic Radiation to Fuel
HERO	–	Hazards of Electromagnetic Radiation to Ordnance
HM&E	–	Hull, Mechanical, and Electrical
LMMEA	–	LO-MIX Maintenance Engineering Analysis
LOE	–	Light-Off Examination
LSP	–	Logistic Support Planning
MDCS	–	Maintenance Data Collection System
MDT	–	Mean Downtime
MEA	–	Maintenance Engineering Analysis
MRC	–	Maintenance Requirement Card
MTBF	–	Mean Time Between Failures
MTBM	–	Mean Time Between Maintenance
MTTR	–	Mean Time to Repair
NAVELEX	–	Naval Electronics System Command
NOSC	–	Naval Ordnance System Command
PEB	–	Propulsion Examination Board
PMS	–	Planned Maintenance Subsystem
POT&I	–	Pre-Overhaul Test & Inspection

RADHAZ	–	Radiation Hazard
RAV	–	Restricted Availability
RF	–	Radio Frequency
R&M	–	Reliability and Maintainability
ROH	–	Regular Overhaul
SARP	–	Ship Alteration and Repair Package
SERVPAC	–	Service Forces, Pacific Fleet
SF	–	Ship's Force
SFOMS	–	Ship's Force Overhaul Management System
SOR	–	Specific Operational Requirements
SRF	–	Ship Repair Facility
SSDI	–	Ship Systems Definition and Index
SWBS	–	Ship Work Breakdown Structure
TAOC	–	Tactical Air Operations Center
TECHEVAL	–	Technical Evaluation
TYCOM	–	Type Commander
WSP	–	Work System Package

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ILLUSTRATIONS AND TABLES

Figure

Table

PART I

INTRODUCTION

PART I – INTRODUCTION

ARINC Research Corporation has provided considerable support to the Navy in assisting the management of ship maintenance programs. Toward that end, the Corporation has applied a wide variety of techniques (some developed in-house) pertaining to maintenance management. This report catalogs these techniques on the basis of their characteristics and applications.

Figure 1 is a summary matrix of tasks accomplished by ARINC Research in support of ship maintenance management versus the techniques resulting from or applied in each of these projects. Each identified technique is cataloged in Part II of this report in the form of a Technique Description Sheet (see sample, Figure 2) containing the following information:

a. Item No. – A sequence number in this catalog

b. Title

c. Description – A narrative statement identifying the technique in terms of its purpose and general application, and the procedural steps associated with its implementation. Where appropriate, the description is supplemented by figures, tables, or other information contributory to an understanding of the technique.

d. Type of Technique – Identification of mechanical aspects of applying the technique – whether it includes a math model or computer program, whether it is essentially an engineering procedure (based on application of engineering principles) or a management procedure (based on management principles), etc. It should be noted that a given technique may involve more than one of the above categories, e.g., it may be classified as an engineering procedure and having a math model as its basis.

e. Cost Parameters – The cost area that the technique addresses – development, procurement, installation, maintenance, operation, management/technical service, and modification.* In cases where the technique addresses total cost, the "Life Cycle" block is marked.

*These cost areas are defined in ARINC Research publication 509-01-2-564, Cost-Effectiveness Evaluation Procedures for Shipboard Electronic Equipment and Systems, Vol. I, Feb. 1966.

FIGURE 1

SHIP'S MAINTENANCE MANAGEMENT TECHNIQUES RESULTING FROM OR APPLIED IN SELECTED ARINC RESEARCH CORPORATION PROJECTS (Sheet 1 of 3)

PROJECT			TECHNIQUE																															
Project/Task Topic	Customer	Contract No.	1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip. Problems	15. Ident. of Shipboard Mech. Equip. Reliability	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedure Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. LO-MIX Maintenance Demonstration Test Conduct	24. Maintenance Engineering Analysis	25. Anal. of Corre...	26.	27.
Reliability and Maintainability Data Feedback Systems	NASL	N00140-66-C-0151													X																			
Reliability and Maintainability Data Source Guide	NASL	N00140-66-C-0151													X																			
Availability of Data Sources for Navy Propulsion Systems	NASL	N00140-66-C-0151													X																			
CVA(N)-68 R&M Program		594-II-9999-T1												X																				
R&M Data Analysis, Retention, and Prediction Techniques for Boiler Systems	NAVSEC	N00189-68-C-0956						X				X			X	X	X						X											
Shipboard R&M Data Bank	NASL	N00140-68-D-0446													X																			
Reliability Prediction Procedure for Shipboard Mechanical Systems	NAVSHIPS	N00024-69-C-5554						X																										
Reliability Prediction for Ships Machinery	ARINC Research	Paper						X																										
Mk 46 Reliability Program	NUC	Various													X	X	X	X	X	X	X													
Shipboard Machinery R&M Data Bank	NAVSHIPS	N00024-72-C-5388													X																			
Validity of NAVSHIPS MDCS/ADP System	NAVSHIPS	N00024-72-C-5414														X																		
Prepare Program Objectives Memorandum (POM) Estimates for Destroyer EOC	NAVSEA/ PERA(CRUDES)	N00140-74-D-0090 (Task 9)																																
Long-Range Maintenance Plan for Surface Combatant Ships	NAVSEA/ PERA(CRUDES)	N00140-74-D-0090 (Task 3)																																
Annual Maint. Cost and Feasibility of Adopting EOC for Destroyers	NAVSEA/ PERA(CRUDES)	N00140-73-D-0074 (Task 14)														X																		
Major Maintenance Burden Equipment for Destroyers	NAVSEA/ PERA(CRUDES)	N00140-74-D-0090 (Task 5)														X	X														X			

…ons								
…of Sys./Eqt. Reliability								
…ral Design Analysis								
18. Failure Analysis by Engineering Investigation					X			
19. Failure Analysis by Laboratory Testing					X			
20. Fault Isolation Procedure Analysis								
21. Maintainability Prediction by Regression							X	
22. Maintainability Demonstration Test Planning								
23. Maintainability Demonstration Test Conduct								
24. LO-MIX Maintenance Engineering Analysis								
25. Maintenance History Analysis of Propulsion Equipment								
26. Anal. of Corrective Maint. Resource Consumption	X							
27. Engineering Assessment of Sys./Eqt. Maintainability								
28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors							X	
29. R&M Indices for Shipboard Equipments						X		
30. Development of Equipment Behavior Measures		X						
31. Analysis of PMS Effectiveness								
32. Measurement/Assessment of Ship Material Condition								
33. Life Cycle Cost Categorization								X
34. Development of Cost Estimating Relationships								X
35. Determination of Annualized Maint. Cost for Ships		X						
36. Eval. of Feasibility of Extending Overhaul Interval		X						
37. Extended Operating Cycle (EOC) Program Planning			X	X				
38. EOC Systems Analysis								
39. Development of Class-Level Critical Equipment List								
40. Development of Ship Class Baseline Repair Profile								
41. Preparation of Technical Repair Standards								
42. Management Plan for Use in LOE Preparation								
43. PEB/LOE Preparation Program								
44. Pre-Overhaul Training of Ship Personnel								
45. Shipcheck Planning								
46. ROH Advance Planning Using Network of Significant Activities								
47. Pre-Overhaul Test and Inspection Procedure								
48. Development of Standardized Work Requests								
49. Scoping and Estimation of Ship's Force ROH Work								
50. Est. of Non-Industrial Labor Reqmts. for SF during ROH								
51. Effectiveness Analysis of Ship's Regular Overhaul								
52. Economic Analysis of Ship's Regular Overhaul		X						
53. EMC/EMI Instruction								
54. EMI Susceptibility Evaluation								
55. Logistics Management Information System								
56. Logistics Management Data Program								
57. Development of Equipment Procurement Specs								
58. Procedure for Cond. Shipboard Habitability Surveys								
59. Development of Habitability Improvement Plans								
60. Det. of Spare Parts Inventory for Weapon System								
61. Logistics Support Planning for Ship Class								
62. Specific Operational Requirement (SOR) Review								
63. Analysis of Mission Requirements and ROH Cycle								

(Figure 1)

2

FIGURE 1. (Sheet 2 of 3)

PROJECT			TECHNIQUE																														
Project/Task Topic	Customer	Contract No.	1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip.	15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Fault Isolation Procedure Analysis	20. Laboratory Testing	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Anal. of Corrective Maintenance History	26. Engineering Analysis of Pro...	27.
Simulation Model for Relating Mission Requirements to Regular Overhaul Cycles	DESLANT/ PERA(CRUDES)	N00140-73-D-0074 (Task 9)										X																					
Pre-ROH Indoctrination Program	PERA(CRUDES)	N00140-74-D-9990 (Task 6)																															
Maintenance Management Guide	COMSERVPAC	N00604-73-C-0450 (Task 1)																															
ATF ROH Standard Work Package	COMSERVPAC/ PERA(CSS)	N00604-73-C0450 (Task 2)																															
Technique for Measuring Ships Material Condition	COMSERVPAC	N00604-73-C0450 (Task 3)																															
[illegible] Staging Diagrams (Using EIC)	COMSERVPAC	N00604-71-C-0431	X																														
Engineering Support to Service Force, Pacific	COMSERVPAC	N00604-71-C-0431					X																										
ROH Planning Logic Network, Policies, Procedures	COMSERVPAC	N00604-71-C-0431																															
Habitability Manual	COMSERVPAC	N00604-71-C-0431																															
Technical Repair Standards	NAVSEA/ PERA(CRUDES)	N00140-73-D-0074; N00140-74-D-0090																															
SFOMS Implementation Assistance and ROH Planning to Selected Ships	PERA(CRUDES) PERA(CSS)	Various																	X														
T-ATF 164 Logistics Support Planning	NAVSEA	N00600-74-D-0597																															
Logistics Support Management and MIS System for Vietnamese Navy	COMNAVFOR	DAJB-01-73-C-0007																															
Communications and Electronics Shipalt Analysis	COMSERVPAC	N00604-73-C-0230			X		X																										

…p.
…tems
…of Sys./Eqt. Reliability
…ural Design Analysis

	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedure Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Cost Estimating Relationships	35. Determination of Annualized Maint. Cost for Ships	36. Eval. of Feasibility of Extending Overhaul Interval	37. Extended Operating Cycle (EOC) Program Planning	38. EOC Systems Analysis	39. Development of Class-Level Critical Equipment List	40. Development of Ship Class Baseline Repair Profile	41. Preparation of Technical Repair Standards	42. Management Plan for Use in LOE Preparation	43. PEB/LOE Preparation Program	44. Pre-Overhaul Training of Ship Personnel	45. Shipcheck Planning	46. ROH Advance Planning Using Network of Significant Activities	47. Pre-Overhaul Test and Inspection Procedure	48. Development of Standardized Work Requests	49. Scoping and Estimation of Ship's Force ROH Work	50. Est. of Non-Industrial Labor Reqmts. for SF during ROH	51. Effectiveness Analysis of Ship's Regular Overhaul	52. Economic Analysis of Ship's Regular Overhaul	53. EMC/EMI Instruction	54. EMI Susceptibility Evaluation	55. Logistics Management Information System	56. Logistics Management Data Program	57. Development of Equipment Procurement Specs	58. Procedure for Cond. Shipboard Habitability Surveys	59. Development of Habitability Improvement Plans	60. Det. of Spare Parts Inventory for Weapon System	61. Logistics Support Planning for Ship Class	62. Specific Operational Requirement (SOR) Review	63. Analysis of Mission Requirements and ROH Cycle
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(Figure 1)

2

FIGURE 1. (Sheet 3 of 3)

PROJECT			TECHNIQUE																														
Project/Task Topic	Customer	Contract No.	1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip. Problems	15. Ident. of Shipboard Mech. Equip. Reliability	16. Engineering Assessment of Sys./Eqt.	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Fault Isolation Procedures by Laboratory Testing	20. Maintainability Procedures Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Anal. of Corrective Maint.	26. Anal. of Propulsion	27. Engineering	
LO-MIX Ships Maintenance Engineering Analysis Technique	NAVSEA	N00123-73-C-1698																							X								
Management Planning and Implementation Support for PEB/LOE	PERA(CRUDES)	N00140-73-D-0074; N00140-74-D-0090																															
Maintenance History Analysis for Destroyer Propulsion System Equipments	NAVSEA/ PERA(CRUDES)	Various												X												X							
R&M Indices for Destroyer Propulsion System Equipments	CNO	N00014-74-C-0216																															
Shipboard Ordnance and Fire Control System R, M, and Logistics Studies	NOS/Lsvl, NOL/NMEF	Various						X		X						X	X		X	X	X											
Application of Ships Staging Diagrams for DE-1052 (Using SWBS)	PHNSY	N00604-75-C-0015		X																													
SFOMS Standards	PERA(CRUDES)	N00140-74-D-0090																															
SSDIs for DDG-2 Class Ships	PERA(CRUDES)	N00140-74-D-0090		X																													
Shipboard Electronic Equipment Study	PERA(CSS)	N66314-74-C-2497 "CL"			X	X																											
Comm Elex Configuration Analysis	COMSERVPAC	N00604-73-C-0181 "CL"			X																												
Engineering Support to Underwater Systems	NUC	Various							X	X	X		X		X	X	X	X		X			X	X			X						
Sonobuoy Studies	NADC	Various											X																				
FAST System R&M Assessment	NAVSHIPS	N00024-68-C-5326															X													X			
Destroyer Engineered Oper. Cycle	PMS 934	Various																															
SARP Development	PERA(CRUDES)	N00140-74-D-0090 (Task 7)																															
Post-ROH Analysis	PERA(CSS) COMSERVPAC	Various																															

	17. Structural Design Analysis	18. Failure Analysis	19. Failure Analysis by Engineering Investigation	20. Fault Isolation Procedures Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Cost Estimating Relationships	35. Determination of Annualized Maint. Cost for Ships	36. Eval. of Feasibility of Extending Overhaul Interval	37. Extended Operating Cycle (EOC) Program Planning	38. EOC Systems Analysis	39. Development of Class-Level Critical Equipment List	40. Development of Ship Class Baseline Repair Profile	41. Preparation of Technical Repair Standards	42. Management Plan for Use in LOE Preparation	43. PEB/LOE Preparation Program	44. Pre-Overhaul Training of Ship Personnel	45. Shipcheck Planning	46. ROH Advance Planning Using Network of Significant Activities	47. Pre-Overhaul Test and Inspection Procedure	48. Development of Standardized Work Requests	49. Scoping and Estimation of Ship's Force ROH Work	50. Est. of Non-Industrial Labor Reqmts. for SF During ROH	51. Effectiveness Analysis of Ship's Regular Overhaul	52. Economic Analysis of Ship's Regular Overhaul	53. EMC/EMI Instruction	54. EMI Susceptibility Evaluation	55. Logistics Management Information System	56. Development of Equipment Data Program	57. Procedure for Cond. Shipboard Procurement Specs	58. Development of Habitability Improvement Plans	59. Det. of Spare Parts Inventory for Weapon System	60. Logistics Support Planning for Ship Class	61. Analysis of Mission Requirement (SOR) Review	62. Specific Operational Requirements and ROH Cycle	63. Analysis of Mission Requirement (SOR) Review
...Equip. Problems	X						X																																								
...Assessment of Sys./Eqt. Reliability		X	X		X	X			X										X																												
...Equip.				X				X																																								

(Figure 1)

2

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title

3. Description

DESIGN

4. Type of Technique	5. Cost Parameters	6. Effectiveness Parameters	7. Status
Math Model ___	Life Cycle ___	Effectiveness ___	Concept ___
Computer Program ___	Development ___	Perf. Capability ___	Technique Developed, Not Applied ___
Engineering Procedure ___	Procurement ___	Availability ___	Technique Applied One Time ___
Management Procedure ___	Installation ___	Reliability ___	Technique Applied Recurrently ___
_____ ___	Maintenance ___	Maintainability ___	
_____ ___	Operation ___	None ___	
_____ ___	Mgt/Tech Service ___	_____ ___	_____ ___
_____ ___	Modification ___	_____ ___	_____ ___
_____ ___	None ___	_____ ___	_____ ___
_____ ___	_____ ___	_____ ___	_____ ___

APPLICATION

8. Type of System/Equipment	9. Life Cycle Phase	10. Functional Areas Supported
Total Ship ___	Concept Form. ___	
Hull Structure ___	Validation ___	
Propulsion ___	Development ___	
Electric Plant ___	Acquisition ___	
Command & Surv. ___	Operation ___	
Auxiliaries ___	_____ ___	
Outfit/Furnish. ___	_____ ___	
Armament ___	_____ ___	
_____ ___	_____ ___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

Figure 2. Sample of Technique Description Sheet

In cases where the technique does not address any aspect of cost, the "None" block is marked.

f. Effectiveness Parameters – The aspect of system effectiveness that the technique addresses, i.e., performance capability, availability, reliability, maintainability, or other effectiveness elements. Techniques that do no specifically address any of these parameters are classified "None".

g. Status – The status of the technique, i.e.:

   1) The technique exists in conceptual form, but requires further development before it can be applied.

   2) The technique has been sufficiently developed to permit application, but application hasn't as yet been attempted.

   3) The technique has been applied once to date.

   4) The technique has been applied recurrently.

h. Type of System/Equipment – The specific ship system to which the technique applies, based on the first level of definition in the Ship Work Breakdown Structure (SWBS). Techniques applicable to an entire ship are marked "Total Ship". Techniques limited in their application to a particular type of ship are so indicated at the bottom of block 8 by a filled-in notation of ship type.

i. Life Cycle Phase – The life cycle phase(s) to which the technique applies – concept formulation, development, validation, acquisition, or operation.

j. Functional Areas Supported – The functional area(s) of ship maintenance management that the technique supports. These functional areas are listed alphabetically in Table 1. Each Technique Description Sheet lists in block 10 the particular areas from Table 1 that the technique supports.

k. References – Those publications, both of ARINC Research and the government, that either describe the technique or illustrate its application.

TABLE 1. LISTING OF FUNCTIONAL AREAS OF SHIP MAINTENANCE MANAGEMENT SUPPORTED BY TECHNIQUES CATALOGED IN APPENDIX A

a. Configuration Management
b. Criticality (of Equipment) Ranking
c. Electrical Design Analysis
d. Electronic Test Equipment
e. EMI/EMC
f. EOC Maintenance Management
g. Failure Analysis
h. Fleet Modernization Program
i. Habitability
j. Life Cycle Cost Analysis
k. Light-Off Examination
l. Logistics Management Information System
m. Logistic Management Program
n. Logistic Support Planning
o. Maintainability Demonstration
p. Maintainability Measurement
q. Maintainability Prediction
r. Maintainability Trend Analysis
s. Maintenance Budgeting
t. Maintenance Cost Analysis
u. Maintenance Engineering Analysis
v. Maintenance Manpower Analysis
w. Maintenance Strategy Planning
x. Maintenance Program Management Information System
y. Material Condition Assessment
z. Pre-Overhaul Test and Inspection
aa. Planned Maintenance System
bb. Production Planning and Control
cc. Reliability Demonstration
dd. Reliability Engineering Analysis
ee. Reliability Measurement
ff. Reliability Prediction
gg. Reliability Program Evaluation
hh. Reliability Trend Analysis
ii. ROH Cost Analysis
jj. ROH Effectiveness Analysis
kk. ROH Planning
ll. ROH Work Package Development
mm. Ship's Force Overhaul Management System
nn. Spares Inventory Determination
oo. Specific Operational Requirements
pp. Structural Design Analysis
qq. Testing
rr. Training

The Technique Description Sheet also shows areas in which the methodologies have potential utility, although not yet applied by ARINC Research. An "X" in blocks 4 through 9 indicates current characteristics and applicability, and the letter "P" denotes potential characteristics or applicability. For example, certain techniques may be marked in block 8 with an "X" opposite "Propulsion" and a "P" opposite "Electric Plant". This reflects the fact that the technique has been applied to propulsion system equipment and could be applied to electric plant equipment.

Figure 3 is a matrix showing the specific functional areas supported by each of the techniques cataloged in Part II. Additional visibility is provided by Figure 4, which summarizes the techniques in terms of their classification(s) by:

a. Type of technique

b. Cost parameters

c. Effectiveness parameters

d. Status

e. Type of ships system/equipment

f. Life cycle phase

FIGURE 3

INDEX OF TECHNIQUES BY FUNCTIONAL AREA SUPPORTED (Sheet 1 of 2)

FUNCTIONAL AREA	TECHNIQUE																															
Functional Area	1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip.	15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedures Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Analysis	31. Analysis
Configuration Management	X	X	X	X	X	X																										
Criticality (of Equipment) Ranking																								X								
Electrical Design Analysis																		X														
Electronic Test Equipment				X																												
EMI/EMC																																
EOC Maintenance Management																														X		
Failure Analysis														X			X	X														
Fleet Modernization Program (FMP)			X		X																											
Habitability																																
Life Cycle Cost Analysis																																
Light-Off Examination (LOE)																																
Logistics Management Information System																																
Logistic Management Program																																
Logistic Support Planning																																
Maintainability Demonstration																					X	X										
Maintainability Measurement									X			X												X	X	X	X	X	X			
Maintainability Prediction									X											X						X	X					
Maintainability Trend Analysis																								X					X			
Maintenance Budgeting																																
Maintenance Cost Analysis												X																				
Maintenance Engineering Analysis						X			X			X		X				X					X			X	X			X		
Maintenance Manpower Analysis																																

...gation
...oratory Testing
...olation Procedures Analysis

21. Maintainability Prediction by Regression						
22. Maintainability Demonstration Test Planning			X			
23. Maintainability Demonstration Test Conduct			X			
24. LO-MIX Maintenance Engineering Analysis	X					
25. Maintenance History Analysis of Propulsion Equipment		X	X			
26. Anal. of Corrective Maint. Resource Consumption			X			X
27. Engineering Assessment of Sys./Eqt. Maintainability	X	X	X			
28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	X	X	X			
29. R&M Indices for Shipboard Equipments			X			
30. Development of Equipment Behavior Measures		X	X		X	
31. Analysis of PMS Effectiveness	X					
32. Measurement/Assessment of Ship Material Condition						
33. Life Cycle Cost Categorization		X		X		
34. Development of Cost Estimating Relationships		X		X		
35. Determination of Annualized Maint. Cost for Ships		X X				
36. Eval. of Feasibility of Extending Overhaul Interval					X	
37. Extended Operating Cycle (EOC) Program Planning					X	
38. EOC Systems Analysis		X			X	
39. Development of Class-Level Critical Equipment List	X		X		X	X
40. Development of Ship Class Baseline Repair Profile						
41. Preparation of Technical Repair Standards	X					
42. Management Plan for Use in LOE Preparation				X		
43. PEB/LOE Preparation Program				X		
44. Pre-Overhaul Training of Ship Personnel						
45. Shipcheck Planning						
46. ROH Advance Planning Using Network of Significant Activities						
47. Pre-Overhaul Test and Inspection Procedure						
48. Development of Standardized Work Requests						
49. Scoping and Estimation of Ship's Force ROH Work						
50. Est. of Non-Industrial Labor Reqmts. for SF During ROH						
51. Effectiveness Analysis of Ship's Regular Overhaul						
52. Economic Analysis of Ship's Regular Overhaul	X					
53. EMC/EMI Instruction					X	
54. EMI Susceptibility Evaluation					X	
55. Logistics Management Information System	X	X	X	X		
56. Logistics Management Data Program			X	X		
57. Development of Equipment Procurement Specs						
58. Procedure for Cond. Shipboard Habitability Surveys						
59. Development of Habitability Improvement Plans				X		
60. Det. of Spare Parts Inventory for Weapon System						
61. Logistics Support Planning for Ship Class			X			
62. Specific Operational Requirement (SOR) Review						
63. Analysis of Mission Requirements and ROH Cycle					X	

(Figure 3)

2

FIGURE 3. (Sheet 2 of 2)

FUNCTIONAL AREA / TECHNIQUE	1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip.	15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedures Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Cost Estimating Relationships	35. Determination of Annualized	36. Eval. of Feasibility	37.
Functional Area																																				
Maintenance Strategy Planning																																X	X			
Material Condition Assessment																															X					
Pre-Overhaul Test & Inspection (POT&I)																																				
Planned Maintenance System (PMS)				X																										X					
Procurement Specification Development																																				
Production Planning and Control																																				
Reliability Demonstration									X	X																										
Reliability Engineering Analysis											X		X		X												X									
Reliability Measurement											X			X		X									X	X		X	X	X						
Reliability Prediction							X	X			X					X											X									
Reliability Program Evaluation										X	X																									
Reliability Trend Analysis																									X					X					
ROH Cost Analysis																																				
ROH Effectiveness Analysis																																				
ROH Planning			X		X																															
ROH Work Package Development																																				
Ship's Force Overhaul Mgt. Sys. (SFOMS)																																				
Specific Operational Requirements																																				
Spares Inventory Determination																																				
Structural Design Analysis																	X																			
Testing									X	X						X			X				X	X				X								
Training																																				

15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedures Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Coct Estimating Relationships	35. Determination of Annualized Maint. Cost for Ships	36. Eval. of Feasibility of Extending Overhaul Interval	37. Extended Operating Cycle (EOC) Program Planning	38. EOC Systems Analysis	39. Development of Class-Level Critical Equipment List	40. Development of Ship Class Baseline Repair Profile	41. Preparation of Technical Repair Standards	42. Management Plan for Use in LOE Preparation	43. PEB/LOE Preparation Program	44. Pre-Overhaul Training of Ship Personnel	45. Shipcheck Planning	46. ROH Advance Planning Using Network of Significant Activities	47. Pre-Overhaul Test and Inspection Procedure	48. Development of Standardized Work Requests	49. Scoping and Estimation of Ship's Force ROH Work	50. Est. of Non-Industrial Labor Reqmts. for SF During ROH	51. Effectiveness Analysis of Ship's Regular Overhaul	52. Economic Analysis of Ship's Regular Overhaul	53. EMC/EMI Instruction	54. EMI Susceptibility Evaluation	55. Logistics Management Information System	56. Logistics Management Data Program	57. Development of Equipment Procurement Specs	58. Procedure for Cond. Shipboard Habitability Surveys	59. Development of Habitability Improvement Plans	60. Det. of Spare Parts Inventory for Weapon System	61. Logistics Support Planning for Ship Class	62. Specific Operational Requirement (SOR) Review	63. Analysis of Mission Requirements and ROH Cycle
																				X	X																											X
																	X															X											X					
																														X		X																
																X																																
																																										X						
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	X									X	X		X	X	X									X																								
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																							X	X	X	X	X		X	X	X		X	X	X	X	X			X				X				
																							X		X							X	X											X				
																							X											X	X													
																																															X	
																																													X			
		X																																														
	X			X			X	X				X																																				
																												X	X									X										

(Figure 3)

2

FIGURE 4

CLASSIFICATION OF TECHNIQUES BASED ON TYPE, COST AND EFFECTIVENESS PARAMETERS, AND APPLICABILITY

CHARACTERISTIC/APPLICATION		TECHNIQUE: 1. Development of SSDIs for Ship Classes Using EIC	2. Development of SSDIs for Ship Classes Using SWBS	3. C-E System Configuration Management Analysis	4. Anal. of Shipboard Elex. Test Eqt. Reqmts & Allow.	5. Validation of Shipalt Status and Applicability	6. Evaluation of ECPs	7. Reliability Prediction by Regression	8. Reliability Pred. by Summation of Failure Rates	9. Reliability Demonstration Test Planning	10. Reliability Demonstration Test Conduct	11. Determination of Shipboard System Figures of Merit	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip.	15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedure Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Cost Estimating Relationships	35. Determination of Annualized Maint. Cost for Ships	36. Eval. of Feasibility of Extending Overhaul Interval	37. Extended Operating Cycle (EOC) Systems Analysis	38. EOC Systems Analysis	39. Develo
TYPE OF TECHNIQUE	Math Model						X	X			X							X			X				X	X		X	X	X		X	X						
	Computer Program				P							X	X	X											X	X		X	X				X	X						
	Engineering Procedure			X	X		X		X	X	X	X			X	X	X	X	X	X		X	X	X	X	X	X		X	X			X	X	X	X		X	X	
	Management Procedure	X	X	X		X																													X						
	Training Procedure																																								
COST PARAMETERS	Life Cycle																																			X	X				
	Development																																				X	X				
	Procurement						X																														X	X				
	Installation						X																														X	X				
	Maintenance						X				X				X								X	X	X		X		X		X					X	X	X	X		X	X	X
	Operation						X																														X	X				
	Mgt/Tech Services																																				X	X				
	Modification						X																								X						X	X				
	None	X	X	X	X	X		X	X	X	X		X	X	X		X	X	X	X	X	X	X	X		X		X				X				X	X	X	X		X	X	
EFFECTIVENESS PARAMETERS	Effectiveness																																	X								
	Performance Cap.					X	X								X					X																			X			
	Availability											X																										X			X		
	Reliability						X	X	X	X	X	X	X			X	X	X	X							X	X		X								X	X				X
	Maintainability						X				X				X				X	X	X	X	X	X	X	X	X	X	X								X	X	X	X		
	Other																											X														
	None	X	X	X	X								X	X																			X		X	X						
STATUS	Concept																																									
	Tech. Developed, Not Applied												X																							X						
	Tech. Applied One Time									X	X									X		X	X			X						X	X							X	
	Tech. Applied Recurringly	X	X	X	X	X	X	X	X			X			X	X	X	X	X	X	X		X			X	X		X	X	X	X		X	X	X	X		X		
TYPE OF SYSTEM/ EQUIPMENT	Total Ship	X	X			X						P	X																													
	Hull Structure	X	X				P					P					P																				P					
	Propulsion	X	X				P	X		P	P	X	P		X	X	P		P			X	P	P	X	X		X	X	X	P				P	P			P	X	
	Electric Plant	X	X				P	X		P	P	P			P	P	P		X			P	P	P	P	X					P				P	P			P	X	
	Command & Surv.	X	X	X	X		P	P	X	P	P	P	P		P	P	P		X	X	P	P	P	P	P	P					P				P	P			P	X	
	Auxiliaries	X	X				P	X		P	P	P	P		P	P	P		P			P	P	P	X	X		X	X	X	P				P	P			P	X	
	Outfit & Furnishings	X	X				P			P	P		P		P		P		P			P	P	P							P				P	P			P	X	
	Armament	X	X				X	P	X	X	X	P	X		P	P	X	X	X		P	P	X	X	X	P			X	P				P	P			X			
LIFE CYCLE PHASE	Concept Formulation							P	P					X								P												P	P						
	Validation		P					P	P			P					X	X				P	P					X						P	P			P			
	Development		P					P	P			P					X	P	X			P						X						P	P			P			
	Acquisition		P		P		P	P	P	X	X		X				X	P				P	X	X	X			X						P	P			P			
	Operation	X	X	X	X	X	X	X	X			X		X	X	X	X	P	X	X	X	X				X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X

X = Applicable; P = Potentially applicable.

	12. Reliability Program Surveillance	13. Establishment of Mechanical Parts Data Bank	14. Data Collection & Analysis of Shipboard Mech. Equip.	15. Ident. of Shipboard Mech. Equip. Problems	16. Engineering Assessment of Sys./Eqt. Reliability	17. Structural Design Analysis	18. Failure Analysis by Engineering Investigation	19. Failure Analysis by Laboratory Testing	20. Fault Isolation Procedure Analysis	21. Maintainability Prediction by Regression	22. Maintainability Demonstration Test Planning	23. Maintainability Demonstration Test Conduct	24. LO-MIX Maintenance Engineering Analysis	25. Maintenance History Analysis of Propulsion Equipment	26. Anal. of Corrective Maint. Resource Consumption	27. Engineering Assessment of Sys./Eqt. Maintainability	28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors	29. R&M Indices for Shipboard Equipments	30. Development of Equipment Failure Behavior Measures	31. Analysis of PMS Effectiveness	32. Measurement/Assessment of Ship Material Condition	33. Life Cycle Cost Categorization	34. Development of Cost Estimating Relationships	35. Determination of Annualized Maint. Cost for Ships	36. Eval. of Feasibility of Extending Overhaul Interval	37. Extended Operating Cycle (EOC) Program Planning	38. EOC Systems Analysis	39. Development of Class-Level Critical Equipment List	40. Development of Ship Class Baseline Repair Profile	41. Preparation of Technical Repair Standards	42. Management Plan for Use in LOE Preparation	43. PEB/LOE Preparation Program	44. Pre-Overhaul Training of Ship Personnel	45. Shipcheck Planning	46. ROH Advance Planning Using Network of Significant Activities	47. Pre-Overhaul Test and Inspection Procedure	48. Development of Standardized Work Requests	49. Scoping and Estimation of Ship's Force ROH Work	50. Est. of Non-Industrial Labor Reqmts. for SF During ROH	51. Effectiveness Analysis of Ship's Regular Overhaul	52. Economic Analysis of Ship's Regular Overhaul	53. EMC/EMI Instruction	54. EMI Susceptibility Evaluation	55. Logistics Management Information System	56. Development of Equipment Data Program	57. Procedure for Cond. Shipboard Habitability Surveys	58. Det. of Spare Parts Inventory for Weapon System	59. Specific Operational Requirement (SOR) Review	60. Analysis of Mission Requirements and ROH Cycle
12. Reliability Program Surveillance		X	X						X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13. Establishment of Mechanical Parts Data Bank	X		X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14. Data Collection & Analysis of Shipboard Mech. Equip.	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15. Ident. of Shipboard Mech. Equip. Problems			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16. Engineering Assessment of Sys./Eqt. Reliability			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
17. Structural Design Analysis	X				X		P	P	X	P	P	P	X	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
18. Failure Analysis by Engineering Investigation					X	P			X	P	P	P	X	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
19. Failure Analysis by Laboratory Testing					X	X	X		X	P	P	P	X	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
20. Fault Isolation Procedure Analysis	X				X	P	P	P		X	P	P	X	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
21. Maintainability Prediction by Regression			X	X	X	P	P	P	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
22. Maintainability Demonstration Test Planning			X	X	X	P	P	P	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
23. Maintainability Demonstration Test Conduct			X	X	X	P	P	P	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
24. LO-MIX Maintenance Engineering Analysis			X	X	X	P	P	P	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
25. Maintenance History Analysis of Propulsion Equipment			X	X	X	P	P	P	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
26. Anal. of Corrective Maint. Resource Consumption			X	X	X	P	P	P	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
27. Engineering Assessment of Sys./Eqt. Maintainability			X	X	X	P	P	P	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
28. Anal. of Shipboard Mech. Eqt. Maint. & Cost Factors			X	X	X	P	P	P	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
29. R&M Indices for Shipboard Equipments			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
30. Development of Equipment Failure Behavior Measures			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
31. Analysis of PMS Effectiveness			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
32. Measurement/Assessment of Ship Material Condition			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
33. Life Cycle Cost Categorization			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
34. Development of Cost Estimating Relationships			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
35. Determination of Annualized Maint. Cost for Ships			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
36. Eval. of Feasibility of Extending Overhaul Interval			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
37. Extended Operating Cycle (EOC) Program Planning			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
38. EOC Systems Analysis			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
39. Development of Class-Level Critical Equipment List			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
40. Development of Ship Class Baseline Repair Profile			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
41. Preparation of Technical Repair Standards			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
42. Management Plan for Use in LOE Preparation			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
43. PEB/LOE Preparation Program			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
44. Pre-Overhaul Training of Ship Personnel			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
45. Shipcheck Planning			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
46. ROH Advance Planning Using Network of Significant Activities			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
47. Pre-Overhaul Test and Inspection Procedure			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
48. Development of Standardized Work Requests			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
49. Scoping and Estimation of Ship's Force ROH Work			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
50. Est. of Non-Industrial Labor Reqmts. for SF During ROH			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
51. Effectiveness Analysis of Ship's Regular Overhaul			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
52. Economic Analysis of Ship's Regular Overhaul			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
53. EMC/EMI Instruction			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
54. EMI Susceptibility Evaluation			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
55. Logistics Management Information System			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
56. Development of Equipment Data Program			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
57. Procedure for Cond. Shipboard Habitability Surveys			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
58. Det. of Spare Parts Inventory for Weapon System			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
59. Specific Operational Requirement (SOR) Review			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
60. Det. of Spare Parts Inventory for Weapon System			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
61. Logistics Support Planning for Ship Class			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
62. Specific Operational Requirement for Weapon System			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
63. Analysis of Mission Requirements and ROH Cycle			X	X	X	P	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

(Figure 4)

2

PART II

TECHNIQUES SUPPORTING SHIPS MAINTENANCE MANAGEMENT

PART II – TECHNIQUES SUPPORTING SHIPS MAINTENANCE MANAGEMENT

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
1	**Development of Ship Systems Definition and Index for Ship Classes Using Equipment Identification Code**

3. Description

A procedure for developing a Ship Systems Definition and Index (SSDI) using the Equipment Identification Code (EIC) as a baseline has been developed and applied to certain ship classes (see references). The SSDI is an orderly description of the total ship in terms of its systems, equipments, and key maintenance items. It includes a structured code, narrative description, and graphical illustrations where appropriate, of the ship and its included systems/equipments. The objectives of the SSDI are to expand on the existing EIC, supplement it through added description, and tailor it to individual ship classes. The SSDI format using the EIC baseline is illustrated by the attached figures.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability			
		Operation		None	X	Technique Applied Recurrently	X
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**Configuration Management**
Hull Structure	X	Validation		
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **AO-143 Class Ship Systems Definition and Index, Pub. W2-D06-TN01, April 1972**
2. **ATF-96 Class Ship Systems Definition and Index, Pub. W2-D06-TN05, Aug. 1972**
3. **General Ship Class EIC Systems Staging Diagrams, Pub. W2-D06-TN02, Nov. 1972**
4. **AOE-1 Class Ship Systems Definition and Index, Pub. W3-D06-TN03, Feb. 1973**
5. **Ship Systems Definition and Index for ARS-7 and ARS-38 Class Ships, Pub. 1620-01-1-1290, March 1974**

Continued

TECHNIQUE DESCRIPTION SHEET

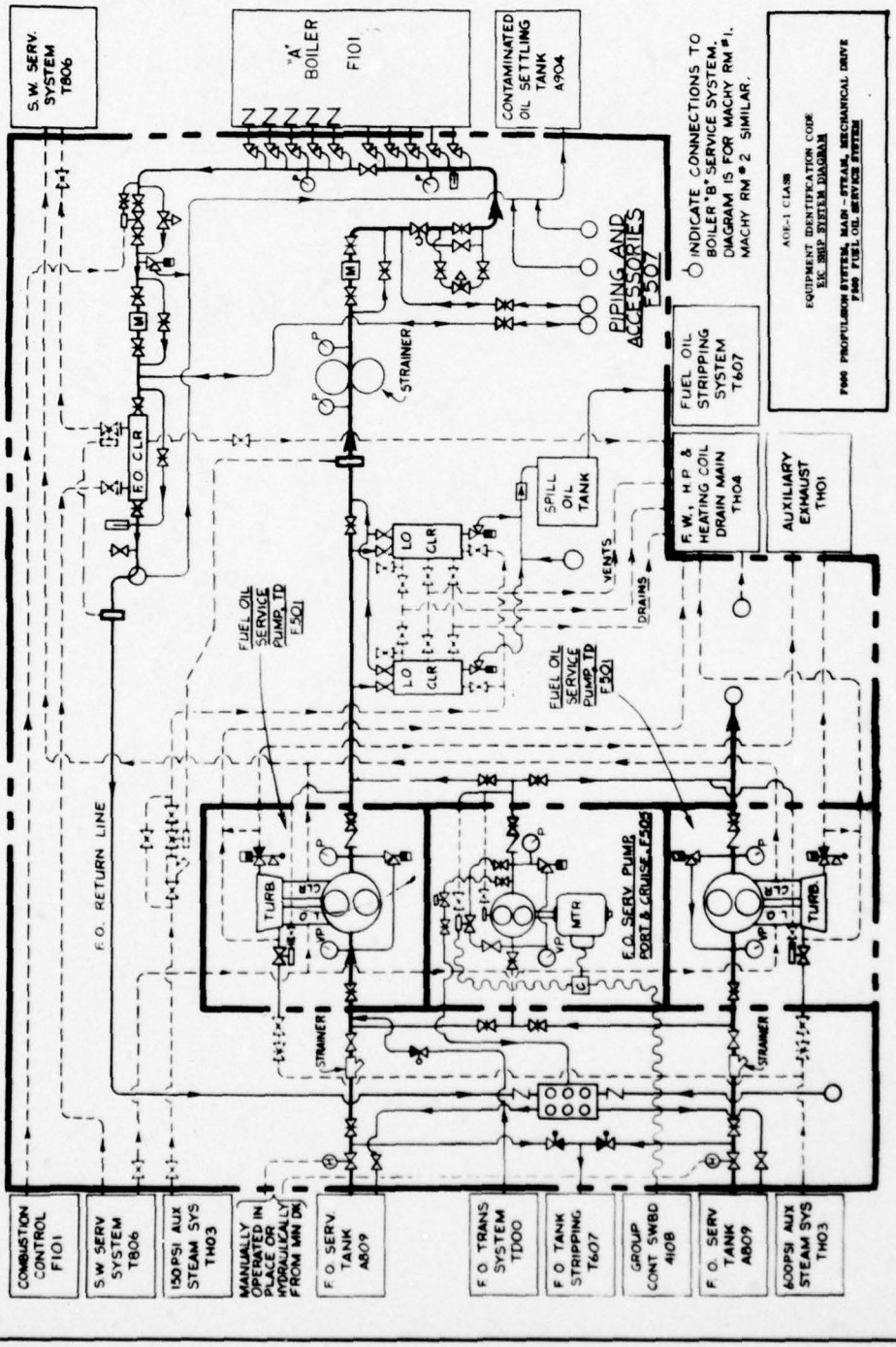
1. Item No.	2. Title
1 (Cont)	Development of Ship Systems Definition and Index for Ship Classes Using Equipment Identification Code (Cont)

Example of SSDI System Diagram Based on EIC

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
1 (Cont)	Development of Ship Systems Definition and Index for Ship Classes Using Equipment Identification Code (Cont)



Example of SSDI Line Diagram Based on EIC

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
2	**Development of Ship Systems Definition and Index for Ship Classes Using Ship Work Breakdown Structure**

3. Description

A procedure for developing SSDIs using the Ship Work Breakdown Structure (SWBS) as a baseline has been developed and applied to certain ship classes (see references). The SSDI is an orderly description of the total ship in terms of its systems, equipments and key maintenance items. It includes a structured code, narrative description, and graphical illustrations where appropriate of the ship and its included systems/equipments. The objectives of the SSDI are to expand on the configuration visibility and control capability of the SWBS and tailor it to individual ship classes. The SSDI format using the SWBS baseline is illustrated by the attached figures.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability			
		Operation		None	X	Technique Applied Recurrently	X
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**Configuration Management**
Hull Structure	X	Validation	P	
Propulsion	X	Development	P	
Electric Plant	X	Acquisition	P	
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			

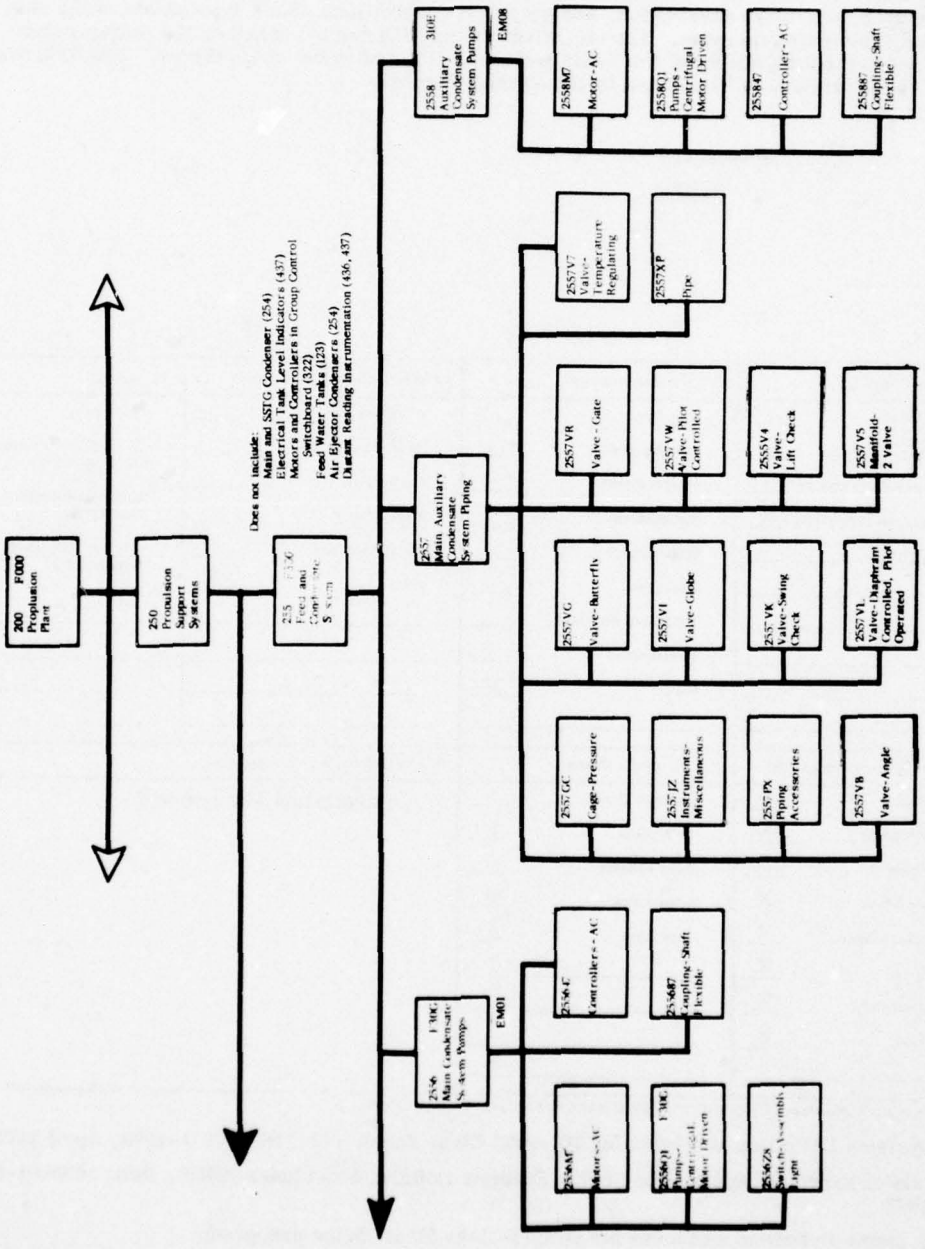
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Ship Systems Definition and Index for DE-1052 Class Ships, Pub. 1630-01-1-1389, April 1975**
2. **Analysis of Expanded Application of Ship Systems Definition and Index (SSDI), Pub. 1630-01-2-1428, July 1975**
3. **Ship Systems Definition and Index for DDG-2 Class Ships (being prepared)**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
2 (Cont)	Development of Ship Systems Definition and Index for Ship Classes Using Ship Work Breakdown Structure (Cont)

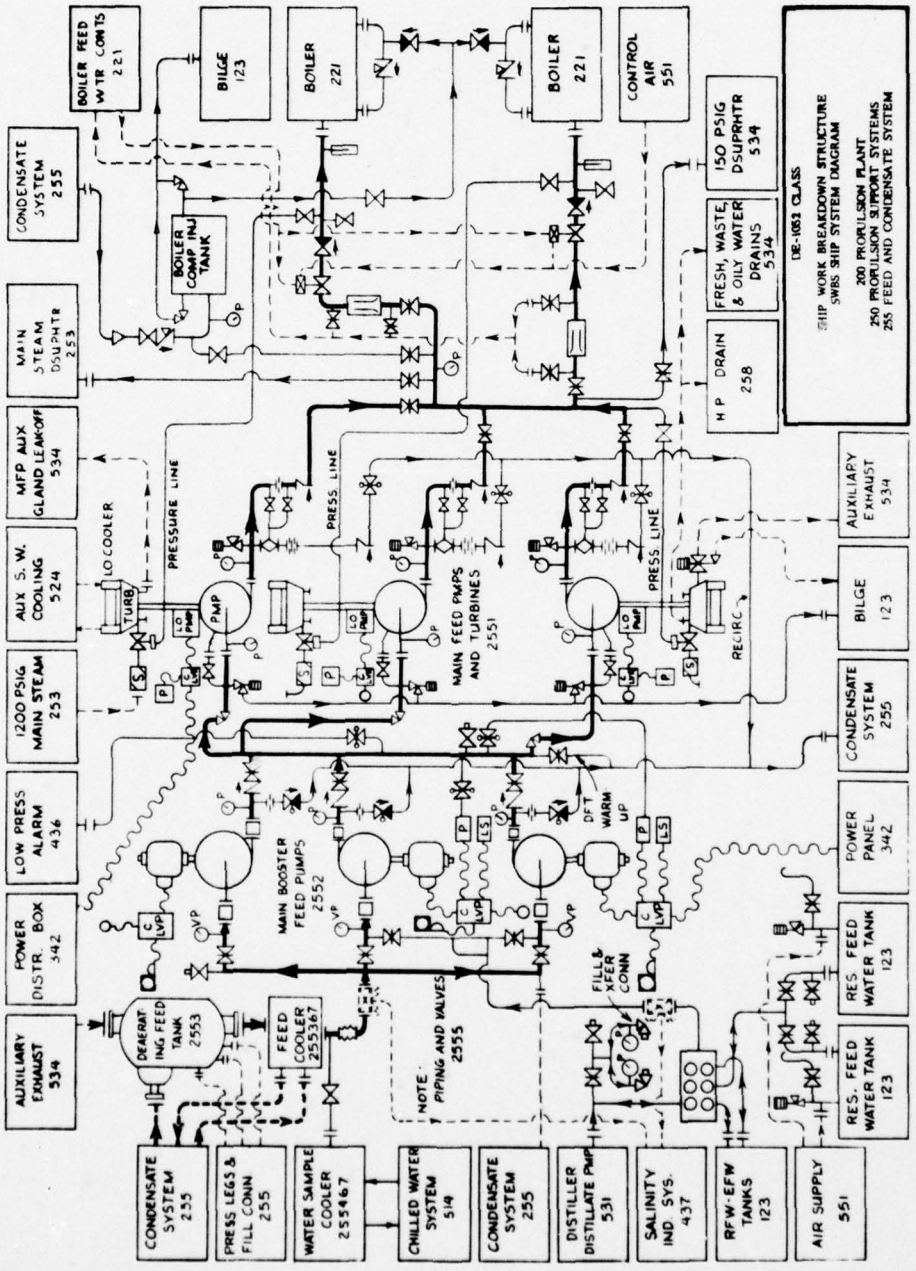


Example of SSDI System Diagram Based on SWBS

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
2 (Cont)	Development of Ship Systems Definition and Index for Ship Classes Using Ship Work Breakdown Structure (Cont)



Example of SSDI Line Diagram Based on SWBS

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
3	**Communication Electronics Systems Configuration Management Analysis**

3. Description

This technique provides for identifying, acquiring, analyzing and reducing the data necessary to generate management planning aids for communication-shipalt configuration management planning. The aids resulting from the process provide visibility regarding shipalt requirements, shipalt completion status, and onboard configuration for all ships of a given class. The technique has been applied to all types of Service Force ships in the Pacific Fleet. The technique can be applied to the electronics suite of any type of ship. Its application is illustrated in the following figure.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Configuration Management**
Hull Structure		Validation		**ROH Planning**
Propulsion		Development		**Fleet Modernization Program**
Electric Plant		Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				
Service Ships	X			

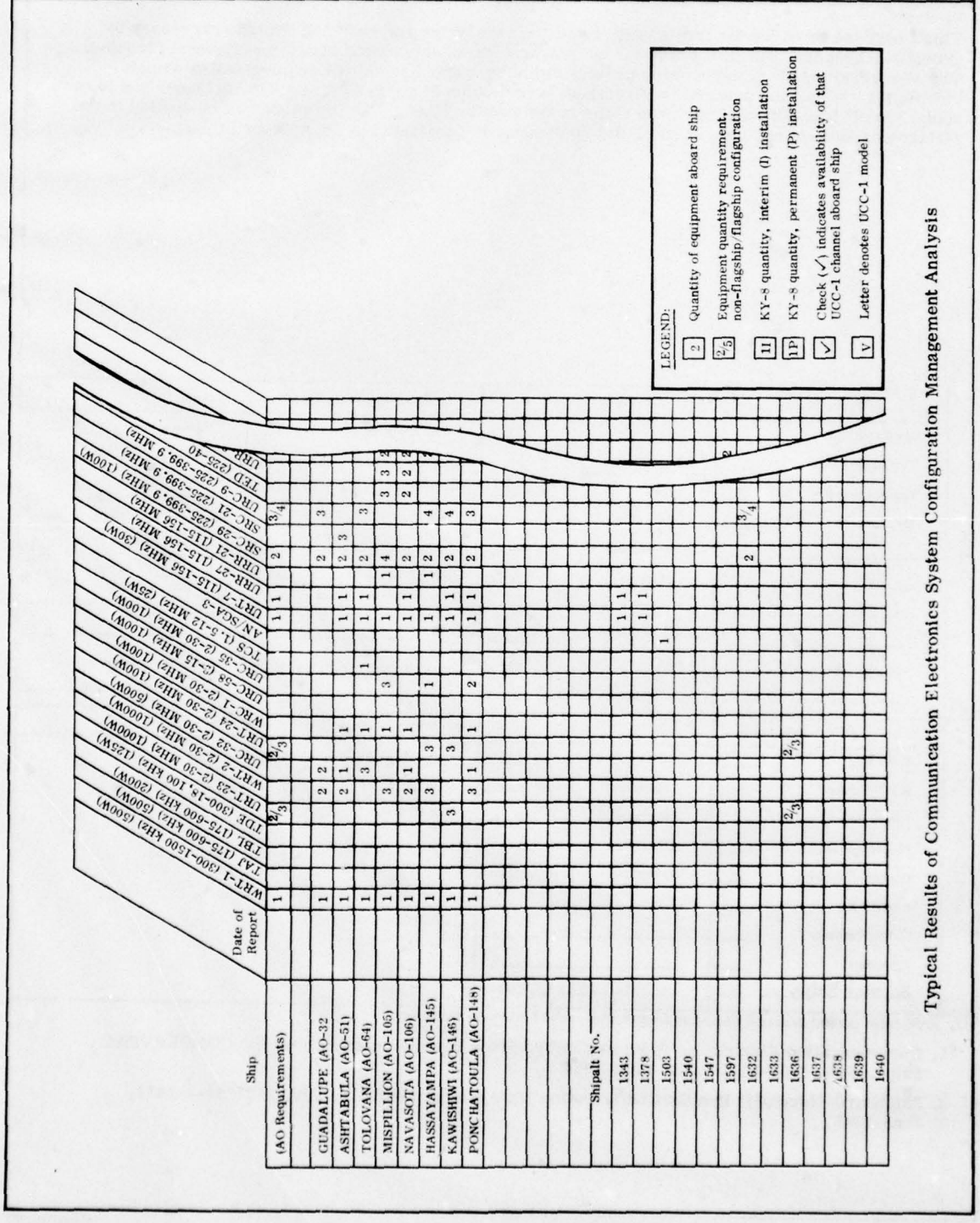
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Communication Electronics Systems Configuration Management Analysis for COMSERVPAC Ships, Pub. 1606-01-1-1288, Feb. 1974**
2. **Shipboard Electronic System Configuration Management Analysis, Pub. 1627-01-4-1412, June 1975**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
3 (Cont)	Communication Electronics Systems Configuration Management Analysis (Cont)



Typical Results of Communication Electronics System Configuration Management Analysis

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
4	Comparative Analysis of Shipboard Electronic Test Equipment Requirements and Allowances

3. Description

This technique involves determining test equipment requirements and allowances, tabulating these data, and analyzing the information to identify anomalies and provide recommendations concerning a ship's electronic test equipment suite. The technique has been applied to a sampling of Service Force ships, as described in ref. 1. The technique is applicable to the analysis of the electronic test equipment suite for any type of ship. Its application is illustrated in the following figure.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program	P	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability			
		Operation		None	X	Technique Applied Recurrently	X
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Planned Maintenance System
Hull Structure		Validation		Configuration Management
Propulsion		Development		Electronic Test Equipment
Electric Plant		Acquisition	P	
Command & Surv.	X	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				
Test Equip.	X			

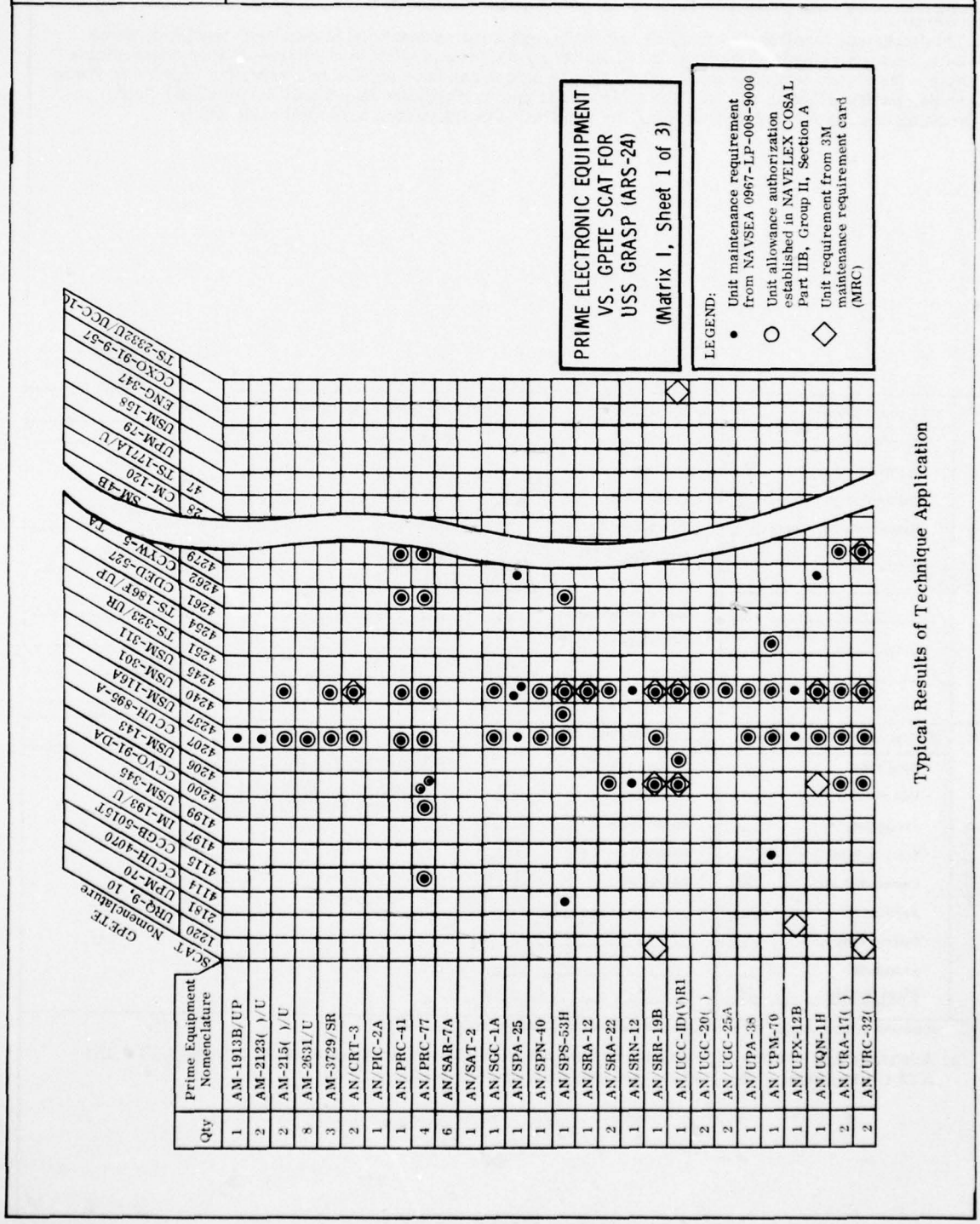
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. Adequacy and Availability of General Purpose Electronic Test Equipment Aboard ARS, ATF and ATS Class Ships, Pub. 1627-01-1-1409, Vol. I, June 1975

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
4 (Cont)	Comparative Analysis of Shipboard Electronic Test Equipment Requirements and Allowances (Cont)



Typical Results of Technique Application

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
5	**Validation of Shipalt Status and Applicability**

3. Description

This technique comprises a procedure and guidelines for determining/validating the applicability and status of approved ship alterations. Associated steps are:

a. **Review/analyze existing records/data as necessary to summarize known shipalt applicability and status.**

b. **Identify unknown status/applicability factors.**

c. **Compile validation work package.**

d. **Conduct validation shipcheck.**

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	X	Technique Developed, Not Applied	___
Engineering Procedure	___	Procurement	___	Availability	___		
Management Procedure	X	Installation	___	Reliability	___	Technique Applied One Time	___
_____	___	Maintenance	___	Maintainability	___	Technique Applied Recurrently	X
_____	___	Operation	___	None	___		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**Configuration Management**
Hull Structure	___	Validation	___	**ROH Planning**
Propulsion	___	Development	___	**Fleet Modernization Program**
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **FMP and Shipalt Validation Packages for USS NEOSHO (AO-143) and Other AO-Type Ships (copies available from Ships & Ordnance Division)**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
6	**Evaluation of Engineering Change Proposals**

3. Description

This procedure involves the engineering analysis necessary to evaluate engineering change proposals (ECPs) for specific equipments. The procedure provides a systematic means of approval/disapproval based on such technical factors as reliability, maintainability, and value. The procedure has been applied to a variety of ECPs for a gun mount (see ref. 2).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability	X	Technique Developed, Not Applied	
Engineering Procedure	X	Procurement	X	Availability			
Management Procedure		Installation	X	Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation	X	None			
		Mgt/Tech Service					
		Modification	X				
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	P	Concept Form.		**Maintenance Engineering Analysis**
Hull Structure	P	Validation		**Configuration Management**
Propulsion	P	Development		
Electric Plant	P	Acquisition	P	
Command & Surv.	P	Operation	X	
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **MIL-STD-480, Configuration Control – Engineering Changes, Deviations and Waivers**
2. **Evaluation of ECPs for the 5"/54 Caliber Mark 45 MOD 0 Gun Mount, Pub. 0978-39-8-1248, June 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
7	Reliability Prediction (of Mechanical Shipboard Equipments) by Regression

3. Description

This technique provides for the development of reliability prediction equations for shipboard mechanical equipments such as pumps, valves, turbines, motor-generator sets, diesel engines, etc. The equations are based on regression analysis involving operational and design parameters such as operating pressures, operating temperatures, number/type of bearings, etc. The prediction equations were based on data from several ship types (see ref. 5). Reliability indices covered in this technique include mean time between failures (MTBF) and mean time between maintenance (MTBM).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
Regression		Maintenance		Maintainability		Technique Applied Recurrently	X
Analysis	X	Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.	P	Reliability Prediction
Hull Structure		Validation	P	
Propulsion	X	Development	P	
Electric Plant	X	Acquisition	P	
Command & Surv.	P	Operation	X	
Auxiliaries	X			
Outfit/Furnish.				
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. A Technique for Design Prediction of Reliability and Maintainability of Mechanical Equipments, Pub. 594-01-4-962, April 1969
2. Interim Report, Literature Search for Available Reliability Prediction Techniques for Mechanical Equipments, Pub. 933-01-1-1018, Nov. 1969
3. Reliability Prediction for Ship's Machinery, Pub. 4711-1082, Oct. 1970
4. Development of a Reliability Prediction Procedure for Shipboard Mechanical Equipments, Pub. 933-01-2-1079, Nov. 1970
5. Development of a Reliability Prediction Procedure for Shipboard Mechanical Equipments, Pub. 933-02-3-1153, Dec. 1971

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
8	**Reliability Prediction by Summation of Failure Rates**

3. Description

Reliability prediction by summation of failure rates essentially involves developing a reliability block diagram, determining the population of parts, summing the part failure rates (as determined from a common source such as MIL-HDBK-217A or FARADA), and calculating the reliability of the system/equipment, based on the block diagram. This technique, described basically in MIL-STD-756, has been applied to certain armament and electronic systems (see ref. 2 through 4).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.	P	**Reliability Prediction**
Hull Structure		Validation	P	
Propulsion		Development	P	
Electric Plant		Acquisition	P	
Command & Surv.	X	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **MIL-STD-756, Reliability Prediction**
2. **Reliability Prediction for Electrical and Electronic Control Circuitry of the MK 42 MOD 10 Gun Mount, Pub. 978-01-1-1129, Aug. 1971**
3. **Reliability Prediction for the Electrical and Electronic Control Circuitry of the MK 45 MOD 0 Gun Mount, Pub. 978-02-2-1168, March 1972**
4. **Initial Reliability Prediction, Remote Unmanned Work System, Pub. D16-16-1-1228, April 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
9	**Reliability Demonstration Test Conduct**

3. Description

Reliability demonstration test planning is the preparing of a plan that details the methods, procedures, schedule, and description of facilities essential to the conduct of a reliability demonstration test. The technique includes stipulation of accept/reject/continue criteria as stipulated in MIL-STD-781B.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Testing**
Hull Structure		Validation		**Reliability Demonstration**
Propulsion	P	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **MIL-STD-781B, Reliability Tests: Exponential Distribution**
2. **Reliability Demonstration Test Plan for the Weapon Control and Setting Subsystem of the Underwater Fire Control System MK 116 Mod 1, Ltr. SDSO-74-115, Encl. (1), May 31 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
10	Reliability Demonstration Test Conduct

3. Description

The technique consists of conducting tests, collecting and analyzing test data, and reporting test results as necessary to evaluate the results of a reliability demonstration test for electronics equipment. The general approach, as described in ref. 1, is applicable to any type of system/ equipment for which a reliability demonstration test is conducted.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Testing**
Hull Structure		Validation		**Reliability Demonstration**
Propulsion	P	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Reliability and Maintainability Demonstration Testing of Weapon Control and Setting Subsystem of Underwater Fire Control System Mk 116 Mod 1, Pub. 1616-08-2-1328, Oct. 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
11	**Determining Shipboard System Figures of Merit**

3. Description

This procedure establishes a methodology for determining figures of merit appropriate to the reliability, maintainability, and cost-effectiveness analysis of shipboard systems. The procedure addresses:

a. **The defining of equipment and its sublevels**

b. **Identification and definition of the figures of merit**

c. **Identification of the data elements and sources**

d. **Establishment of computation procedures.**

The procedure is described in ref. 1. It has been applied to a variety of propulsion system equipments aboard DLG-type ships (see ref. 2).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability	X		
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement**
Hull Structure		Validation		**Maintainability Measurement**
Propulsion	X	Development		**Reliability Prediction**
Electric Plant	P	Acquisition		**Maintainability Prediction**
Command & Surv.	P	Operation	X	**Maintenance Engineering Analysis**
Auxiliaries	P			**Reliability Engineering Analysis**
Outfit/Furnish.				
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Procedural Techniques for Analysis of Historical Maintenance Data Relating to Shipboard Mechanical Equipments, Pub. 594-01-1-959, April 1969 (Ch. 2)**

2. **Reliability and Maintainability Analysis of Selected Mechanical Equipments, Pub. 594-01-2-960, April 1969**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
12	**Reliability Program Surveillance**

3. Description

Reliability program surveillance is the review and analysis of a contractor's reliability program activity as necessary to evaluate his reliability program, including the program plan, reliability predictions, failure mode and effects analyses, and other elements prescribed in MIL-STD-785.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	P	Concept Form.		**Reliability Program Evaluation**
Hull Structure	P	Validation	P	
Propulsion	P	Development	P	
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **MIL-STD-785A, Reliability Program for Systems and Equipment Development and Production**
2. **Results of Reliability Program Surveillance of AN/SSQ-50 Sonobuoy Product Improvement Program Through Acceptance of First Production Lot, Pub. OE08-01-2-1279, December 1973**
3. **Final Summary Report-Reliability Program Surveillance of AN/SSQ-50 Sonobuoy Product Improvement Production Program (Lots 1 through 8), Pub. 1135-01-1-1355, January 1975**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
13	**Establishment of Mechanical Parts Data Bank**

3. Description

This procedure encompasses the steps required in formulating a data bank covering shipboard mechanical equipment parts. The procedure includes the steps associated with establishing data bank objectives; identifying data sources; and collecting, processing, and analyzing the data. Potential data sources are identified in the references.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	X
Engineering Procedure		Procurement		Availability		Technique Applied One Time	
Management Procedure		Installation		Reliability		Technique Applied Recurrently	
		Maintenance		Maintainability			
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**Reliability Engineering Analysis**
Hull Structure		Validation		**Maintenance Engineering Analysis**
Propulsion		Development	X	**Reliability Prediction**
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Reliability and Maintainability Data-Source Guide, Pub. 527-10-9-725, Jan. 1967**

2. **Shipboard Mechanical-Part Failure Rates: Data Sources and Technique for Establishing a Failure Rate Data Bank, Pub. 594-01-3-961, April 1969**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
14	**Data Collection and Analysis of Shipboard Mechanical Equipment**

3. Description

This procedure covers the collection and processing of MDCS and other data as necessary to compute reliability and maintainability figures of merit for shipboard mechanical systems. The procedure, as illustrated in the attached figure, is described in ref. 1. The procedure has been applied to a variety of shipboard mechanical equipments, as reported in ref. 2.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement**
Hull Structure		Validation		**Maintainability Measurement**
Propulsion	X	Development		**Maintenance Cost Analysis**
Electric Plant	P	Acquisition		
Command & Surv.	P	Operation	X	
Auxiliaries	P			
Outfit/Furnish.				
Armament	P			

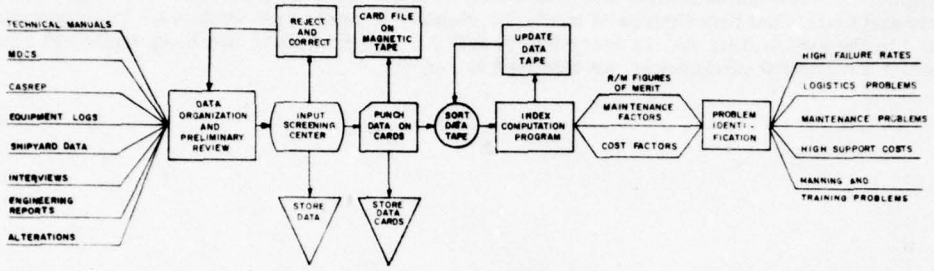
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Procedural Techniques for Analysis of Historical Maintenance Data Relating to Shipboard Mechanical Equipments, Pub. 594-01-1-959, April 1969 (Ch. 5)**
2. **Reliability and Maintainability Analysis of Selected Mechanical Equipments, Pub. 594-01-2-960, April 1969**
3. **Final Report – Pilot Program for Establishment of a Shipboard Machinery Reliability and Maintainability Data Bank, Pub. 588-02-3-1058, May 1970**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
14 (Cont)	Data Collection and Analysis of Shipboard Mechanical Equipment (Cont)



Work Flow for Data Collection and Analysis

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
15	**Identifying Shipboard Mechanical Equipment Problems**

3. Description

This procedure provides for combined statistical and engineering analysis of shipboard mechanical systems leading to identification of problems in any of the following areas: design, installation, repair-parts support, documentation, training and manning, support-equipment availability, and cost. The procedure, as described in ref. 1, has been applied to a variety of selected ship propulsion system equipments (see ref. 2).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability	X	Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Maintenance Engineering Analysis**
Hull Structure		Validation		**Reliability Engineering Analysis**
Propulsion	X	Development		
Electric Plant	P	Acquisition		
Command & Surv.	P	Operation	X	
Auxiliaries	P			
Outfit/Furnish.				
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Procedural Techniques for Analysis of Historical Maintenance Data Relating to Shipboard Mechanical Equipments, Pub. 594-01-1-959, April 1969 (Ch. 4)**
2. **Reliability and Maintainability Analysis of Selected Mechanical Equipments, Pub. 594-01-2-960, April 1969**
3. **Management Analysis Summary of the Toxic Gas Problem in Enclosed Mounts and Turrets, Pub. 0978-21-10-1272, 30 November 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
16	**Engineering Assessment of System/Equipment Reliability**

3. Description

This technique comprises design/document review, prediction, observation of tests, and related analyses as necessary to assess the reliability of a shipboard system/equipment. Application of this technique to a variety of items is illustrated in the references cited below. The objective of this technique is to assess compliance with stated requirements, identify problems, and provide recommended design, documentation, and procedural changes.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement**
Hull Structure		Validation	X	**Failure Analysis**
Propulsion	P	Development	X	**Testing**
Electric Plant	P	Acquisition	X	**Reliability Prediction**
Command & Surv.	P	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Final Report – Reliability Prediction and Assessment Program for Naval Mines (U) (CONFIDENTIAL) Pub. 904-01-1-984, July 1967**
2. **An Analysis of the Reliability, Maintainability and Availability of the TAOC in the Military Service Environment, Pub. 555-01-10-874, April 1960**
3. **Evaluation of Extending Service Life of Seawater Battery MK 61, MOD 0, Pub. 468-01-1-883, July 1968**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
16 (Cont)	Engineering Assessment of System/Equipment Reliability (Cont)

References (Cont)

4. Assessment of the Reliability and Maintainability Characteristics of the SSN-594 Class Submarine ASW System, Pub. 574-01-1-907, August 1968
5. Reliability Assessment of the Mines MK 52 and 55, Mods 1 through 6 (U) (CONFIDENTIAL), Pub. 569-01-1-905, August 1968
6. Reliability and Maintainability Assessment of the Fast Automatic Shuttle Transfer (FAST) System (Missile Stream), Pub. 589-02-2-971, April 1969
7. Assessment of the Reliability and Maintainability Characteristics of the SSN-637 Class Submarine ASW System (U) (CONFIDENTIAL), Pub. 901-01-2-1005, Oct. 1969
8. Users Manual – Data and Computational Procedures for Assessment of the Reliability and Maintainability Characteristics of the SSN-637 Class Submarine ASW System, Pub. 901-01-4-1008, Oct. 1969
9. Final Report on the Voltage-Transient Tests of the Electrical and Electronic Control Circuitry of the Mark 45 Mod 0 Gun Mount, Pub. 978-03-3-1174, May 1972
10. Reliability Test of the MK 45 MOD 0 5"/54 Caliber Gun Mounts, Pub. 0978-06-6-1207, Jan. 1973
11. Analysis of Reliability-Test Results and Practicality of Teardown Inspection for the 5"/54 Caliber MK 42 MOD 7 Gun Mounts, Pub. 978-07-7-1219, March 1973
12. Engineering Assessment of Coastal Patrol and Interdiction Craft (CPIC) Weapon System, Pub. 1625-01-1-1353, Sept. 1974
13. A Reliability-Maintainability-Availability Assessment of 3-Inch 50-Caliber Rapid Fire Twin Gun Mounts, Mark 33 Mod 0 and Mod 13, Pub. 1622-02/03-1-1345, Jan. 1975

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
17	**Structural Design Analysis**

3. Description

This technique incorporates the procedures necessary to establish design criteria, perform stress analyses, identify deficiencies, and recommend changes relative to mechanical systems.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Structural Design Analysis**
Hull Structure		Validation	X	
Propulsion		Development	P	
Electric Plant		Acquisition	P	
Command & Surv.		Operation	P	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Design Analysis of Modified Bulb Support Structure in DOT Underwater Light Assembly (12000 and 20000 Feet), Pub. W2-D16-TN03, Oct. 1972**

2. **Design Analysis of Work System Package (WSP) for Underwater Applications, Pub. W3-1616-TN02, Nov. 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
18	**Failure Analysis by Engineering Investigation**

3. Description

This technique is that of engineering analysis of equipments that have failed in the field. The approach consists of investigating cause of failure from field data, and analyzing circuitry/operation as necessary to formulate corrective action. The general approach is applicable to any type of equipment.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Failure Analysis**
Hull Structure	P	Validation		
Propulsion	P	Development	X	
Electric Plant	X	Acquisition	X	
Command & Surv.	X	Operation	X	
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Quarterly Status Report #4, MK 46 Torpedo Reliability Data Center Failure Information, Pub. W7-417-TN005-1, Dec. 1967**
2. **Analysis of Power Distribution and Power Dissipation in the 5"/54 MK 42 MOD 9 and 10 Gun Mounts, Pub. 1621-01-1-1307, July 1974**
3. **Evaluation of 30 KW and 2.5 KW Generators Used on SERVPAC ARS and ATF Class Ships, Pub. 1620-01-2-1338, Nov. 1974**
4. **Reliability and Maintainability Assessment of Mobile Submarine Simulator from TECHEVAL Data (U), CONFIDENTIAL, Pub. 1616-10-5-1417, June 1975**
5. **Reliability and Maintainability Assessment of Mobile Submarine Simulation During Technical Evaluation (U), CONFIDENTIAL, Pub. 1616-18-8-1485, March 1976**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
19	**Failure Analysis by Laboratory Testing**

3. Description

This technique involves laboratory analysis of equipments that have failed in the field, i.e., testing the equipments, isolating failures as necessary to establish failure mode, and developing recommendations for preventing recurrence. This technique has been applied to various shipboard electronic equipments (see reference) and is generally applicable to any item that can be tested under laboratory conditions.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability	X	Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	
Management Procedure		Installation		Reliability	X		
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Failure Analysis**
Hull Structure		Validation		**Testing**
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Analysis of Failed Power Supplies Used in the 5"/54 Caliber MK 42 Gun Mount EP-1 Control Panel, Pub. 0978-23-11-1284, Jan. 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
20	Fault Isolation Procedure Analysis

3. Description

Fault isolation procedure analysis encompasses the review of documentation, observation of maintenance practices, and design analysis as necessary to evaluate existing fault isolation procedures. As described in ref. 1, this technique has been applied to the Mk 42 Mod 9 Gun Loading System. Application of the technique may result in design/procedural changes.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	X
Management Procedure		Installation		Reliability		Technique Applied Recurrently	
		Maintenance		Maintainability	X		
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Maintenance Engineering Analysis
Hull Structure		Validation		Electrical Design Analysis
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.	P	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. MK 42 Mod 9 Gun Loading System: Fault Isolation Procedure Analysis, Pub. 1621-02-2-1331, Sept. 1974

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
21	**Maintainability Prediction (of Mechanical Shipboard Equipments) by Regression**

3. Description

This technique involves the development of maintainability prediction equations for shipboard mechanical equipments such as pumps, valves and turbines. The equations are based on regression analysis involving operational parameters (e.g., pressure, temperature) and design parameters (e.g., number of bearings). The prediction equations are based upon data from 17 destroyers. The maintainability indices included in the technique include mean time to repair (MTTR) and mean down time (MDT).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
Regression		Operation		None			
Analysis	X	Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.	P	**Maintainability Prediction**
Hull Structure		Validation	P	
Propulsion	X	Development	P	
Electric Plant	P	Acquisition	P	
Command & Surv.	P	Operation	X	
Auxiliaries	P			
Outfit/Furnish.				
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **A Technique for Design Prediction of Reliability and Maintainability of Mechanical Equipment, Pub. 594-01-4-962, April 1969**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
22	**Maintainability Demonstration Test Planning**

3. Description

The technique consists of preparing a plan that details procedures, conditions, data collection methods, schedule, etc., essential to the conducting of a maintainability demonstration test in accordance with ref. 1. Ref. 2 gives the approach to and results of the application of this technique to a selected item of equipment.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	X
Management Procedure		Installation		Reliability		Technique Applied Recurrently	
		Maintenance		Maintainability	X		
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Testing**
Hull Structure		Validation	P	**Maintainability Demonstration**
Propulsion	P	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **MIL-STD-471, Maintainability Demonstration**

2. **Maintainability Demonstration Test Plan for the Weapon Control and Setting Subsystem of the Underwater Fire Control System MK 116 MOD 1, Ltr. SDSO-74-387, Encl. (1), 12 Aug. 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
23	**Maintainability Demonstration Testing**

3. Description

The technique includes test monitoring, test-data collection and analysis, and the reporting of test results as necessary to evaluate a maintainability demonstration test. The general approach illustrated by ref. 1 is applicable to any type of system/equipment for which a maintainability demonstration test is conducted.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	X
		Maintenance		Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Testing**
Hull Structure		Validation		**Maintainability Demonstration**
Propulsion	P	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Reliability and Maintainability Demonstration Testing of Weapon Control and Setting Subsystem of Underwater Fire Control System, MK 116 Mod 1, Pub. 1616-08-2-1328, Oct. 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
24	LO-MIX Maintenance Engineering Analysis (LMMEA) Technique

3. Description

A technique was developed for performing a maintenance engineering analysis of HM&E, ordnance, and electronic equipments on the LO-MIX class of ships in a manner that is less time-consuming and less costly than analyses performed in accordance with MIL-M-24365A (ref. 1).

The technique is versatile because it is applicable to equipments for which there are no historical maintenance data, and which have not been subjected to maintenance engineering analysis conforming to MIL-M-24365A. Analyses performed per this technique are compatible with the input requirements of the Trident Integrated Logistic Support System. Under the technique, any one of three classes of analysis can be performed, depending on the nature of the item. The analysis classes are described on the attached sheet.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	
Management Procedure		Installation		Reliability		Technique Applied Recurrently	X
		Maintenance	X	Maintainability	X		
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Maintenance Engineering Analysis
Hull Structure		Validation		
Propulsion	X	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	X			
Outfit/Furnish.	P			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. MIL-M-24365A, Maintenance Engineering Analysis, Establishment of, and Procedures and Formats for Associated Documentation, General Specification for, July 1970
2. LO-MIX Maintenance Engineering Analysis Technique, Pub. 1616-09-3-1341, Nov. 1974
3. LO-MIX Maintenance Engineering Analysis (LMMEA) Instructions and Forms, Pub. 1616-12-4-1393, June 1975
4. LO-MIX Maintenance Engineering Analysis (LMMEA) Pilot Effort, Pub. 1616-12-5-1418, June 1975

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
24 (Cont)	LO-MIX Maintenance Engineering Analysis (LMMEA) Technique (Cont)

The Class I LMMEA is reserved for those units undergoing test and development. It is an in-depth analysis of units for which neither a standard MEA nor historical maintenance data are available. The engineer proceeds by collecting all available information in the form of drawings, design specifications, design criteria, and similar sources. This information is analyzed to determine what operating equipments the unit resembles. The operating equipments similar to the unit are analyzed to determine the unit's maintenance engineering requirements. These requirements are entered on the LMMEA Analysis Sheet. The Class I LMMEA is considered a unique class because of the time required for raw-data identification and collection. However, a Class I LMMEA can usually be completed in less than three months.

The Class II LMMEA identifies the maintenance engineering requirements of a lead unit for an equipment group through an in-depth analysis of existing data on the unit. The engineer assembles all identifiable data on the unit, using the LMMEA Analysis Sheet as a guide. If the unit is in the Case I or Case II category of data availability, little more than the standard MEA will be necessary. For units that are in the Case I or Case II category, a Class II LMMEA can be produced in less than two weeks. If the unit is in the Case III category, documents such as technical manuals, drawings, TRSs, APLs, Maintenance History Analyses, MIL-Standards, and others will be required. The LMMEA Analysis Sheet is used as a guide in researching and analyzing the documentation collected, and the data are entered on the LMMEA Analysis Sheet. For units in the Case III category, a Class II LMMEA can be produced in less than three weeks.

The Class III LMMEA is a method of identifying the maintenance engineering requirements of a follow-on unit of an equipment group. The engineer analyzes the requirements identified for the lead unit of that equipment group and relates those requirements to the unit of interest. The documentation required is a description of the unit under consideration and the completed LMMEA for the lead unit of the equipment group to which the unit under consideration belongs. A Class III LMMEA can be produced in less than three days.

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
25	**Maintenance History Analysis of Propulsion Equipment**

3. Description

This technique involves the application of a set of MDCS data sort programs designed to support accomplishment of the following analytical process:

a. **Compilation of maintenance event and man-hour history**

b. **Calculation of parts usage frequency**

c. **Identification of malfunction type**

d. **Trend analysis**

The technique has been applied to selected propulsion system equipments for various destroyer classes (see references). The attached table illustrates typical results from application of the technique. While application to date has been limited to propulsion equipments in destroyers, it generally is applicable to any one type of ship/system for which 3M data are collected.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Trend Analysis**
Hull Structure		Validation		**Maintainability Trend Analysis**
Propulsion	X	Development		**Reliability Measurement**
Electric Plant	X	Acquisition		**Maintainability Measurement**
Command & Surv.	P	Operation	X	
Auxiliaries	X			
Outfit/Furnish.				
Armament	P			
Destroyers	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Maintenance-History Analysis of Main Feed Pump Turbines for DDG-2 Class Ships, Pub.1012-01-2-1231, Feb. 1973**
2. **Approach for Development of Maintenance History Analysis for DDG-2 Class Propulsion Equipment, Pub. 1012-01-1-1230, Feb. 1973**
3. **Data Summary and Results of a Study of Candidate Equipments for Maintenance History Analysis, 1200 PSI Propulsion Equipment for DLG-9 Class Ships, Pub. 1012-01-3-1232, Feb. 1973**

Continued

1. Item No.	2. Title
25 (Cont)	**Maintenance History Analysis of Propulsion Equipment (Cont)**

References (Cont)

4. Maintenance-History Analysis for DDG-2 Class Propulsion Equipment, Pub. 1012-01-4-1239, May 1973

5. Maintenance History Analysis for DLG-9 Class Propulsion Equipment, Pub. 1117-01-1-1250, July 1973

Equipment Name	Related CID/AFL Number(s)	Number of Equipments	Total Operating Hours	Total CM Events	Total CM Man-Hours	Average Operating Hours Between CM Events	Average CM Man-Hours Per Event	Average Number of CM Events Per Ship Per Month	Average CM Man-Hours Per Ship Per Month
Distillers	080100016	10	165,762	565	9,547.6	293	16.9	1.99	33.2
	080030009	10	232,992	696	14,989.3	335	21.5	2.04	43.8
Forced Draft Blowers	057960005	40	437,344	813	16,209.6	538	19.9	2.64	52.6
	057960009	8	83,952	309	5,858.9	272	19.0	4.29	81.4
	057990003	16	198,750	212	1,489.5	938	7.0	1.51	10.6
	057800152	16	159,792	182	1,098.4	878	6.0	1.65	10.0
Main Feed Pump	016031226	18	106,018	234	3,190.7	453	13.6	1.31	17.9
	017020014	42	333,617	718	10,307.2	465	14.4	1.58	22.8
Main Feed Pump Turbine	057300043	18	106,018	271	2,973.8	391	10.9	1.52	16.7
	057260147[3]	42	333,617	576	4,658.3	579	8.1	1.27	10.3
Combustion and Feedwater Control System	619510065	12	214,764	219	1,636.6	985	7.4	1.23	9.1
	619510060	28	6[illegible]5,074	1,220	5,544.1	545	4.5	2.70	12.3
SSTG Turbine and Reduction Gears[4]	057150225	20	107,493	90	1,736.0	1,194	19.3	0.79	15.2
High Pressure Turbine	051150015, -17, -21	10	118,902	269	1,692.5	442	6.3	0.93	5.9
	051010074, -75, -76	10	183,800	352	8,594.6	522	24.4	1.03	25.1
Low Pressure Turbine	051150016, -18	10	118,902	105	1,772.8	1,132	16.9	0.36	6.2
	051010076, -82, -77	10	183,800	92	3,184.3	1,998	34.6	0.27	9.3
Auxiliary Circulating Pump[10]	016050209	8	60,912	17	639.0	3,583	37.6	0.33	12.4
Auxiliary Condensate Pump[10]	016020978	8	107,493	23	101.7	4,674	4.4	0.45	2.0
Main Feed Booster Pump	016000361	60	448,717	800	13,010.3	561	16.3	1.27	20.7
Main Feed Booster Pump Turbine[3]	057950056	18	165,076	238	3,325.8	694	14.0	0.41	5.3
Main Condensate Pump	016020495	40	457,515	544	12,192.3	841	22.4	0.86	19.4
Main Condensate Pump Turbine[3]	057950053	18	200,730	383	5,550.4	524	14.5	0.69	9.9
Main Lube Oil Pump[3]	016160255	40	426,396	133	904.2	3,280	7.0	0.21	1.4
	016160325								
	016160322	20	136,215	12	234.3	11,351	19.5	0.02	0.4
	016160417								
Main Lube Oil Pump Turbine[3]	057150137	2							
	057150170	16	275,459	486	3,638.1	567	7.5	0.77	5.8
	057150178	2							
Soot Blowers[3]	813030028[8]	132							
	813020074	56	470,190	506	5,142.6	929[2]	10.2	0.80	8.2
	813020075	112							
	813020081	84							
Main Reduction Gear[3]	691050039								
	691050040	10	118,902	109	599.9	1,090	5.5	0.37	1.75
	691050043								
	691050044								
	691150094	10	183,800	84	706.3	2,188	8.4	0.24	2.1
	691150095								
SSTG AC Generator[3]	161340005	20	107,493	20	280.3	5,375	14.0	0.18	2.5
Main Circulating Pump Turbine[6]	057950046	12	155,574	169	1,936.3	921	11.5	0.47	5.3
Main Circulating Pump[3]	016020490	20	266,813	93	773.7	2,869	8.3	0.15	1.2
Main Salt Water Cooling Pump	016110076	20	439,919	162	1,646.0	2,716	10.2	0.26	2.6
Main Gland Exhaust Motor[3]	174802060	20	294,476	71	898.8	4,148	12.7	0.18	2.3
Reserve Feed Transfer Pump	016060107	20	--	79	602.6	7,306[11]	7.7	0.13	0.9
Main Feed Boost Pump Motor[3, 9]	174010180	40	152,936	80	2,751.1	1,912	34.4	0.23	7.9
Main Condenser Piping[3]	--	20	294,476	85	585.6	3,464	6.9	0.22	1.5
Steam Smothering Piping[3]	--	40	--	93	1,170.5	--	12.6	0.24	3.0

[1] Includes only data from 1000-kW sets (i.e., DLG-6, -7, -9, -14, -15).
[2] Boiler operating hours between corrective-maintenance events.
[3] Excludes DLG-15 data.
[4] Excludes DLG-11 data.
[5] Some corrective-maintenance events have been omitted as nonrepresentative.
[6] Excludes DLG-10, -12, -13, and -14 data.
[7] Includes only Generation I MDCS data (July 1966 to December 1969).
[8] Excludes DLG-9 data.
[9] Includes only DLG-6, -7, and -8 data.
[10] For DLG-6 and DLG-15 only (after AAW conversion).
[11] Average ship steaming hours between corrective-maintenance events.

Reliability and Maintainability Summary for DLG-9 Class Propulsion-System Equipment

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
26	**Analysis of Corrective Maintenance Resource Consumption**

3. Description

A procedure was developed for identifying and ranking ship systems/equipments on the basis of maintenance resource consumption. The applicable maintenance resource measures include number of corrective maintenance actions, man-hours required and parts cost. The procedure was applied to a sampling of 108 destroyers involving seven classes (DE-1040, DE-1052, DEG-1, DLG-6, DLG-16, DLG-26, and DDG-2). The technique, based on use of MDCS data, includes methodology for using results to identify areas for further engineering analysis. The attached figure illustrates results of applying this technique.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement** **Maintainability Measurement** **Ships Systems/Equipment Criticality Ranking**
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				
Destroyers	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **An Analysis of Corrective-Maintenance-Resource Consumption for Seven Destroyer Classes, Pub. 1225-01-1-1368, March 1975.**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
26 (Cont)	Analysis of Corrective Maintenance Resource Consumption (Cont)

Functional Area	EIC	Percent of Maintenance Man-Hours
1. Propulsion	F	19.7
2. Auxilary Systems	T	15.0
3. Administration/Habitability	1	8.7
4. Communications and Data	Q	6.4
5. Radar/IFF	P	
6. Surface Missile	5	5.8
7. Guns	G	5.1
8. Hull Structure	A	4.2
9. Navigation	L	3.7
10. Electronic Test Equipment	W	2.9
11. Interior Communications	M	2.8
12. Sonar	R	2.8
13. Countermeasures	N	2.5
14. Anti-Submarine Warfare	J	2.4
15. Electric Power Distribution	4	2.4
16. Support Services	U	2.2
17. Boats, Stowage/Handling	Y	2.1
18. Electric Power Generation	3	2.1
19. Special Systems	Z	0.7
20. Naval Intelligence Processing	H	0.1
21. Specialized Ordnance Equipment	8	0.1

Total Man-Hours Reported in Period 1970 Through 1973 From 108 Destroyers: 7,730,400

Typical Results of Maintenance Resource Consumption Analysis

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
27	**Engineering Assessment of System/Equipment Maintainability**

3. Description

This technique encompasses design/document review and the observation of tests and related analyses as necessary to assess the maintainability of a shipboard system/equipment. Application of this technique to a variety of items is described in the references cited below.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Maintainability Measurement**
Hull Structure		Validation	X	**Maintainability Prediction**
Propulsion		Development	X	**Maintenance Engineering Analysis**
Electric Plant		Acquisition	X	**Testing**
Command & Surv.		Operation	X	
Auxiliaries	X			
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Reliability and Maintainability Assessment of the Fast Automatic Shuttle Transfer (FAST) System (Missile Stream), Pub. 589-02-2-971, April 1969**
2. **Assessment of the Reliability and Maintainability Characteristics of the SSN-637 Class Submarine ASW System (U) (CONFIDENTIAL), Pub. 900-01-2-1005, Oct. 1969**
3. **Users Manual – Data and Computational Procedures for Assessment of the Reliability and Maintainability Characteristics of the SSN-637 Class Submarine ASW System, Pub. 901-01-4-1008, Oct. 1969**
4. **Engineering Assessment of Coastal Patrol and Interdiction Craft (CPIC) Weapon System, Pub. 1625-01-1-1353, Sept. 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
28	**Analyzing Shipboard Mechanical Equipment Maintenance and Cost Factors**

3. Description

This procedure consists of the collection of data and accomplishment of calculations as necessary to compute certain significant maintenance and cost factors associated with shipboard mechanical equipment. The maintenance and cost factors covered by this procedure are illustrated in the attached tables. The procedure is described in ref. 1, and its application to selected destroyer propulsion equipments is reported upon in ref. 2.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement**
Hull Structure		Validation		**Maintainability Measurement**
Propulsion	X	Development		**Reliability Prediction**
Electric Plant	P	Acquisition		**Maintainability Prediction**
Command & Surv.	P	Operation	X	**Maintenance Engineering Analysis**
Auxiliaries	P			**Reliability Engineering Analysis**
Outfit/Furnish.				
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Procedural Techniques for Analysis of Historical Maintenance Data Relating to Shipboard Mechanical Equipments, Pub. 594-01-1-959, April 1969 (Ch. 3)**

2. **Reliability and Maintainability Analysis of Selected Mechanical Equipments, Pub. 594-01-1-960, April 1969**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
28 (Cont)	**Analyzing Shipboard Mechanical Equipment Maintenance and Cost Factors (Cont)**

Item	Maintenance Factor	Formula
1	Percent replacement parts within assembly, by equipment by vendor	$\frac{\text{Total number of parts replaced within a given assembly}}{\text{Total parts replaced within next higher assembly}} \times 100$
2	Type of equipment failure (High 5). Rank in descending order, by equipment, by vendor.	Total of given types of failures
3	Cause of equipment failure (High 5). Rank in descending order, by equipment, by vendor.	Total of a given failed part type/name
4	Number of cluster removals	Total number of corrective maintenance actions occurring within successive 30-day intervals which required two or more part replacements for each equipment, by vendor.
5	Manufacturers of high-replacement-rate equipments (High 2). Rank in descending order, by vendor.	$\frac{\text{Total parts replaced, by equipment by vendor}}{\text{Total operating hours, by equipment by vendor}}$
6	Technician's level and rating for majority of equipment repairs requiring part replacements	List technician levels or grades used during equipment maintenance requiring part replacement and the corresponding percent of total maintenance performed by each grade, by equipment, by vendor.
7(a)	Number "Hits"	Number of satisfied stock requests by equipment, by vendor.
7(b)	Number "Misses"	Number of unsatisfied stock requests* by equipment, by vendor.
8	Mean time awaiting parts	Same as Item 16, Table 2 (MTLA)
9	Number of parts replaced due to equipment failure (corrective maintenance)	Total parts replaced due to equipment failure, by equipment, by vendor.
10(a)	Number of parts replaced during planned maintenance	Total parts replaced during planned maintenance, by equipment, by vendor.
10(b)	Number of parts replaced during preventive maintenance	Total parts replaced during preventive maintenance, by equipment, by vendor.
11	Number of maintenance actions	Total maintenance actions by equipment, by vendor, by ship.
12	Percent of total maintenance actions by equipment within system. Rank in decreasing order.	$\frac{\text{Total maintenance actions by equipment}}{\text{Total maintenance actions by system}} \times 100$
13	Technician's levels and ratings for all maintenance actions	List number of technician levels or grades used for equipment maintenance and the corresponding percent of total maintenance performed by each grade, by equipment, by vendor.
14	Ratio of troubleshoot man-hours to total maintenance man-hours	$\frac{\text{Total troubleshoot man-hours by equipment, by vendor}}{\text{Total maintenance man-hours by equipment, by vendor}}$
15	Number of preventive maintenance actions	Total number of preventive maintenance actions by equipment, by vendor.
16	Average number of parts used per maintenance action	$\frac{\text{Total parts used}}{\text{Total maintenance actions}}$

* As used here, an unsatisfied stock request means any stock request that is not satisfied immediately upon submittal.

Formulas for Maintenance Factors

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
28 (Cont)	**Analyzing Shipboard Mechanical Equipment Maintenance and Cost Factors (Cont)**

Item	Cost Factor	Formula
1	Parts Cost	$\sum_{i=1}^{n}$ (Number of Parts of i^{th} Type Replaced) (Cost of i^{th} Part Type) where n = Number of Types of Parts Replaced
2	Average Logistics Cost per Maintenance Action	Total Logistic Actions x Average Cost/Logistic Action / Total Maintenance Actions
3	Average Man-Hour Cost per Maintenance Action	Total Maintenance Man-Hours x Average Cost/Man-Hour / Total Maintenance Actions
4	Average Man-Hour Cost per Corrective Maintenance Action	Total Corrective Maintenance Man-Hours x Average Cost/Man Hour / Total Corrective Maintenance Actions
5	Average Man-Hour Cost per Preventive Maintenance Action	Total Preventive Maintenance Man-Hours x Average Cost/Man Hour / Total Preventive Maintenance Actions
6	Average Man-Hour Cost per Planned Maintenance Action	Total Planned Maintenance Man-Hours x Average Cost/Man-Hour / Total Planned Maintenance Actions
7	Average Parts Cost per Maintenance Action	Total Cost of Replaced Parts / Total Maintenance Actions
8	Average Parts Cost per Corrective Maintenance Action	Total Cost of Parts Replaced During Corrective Maintenance / Total Corrective Maintenance Actions
9	Average Parts Cost per Preventive Maintenance Action	Total Cost of Parts Replaced During Preventive Maintenance / Total Preventive Maintenance Actions
10	Average Cost to Support per Maintenance Action	Item 2 + Item 3 + Item 7
11	Average Cost to Support per Equipment Operating Hour	Item 10 x Total Maintenance Actions / Total Equipment Operating Hours
12	Average Total Cost to Support per Year	Item 10 x Total Maintenance Actions / Number Years Observed
13	Average Cost to Support per Year at each Maintenance Echelon	Item 10 by Maintenance Echelon x Total Maintenance at Each Echelon / Number of Years Observed for Appropriate Echelon (i.e., Shipboard, Tender, or Shipyard)

Formulas for Cost Factors

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
29	**Reliability and Maintainability Indices for Shipboard Equipments**

3. Description

A procedure for utilizing 3M data to compute reliability and maintainability indices was developed and applied to selected shipboard systems. The procedure utilizes computer programs for identifying and classifying MDCS maintenance events and calculating the indices: mean time between failures (forced shutdown), mean time between corrective maintenance, mean time to repair and median time to repair. The technique was applied to selected shipboard main propulsion and auxiliary equipment for all types of ships, and compiled into a data bank for shipboard machinery. The attached figure illustrates the format and content of the data bank.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service		Utilization	X		
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Measurement**
Hull Structure		Validation		**Maintainability Measurement**
Propulsion	X	Development		
Electric Plant		Acquisition		
Command & Surv.		Operation		
Auxiliaries	X			
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Establishment of Reliability and Maintainability Data Bank for Shipboard Machinery, Vol. I – Description of Technique; Vol. II – Data Sheets, Pub. OE13-01-1-1224, March 1973**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
29 (Cont)	Reliability and Maintainability Indices for Shipboard Equipments

SHIPBOARD MACHINERY
RELIABILITY AND MAINTAINABILITY DATA BANK

Equipment Identification

Noun Name: Turbine, Main Feed Booster Pump
General Description: Turbine Steam Main Feed Booster Pump
CID/APL Number(s): 057150032 Federal Stock Number: 4320-368-3092
Equipment Identification Code: ZQ12000/F308300
Technical Manual: 347-1051
Manufacturer: 16712 De Laval Turbine Inc.

Basic Data

Ship Population: DD 697,709,716,718,723 *(1) Equip. Population/Ship: 4 ea/DD
Equip. Population in Data Base: 192 Data Assessment Period: 7/1/67 - 6/30/69
Utilization Factors: DD-S: A = 0.50; B = 0.33; C = 0.00;
Total Equip. Operating Time (hours): 925212
Total Number of: Failures (CM_f): 52 Corrective Maintenance Events (CM): 484
Total CM_f Repair Man-Hours: 2076 Total CM Repair Man-Hours: 6728
Maintenance Factors: 0.67

Reliability Indices**

Mean Time Between Failure
(Forced Shutdown Corrective Maintenance)

$MTBCM_f$: 7792
90% Confidence Interval
Upper Limit: 22715
Lower Limit: 14122

Mean Time Between Corrective Maintenance

MTBCM: 1912
90% Confidence Interval
Upper Limit: 2063
Lower Limit: 1773

Maintainability Indices

Corrective Maintenance — (Forced Shutdown Failure Events Only)

$MTTR_f$: 26.6
$MCMM_f$: 10.1
Max. Observed MH: 324
$\overline{MCMM}_f$: 39.9
Variance: 4744

Corrective Maintenance — (All Events)

$MTTR_{cm}$: 9.3
$MCMM_{cm}$: 3.0
Max. Observed MH: 512
$\overline{MCMM}_{cm}$: 13.9
Variance: 1617

Indicated Distribution(s): Exponential ____ Normal ____ Log Normal X

*REMARKS: *(1) 725,730,743,745,746,755,758,759,760,780,781,782,783,786, 787,789,790,806,808,818,819,820,826,830,832,836,837,839,840,851,852,864, 870,871,875,876,880,881,884,885,886,888; **Reliability indices developed for ARINC Research Publication 933-02-3-1153, dated December 1971

Example of R&M Indices

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
30	**Development of Equipment Behavior Measures**

3. Description

Measures of equipment behavior were developed and applied to selected propulsion equipments of certain destroyer classes. The measures reflect reliability, maintainability, degradation maintenance burden, and parts-cost burden. Data used in applying the technique consist of MDCS data, casualty reports, overhaul departure reports, and records of steaming hours. The attached figures illustrate typical results of the application of the procedure. The procedure is applicable to any system/equipment for which MDCS and utilization data are available, and is useful in evaluation of maintenance plans on other analyses involving reliability/maintainability trends.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Reliability Trend Analysis**
Hull Structure		Validation		**Maintainability Trend Analysis**
Propulsion	X	Development		**Reliability Measurement**
Electric Plant		Acquisition		**Maintainability Measurement**
Command & Surv.		Operation	X	**Maintenance Strategy Planning**
Auxiliaries	X			**EOC Maintenance Management**
Outfit/Furnish.				
Armament				
Destroyers	X			

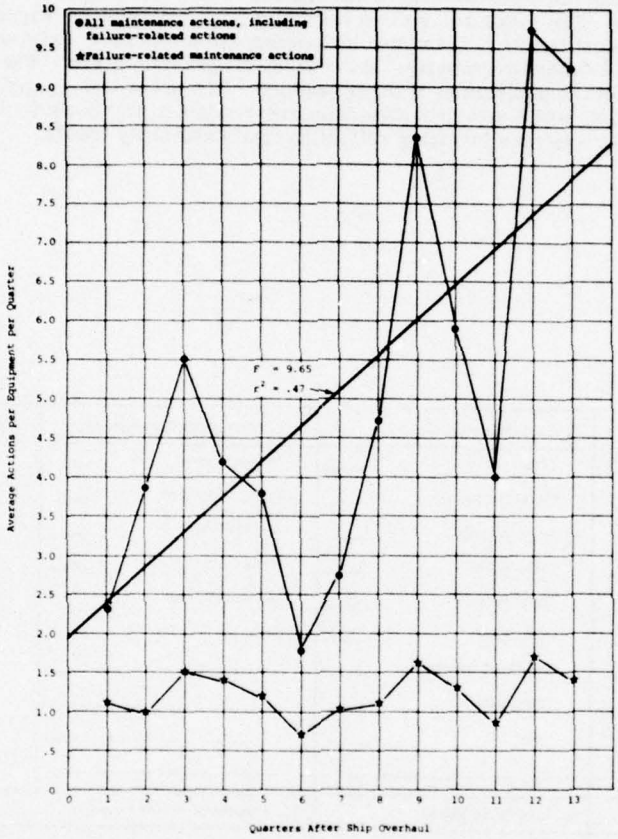
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Executive Summary, A Study to Determine the Annualized Maintenance Cost and Feasibility of Adopting EOC for Destroyer-Type Ships, Pub. 1024-01-1-1293, March 1974**
2. **Final Report, A Study to Determine the Annualized Maintenance Cost and Feasibility of Adopting EOC for Destroyer-Type Ships, Pub. 1024-01-2-1297, June 1974**
3. **Development of Equipment Behavior Measures for Selected Equipments in the Propulsion Plant of DDG-2 Class Ships, Pub. 1623-01-1-1347, Dec. 1974**
4. **Determining Reliability and Degradation of Shipboard Machinery, Pub. 6801-1448, Jan. 1976**

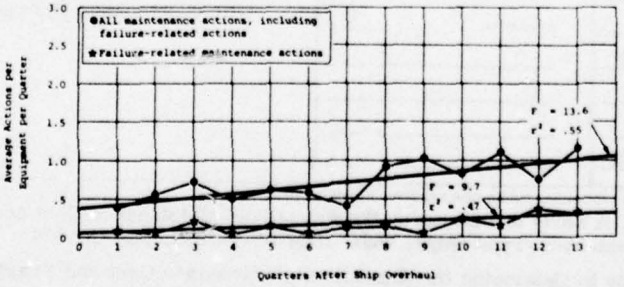
Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
30 (Cont)	Development of Equipment Behavior Measures (Cont)



Degradation Measures for the Main Boiler



Degradation Measures for the Forced Draft Blower

Sample Results of Behavior-Measure Technique Application

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
31	**Analysis of Planned Maintenance System Effectiveness**

3. Description

This technique is an engineering process designed to determine the degree of readiness improvement attributable to the Planned Maintenance System (PMS). The procedure involves the following steps:

a. **Evaluate all pertinent Navy reports to determine indicators of equipment readiness and PMS accomplishment rates.**

b. **Develop data acceptance guidelines to eliminate any data source that may bias the overall results.**

c. **Correlate equipment readiness indicators with PMS accomplishment rates.**

d. **Evaluate the validity of the results with respect to sample size and any basic assumptions.**

e. **Recommend any necessary further actions.**

Application of the above procedure to selected equipments and ships is illustrated by ref. 1.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness	X	Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	X
		Maintenance		Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification	X				
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Planned Maintenance System (PMS)**
Hull Structure	P	Validation		**Maintenance Engineering Analysis**
Propulsion	P	Development		
Electric Plant	P	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Effectiveness of PMS for Shipboard Electronic Equipment, Vol. III, Pub. 1627-01-3-1411, June 1975**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
32	**Measurement/Assessment of Ship Material Condition (Based on Quantity of Deferred Maintenance)**

3. Description

The procedure provides for measuring/assessing ship system/equipment material condition based on quantity of deferred maintenance, impact on operational capability, and mission essentiality. Data bases used in procedure include casualty reports and the Current Ships Maintenance Project (CSMP). The procedure consists of seven basic steps, designed to:

a. **Classify systems/equipments in terms of mission essentiality.**

b. **Classify systems/equipments in terms of operational status.**

c. **Classify systems/equipments in terms of extent of required maintenance.**

d. **Summarize material condition status.**

e. **Rank systems/equipments.**

f. **Determine trends in material condition.**

g. **Compare material condition against a standard.**

The attached figure illustrates the procedure.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	X	Technique Developed, Not Applied	___
Engineering Procedure	X	Procurement	___	Availability	___	Technique Applied One Time	X
Management Procedure	___	Installation	___	Reliability	___	Technique Applied Recurrently	___
_____	___	Maintenance	X	Maintainability	___		
_____	___	Operation	___	None	___		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	___	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**Material Condition Assessment**
Hull Structure	___	Validation	___	
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **A Recommended Procedure for Measuring and Assessing Ship Material Condition, Pub. 1613-01-1-1335, Nov. 1974**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
32 (Cont)	**Measurement/Assessment of Ship Material Condition (Based on Quantity of Deferred Maintenance) (Cont)**

EIC	Nomenclature	CASREPT History: Ship A	Ship B	Ship C	Mission Essential Item	Remarks
1100	Hull Fittings					
1300	Canvas/Rigging					
1400	Ladders and Gratings					
1500	Bulkheads and Doors					
1600	Deck Covering					
1700	Hull Insulation and Sheathing					
1800	Storerooms/Stowage Lockers (Salvage Equip.)	X	X	X	•	Salvage Equipment

Ship: _____ Date: _____

EIC	Nomenclature	Operational Status: Inoperative	Reduced Capability	Degraded; No Mission Effect	No Degradation
1100	Hull Fittings			X	
1300	Canvas/Rigging			X	
1400	Ladders & Gratings			X	
1500	Bulkheads and Doors			X	
1600	Deck Covering			X	
1700	Hull Insulation and Sheathing			X	
1800	Storero...	X			

SHIP: _____ Date: _____

EIC	Nomenclature	Maintenance Required: Major	Moderate	Minor	Insig.	None
1100	Hull Fittings		X			
1300	Canvas/Rigging			X		
1400	Ladders and Gratings		X			
1500	Bulkheads and Doors		X			
1600	Deck Covering		X			
1700	Hull Insulation and Sheathing		X			
1800	Storerooms/Stowage Lockers (Salvage Equip.)		X			
1900	Wo... boratory and					

DATA COLLECTION

DATA SUMMARIZATION

STEP 1
Classify systems/equipments in terms of mission essentiality.

STEP 2
Classify systems/equipments in terms of operational status.

STEP 3
Classify systems/equipments in terms of maintenance required.

STEP 4
Tabulate material condition.

	INOPERATIVE: EIC	Nomenclature	REDUCED CAPABILITY: EIC	Nomenclature	DEGRADED; NO MISSION EFFECT: EIC	Nomenclature
Major Maintenance	T800	Firemain System	TF00	Compressed Air System	1500	Bulkhead and Doors
Moderate Maintenance						
Minor Maintenance						
Insignificant Maintenance						
No Maintenance						

SUMMARIZATION

DATA ANALYSIS

STEP 4
...bulate material ...ndition.

STEP 5
Rank systems/ equipment in terms of importance.

STEP 6
Monitor material condition changes.

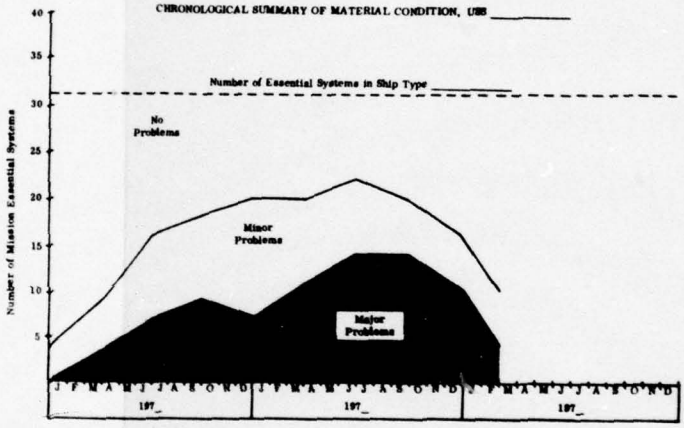
STEP 7
Compare material condition against baseline.

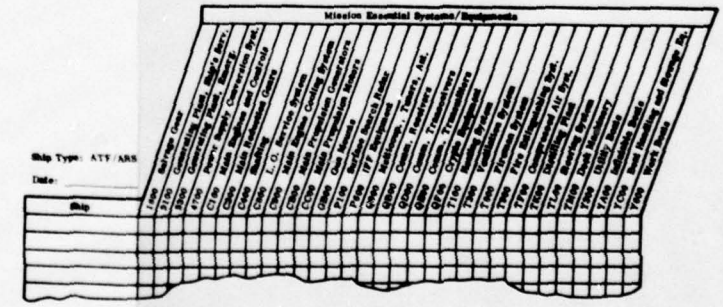
REDUCED CAPABILITY		DEGRADED; NO MISSION EFFECT	
EIC	Nomenclature	EIC	Nomenclature
TF00	Compressed Air System	1500	Bulkhead and Doors

Ship: _____ Date: _____

A. Ranking Based on Extent of Maintenance Required to Restore			B. Ranking Based on Impact on Performance Capability		
Rank	EIC	System/Equipment	Rank	EIC	System/Equipment
1	T800	Firemain System	1	T800	Firemain System
2	TF00	Compressed Air System	2	TF00	Compressed Air System
3	3100	Ship Service Generators	3	1800	Storeroom Eq. (Salvage Gear)
	C100	Main Engines		QU00	Communication Transceivers
	T100	Heating Syst. (Aux. Boiler)	5	P100	Surface Search Radar
	T300	Ventilation System	6	3100	Ship Service Generators
7	TM00	Deck Machinery		C100	Main Engines
8	1800	Storeroom Eq. (Salvage Gear)		T100	Heating Syst. (Aux. Boiler)
	QD00	Comm. Trans		T300	

CHRONOLOGICAL SUMMARY OF MATERIAL CONDITION, USS _____





Category Definitions

Category A -- System equipment contains inoperative material; major corrective maintenance required

Category B -- System equipment contains reduced capability material; major corrective maintenance required

Category C -- System equipment contains inoperative material; moderate corrective maintenance required

Category D -- System equipment contains reduced capability material; moderate corrective maintenance required

Procedure for Measuring/ Assessing Material Condition

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
33	**Life-Cycle Cost Categorization**

3. Description

The technique permits assessing/estimating life-cycle cost-of-ownership using a structured set of cost categories. In the procedure, life cycle cost is defined as consisting of eight major categories, each of which is further broken out into elemental cost factors (see attached figure). The cost categorization system has been applied, using historical data, to a sampling of shipboard electronic equipments to determine life cycle cost of ownership (see ref. 1).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle	X	Effectiveness		Concept	
Computer Program	X	Development	X	Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement	X	Availability			
Management Procedure		Installation	X	Reliability		Technique Applied One Time	
		Maintenance	X	Maintainability		Technique Applied Recurrently	X
		Operation	X	None	X		
		Mgt/Tech Service	X				
		Modification	X				
		None					
		Disposal	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	P	Concept Form.	P	**Maintenance Cost Analysis** **Life Cycle Cost Analysis**
Hull Structure	P	Validation	P	
Propulsion	P	Development	P	
Electric Plant	P	Acquisition	P	
Command & Surv.	X	Operation	X	
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	P			

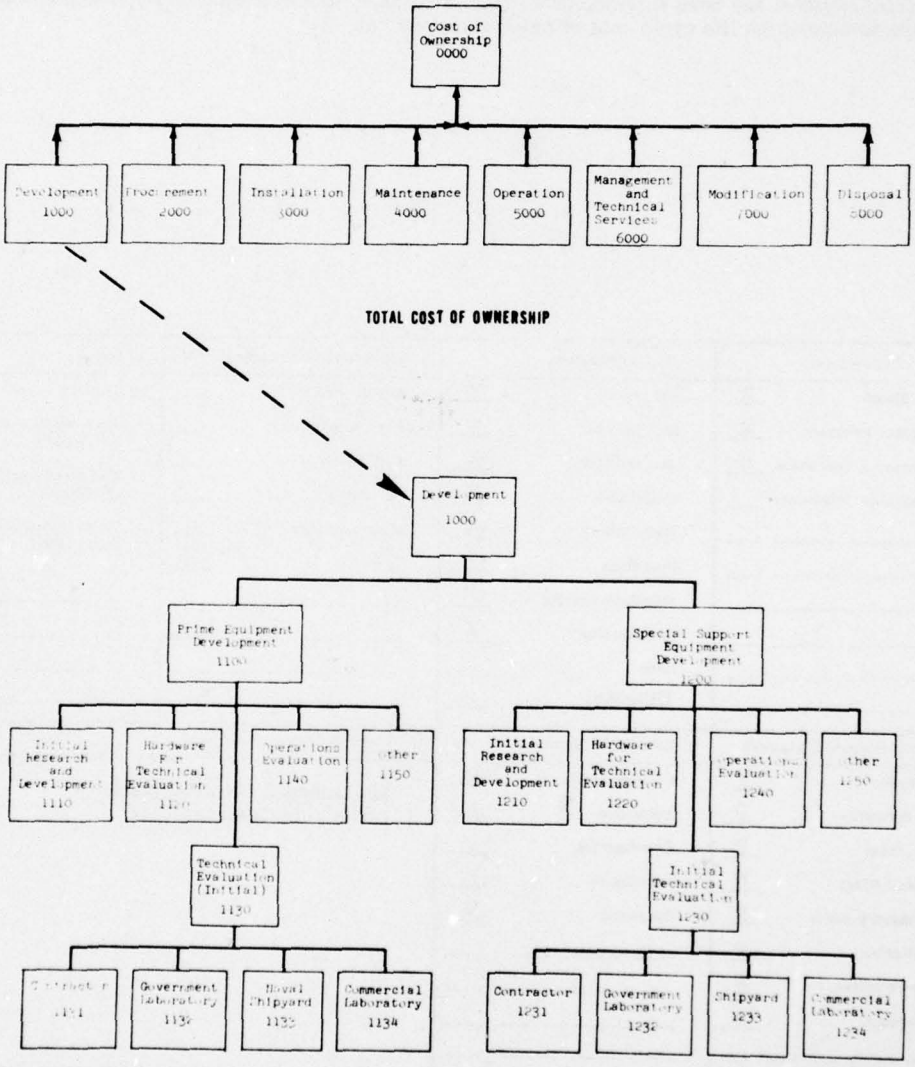
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Cost Evaluation of Selected Equipments, Vol. I, Pub. 541-01-1-766, April 1967**
2. **Some Life-Cycle Cost Estimates for Electronic Equipments; Methods and Results, Pub. 4670-824, Sept. 1967**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
33 (Cont)	Life-Cycle Cost Categorization (Cont)



Breakdown of Life-Cycle Cost of Ownership

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
34	Development of Cost-Estimating Relationships

3. Description

This technique provides for the development of mathematical equations that can be used to forecast cost of ownership (or some element thereof), where cost is expressed as a function of electrical, physical, environmental or other equipment-oriented factor. The procedure for developing cost-estimating relationships (CERs) is illustrated in the attached figure. The technique has been applied to a sampling shipboard electronic equipments (see ref. 1)

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle	X	Effectiveness		Concept	
Computer Program	X	Development	X	Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement	X	Availability	X		
Management Procedure		Installation	X	Reliability	X	Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation	X	None			
		Mgt/Tech Service	X				
		Modification	X				
		None					
		Disposal	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.	P	Life Cycle Cost Analysis
Hull Structure		Validation	P	Maintenance Cost Analysis
Propulsion	P	Development	P	
Electric Plant	P	Acquisition	P	
Command & Surv.	X	Operation	X	
Auxiliaries	P			
Outfit/Furnish.	P			
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

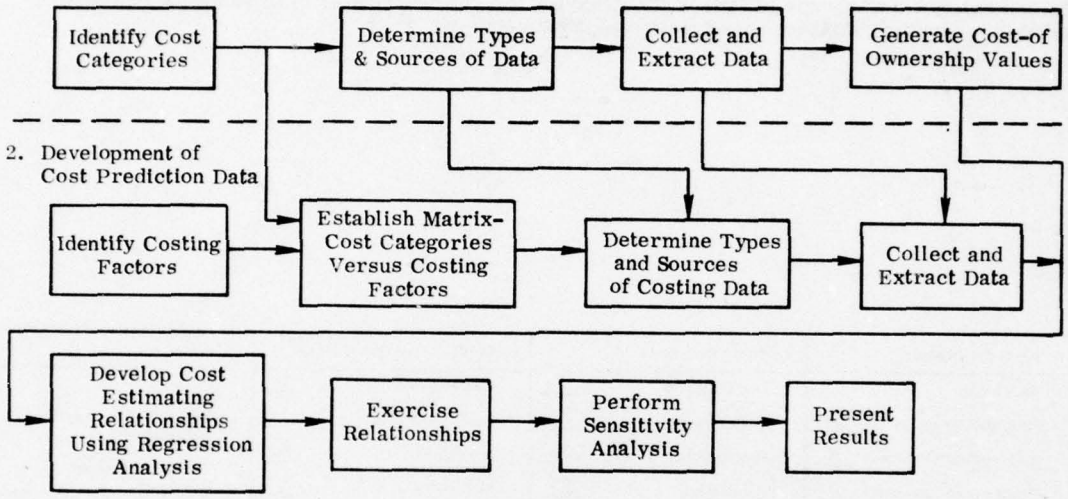
1. Development of Cost Estimating Relationships, Vol II, Pub 540-01-1-766, April 1967

2. Some Life-Cycle Cost Estimates for Electronics Equipments: Methods and Results, Pub. 4670-824, Sept. 1967

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
34 (Cont)	Development of Cost-Estimating Relationships (Cont)



Program for the Development of Cost Estimating Relationships

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
35	**Determination of Annualized Maintenance Cost for Ships**

3. Description

This procedure involves the collection of data and performance of calculations as necessary to compute the annual cost of maintenance for Navy ships. The specific categories of cost included in the calculation are summarized on the attached sheet. The procedure has been applied to selected destroyer classes (see ref. 1) incident to feasibility studies for extending their overhaul cycles.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance	X	Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**Maintenance Budgeting**
Hull Structure		Validation		**Maintenance Cost Analysis**
Propulsion		Development		**Maintenance Strategy Planning**
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **A Study to Determine the Annualized Maintenance Cost and Feasibility of Adopting an Extended Overhaul Cycle for Destroyer-Type Ships, Pub. 1024-01-1-1293, March 1974**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
35 (Cont)	Determination of Annualized Maintenance Cost for Ships (Cont)

ITEMS INCLUDED IN COMPUTATION OF ANNUALIZED MAINTENANCE COST

a. Overhaul Cost – That charged during overhaul for repair.

b. Ship's Force/Tender Material Cost – That expended by the ship's force/tender for material used in corrective maintenance.

c. Restricted Availability Cost – That expended by type commanders in restricted availabilities. Return costs (i.e., costs actually incurred versus costs paid by the TYCOMs) are used when available.

d. Technical Availability Cost – That expended by the TYCOMs in technical availabilities. Return costs are used when available.

e. Miscellaneous Technical Availability Cost – That expended by the TYCOMs for miscellaneous technical availabilities. Return costs are used when available.

f. In-Voyage Repair Cost – That expended by the TYCOMs for repairs incurred while ships are en route to an operational commitment. Return costs are used when available.

g. Ship Repair Facility Cost – That expended by CINCPACFLT in availabilities at the SRFs.

h. DATC Cost – That associated with the manpower expended by the Development and Training Center, as reported in the Maintenance Data Collection System.

i. Ship's Force/Tender Labor Cost – A fixed man-hour cost for the base year, which includes ship's force man-hours.

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
36	**Evaluating Feasibility of Extending Overhaul Interval**

3. Description

This procedure includes the steps necessary to evaluate the feasibility of extending the overhaul interval of ships. The steps in the procedure are described in ref. 1, para 3.3. The procedure has been used in evaluating the feasibility of extending the overhaul cycle for a variety of destroyers (see ref. 1).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		*Installation*		*Reliability*		Technique Applied One Time	
		Maintenance	X	Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**Maintenance Strategy Planning** **EOC Maintenance Management**
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **A Study to Determine the Annualized Maintenance Cost and Feasibility of Adopting an Extended Overhaul Cycle for Destroyer-Type Ships, Pub. 1024-01-1-1293, March 1974**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
37	**Extended Operating Cycle Program Planning**

3. Description

A technique for planning an Extended Operating Cycle (EOC) program is currently being developed and applied to the EOC program for DD-class ships. The approach consists of a definitive set of actions which include a variety of management tasks including: identification and scheduling of the program elements; defining resource requirements; identification of major milestones; formulation of a management program; and a number of supportive tasks.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	X	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	X
Engineering Procedure	___	Procurement	___	Availability	X		
Management Procedure	X	Installation	___	Reliability	X	Technique Applied One Time	___
		Maintenance	___	Maintainability	X	Technique Applied Recurrently	___
		Operation	___	None	___		
		Mgt/Tech Service	___				
		Modification	___				
		None	___				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**EOC Maintenance Management**
Hull Structure	___	Validation	___	
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___			
Outfit/Furnish.	___			
Armament	___			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **A Study to Determine the Annualized Maintenance Cost and Feasibility of Adopting an Extended Overhaul Cycle for Destroyer-Type Ships, Pub. 1024-01-1-1293, March 1974**

2. **Destroyer Extended Operating Cycle (EOC) Program Requirements, Pub. 1229-01-1-1358, Jan. 1975**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
38	Extended Operating Cycle Systems Analysis

3. Description

EOC systems analysis is an engineering process that evaluates the design and experience of a selected ship system and develops an overhaul maintenance plan for the item. Outputs of the process are compiled in an system maintenance plan, which contains:

a. A concise statement of the system maintenance concept

b. A summary of major maintenance actions, or maintenance profile (as illustrated in the attached Figure 1)

c. A detailed tabulation of maintenance requirements (as illustrated in Figure 2)

d. A statement of material condition standards

e. A description of material condition assessment requirements

The technique is applicable to any ship system/equipment.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability	X	Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	
Management Procedure		Installation		Reliability	X		
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Maintenance Engineering Analysis
Hull Structure	P	Validation	P	ROH Planning
Propulsion	P	Development	P	SFOMS
Electric Plant	P	Acquisition	P	Maintainability Prediction
Command & Surv.	X	Operation	X	Reliability Prediction
Auxiliaries	X			EOC Maintenance Management
Outfit/Furnish.	P			ROH Work Package Development
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. EOC Systems Analysis Process, Informal Report, Aug. 1975 (Copies available from Ships and Ordnance Division)

2. System Maintenance Plan for 12000 GPD Distilling System, FF-1052 Class, Informal Report, Aug. 1975 (Copies available from Ships and Ordnance Division)

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
38 (Cont)	**Extended Operating Cycle Systems Available (Cont)**

MAINTENANCE PROFILE — CLASS FF-1052 — [illegible]-26CX SONAR — SWBS 463_ — CONTROL NUMBER 4631-301 — PAGE NUMBER 1 OF 5

OPERATING PROFILE	QUARTER AFTER BOH	EQUIPMENT COMPONENT: SONAR SIGNAL PROCESSING AND RECEIVING AND TRANSDUCER	EQUIPMENT COMPONENT: SONAR DOME PRESSURIZATION	[illegible]ONAR POWER [illegible]PPLY	ANTICIPATED ON CONDITION MAINTENANCE, SONAR, DOME, LAPS	TOTAL MAINTENANCE BURDEN (Man-Hours unless noted otherwise)		
							HARD TIME	ESTIMATED CONDITIONAL
WORK-UP	1	S-W1-0-1 (X12) S-M1-0-1.2 (X2) S-M2-0-.2 (X2)	D-D1-0-.3 (X90) D-W1-0-1.6 (X12) D-M1-0-1.6 (X2) D-M2-0-1 (X2) D-M3-0-1 (X2) D-M4-0-1 (X2)	.1 (X2) 1.5 (X2) 1.2 (X2) .6 (X3)	S-R1-0-1 (X3) S-R2W-0-1 (X3) S-R3-0-.5 (X2)	ORG	77.6	7.0
	2	S-W1-0-1 (X13) S-M1-0-1.2 (X3) S-M2-0-.2 (X3) S-Q1R (a-j)-0-20.3 S-Q2R (a-c)-0-10.5 S-Q3-0-.4 S-Q4-0-3 S-Q5-0-8 S-Q6-0-24 S-Q7-0-4 S-Q8-0-2 S-Q9-0-2 S-Q10-0-9	D-D1-0-.3 (X90) D-W1-0-1.6 (X13) D-M1-0-1.6 (X3) D-M2-0-1 (X3) D-M3-0-1 (X3) D-M4-0-1 (X3) D-Q1-0-.8	-.1 (X3) 0-1.5 (X3) 0-1.2 (X3) 0-.6 (X4) 0-7 -6 .5	S-09-0-1 S-016-0-6 S-08-0-1 S-011-0-2 S-04-0-4.5 S-R1-0-1 (X8) S-R2W-0-1 (X12) S-R3-0-.5 (X4)	ORG	187.1	38.5
	3	S-W1-0-1 (X13) S-M1-0-1.2 (X3) S-M2-0-.2 (X3) S-Q1R (a-j)-0-20.3 S-Q2R (a-c)-0-10.5 S-Q3-0-.4 S-Q4-0-3 S-Q5-0-8 S-Q6-0-24 S-Q7-0-4 S-Q8-0-2 S-Q9-0-2 S-Q10-0-9 S-S1-0-.5 S-S2-0-.5 S-S3-0-1	D-D1-0-.3 (X90) D-W1-0-1.6 (X13) D-M1-0-1.6 (X3) D-M2-0-1 (X3) D-M3-0-1 (X3) D-M4-0-1 (X3) D-Q1-0-.8 D-S1-1-16	L- (X3) .5 (X3) 1.2 (X3) .6 (X2) -7 -6 0-.5 0-8 -1.6	S-09-0-1 S-010-0-4 S-017-0-4 S-012-0-4 S-08-0-1 S-011-0-1 S-04-0-4.5 S-013-0-10.5 S-R1-0-1 (X1) S-R2W-0-1 (X2) S-R3-0-.5 (X2)	ORG IMA	198.7 16.0	34.0
		S-W1-0-1 (X13) S-M1-0-1.2 (X3) S-M2-0-.2 (X3) S-Q1R (a-	D-D1-0-.3 (X90) D-W1-0-1.6 (X13) -0-1.6 (X3) (X3)	L-[illegible] (X3) L-[illegible] (X3) L-	S-09-0-1 (X2) S-014-0-8.4 S-011-0-2			

Figure 1. Example of Maintenance Profile Summary

Code	Maintenance Action	Condition Monitoring Action	Burden	Frequency	Condition Threshold
2.0.W.1	Turn pump by hand/power	None	0.1	Weekly	
2.0.M.1		Inspect packing gland adjustment	0.3	Monthly	
2.0.0.1	Renew packing	See Code 2.0.M.1	2.0	Conditional (Est: Semi-annually)	Accomplish when measured distance between packing gland and pump housing is less than 1/4 inch
2.0.S.1		Check shutoff head pressure	0.2	Semi-annually	
2.0.0.2	Inspect pump internals and replace worn parts	See Code 2.0.S.1	15.0	Conditional	Accomplish when shutoff head pressure measurement is less than 23 psig (75% of 30 psig)

Figure 2. Example of Maintenance Requirements Tabulation

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
39	**Class-Level Critical Equipment List Development**

3. Description

This technique consists of the development of a ship class-level ranked equipment list based on the following factors:

a. Maintenance burden

b. CASREPT frequency

c. Mission criticality

The objective of the technique is to provide visibility for establishing work priorities in the maintenance program. The technique is based on utilization of a variety of source data, including CASREPTs, MDCS, and baseline repair profiles. The technique has been applied to the FF-1052 class, with the results partially illustrated by the attached figure. The technique can be applied to any ship class for which source data are available.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**EOC Maintenance Management**
Hull Structure	X	Validation		**Maintainability Measurement**
Propulsion	X	Development		**Reliability Measurement**
Electric Plant	X	Acquisition		**ROH Planning**
Command & Surv.	X	Operation	X	**Ships Systems/Equipment Criticality Ranking**
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			
FF-1052	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **FF-1052 Class Critical Equipment List Development, Informal Report, Aug. 1975 (copies available from Ships and Ordnance Division)**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
39 (Cont)	Class-Level Critical Equipment List Development (Cont)

FF 1052 CLASS

CRITICAL EQUIPMENT LIST

MAINTENANCE BURDEN FACTOR ORDER

Equipment Nomenclature	SSDI	MBF Rank	Total MDCS	No. of CASREPTS	Overhaul Freq. %	Mission Critical
Main Boiler	2211	1	14.829	218	100	X
AN/WLR-1C (E.C.M.)	4721	2	2.389	155	100	X
Main Feed Pump	2551	3	3.387	106	90	X
ASROC Launcher	7211	4	2.525	102	90	X
SSTG Sets	3111	5	2.592	57	100	X
Forced Draft Blowers	2511	6	3.575	95	80	X
H.P. Air Compressor	5511	7	24.351	58	80	X
MK 19 Gyro	4262	8	1.991	57	90	X
AN/SQS-26CX Sonar	4631	9	11.882	133	70	X
EM. Diesel Gen. Sets	3111	9	2.190	95	80	X
AN/SRC-21 (Radio)	4414	11	1.881	67	80	X
Air Conditioning Unit	5142	12	1.938	43	90	X
Fire & Flushing Pumps	5211	13	6.003	149	60	X
AN/SRC-20 (Radio)	4414	14	1.219	51	90	X
AN/ULQ-6C (E.C.M.)	4711	15	2.405	172	60	X
AN/URT-23(V) Radio	4412	16	1.367	31	90	X
MK NC-2 Plotting Table	4264	16	1.186	47	90	X
AN/SPA-50A (Radar Range Ind.)	4111	16	1.065	82	80	X
Personnel Boat	5831	19	2.269	23	90	X
AN/SLA-15 Antenna	4711	20	.752	51	100	X
AN/URA-38 (Radio)	4411	21	.833	45	90	X
AN/SPS-40 (Radar)	4521	22	7.279	271	40	X
AN/SPS-10F (Radar)	4511	23	1.827	67	60	X
MK 53 Mod 0 Attack Console (MK 114 FCS)	4831	24	3 021	32	65	X
Gun 5"/54	7111	24	.419	222	90	X
AN/SPG-53 (GFCS Radar)	4811	26	5.723	160	40	X
AN/WLA-3A (Amplifier)	4721	27	1.259	20	80	X
Mn. Feed Booster Pump	2552	28	2.593	75	50	X
AN/UQN-4 (Sonar Xducer)	4241	29	.662	20	100	X
L.P. Air Compressor	5515	30	1.287	23	70	X
AN/SQS-26 Power Supply (LAPS)	4631	31	.904	35	75	X
AN/WRT-1A (Radio)	4412	32	1.019	30	70	X
AN/SPA-4 (Radar Range Ind.)	4111	33	1.240	17	70	X
Automatic Combustion Control	2212	34	.760	9	90	X
L.P. & H.P. Turbines	2311	35	1.854	46	40	X
AN/SPA-66 (Radar Ind.)	4111	35	1.052	55	50	X
BPDSMS	7212	37	11.580	81	0	X
MK 16 MOD 2 Stable Element	4811	38	.777	57	50	X
Prairie Masker Comp.	5517	39	1.312	39	40	X
Dead Reckoning Analyzer (DRA)	4263	40	1.488	67	25	X
MK 68 Mod 3 Gun Director	4811	41	1.230	24	50	X
SSTG Govs		41			70	X

Example of Class-Level Critical Equipment List

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
40	**Ship Class Baseline Repair Profile Development**

3. Description

This technique comprises the review of prior ROH history (i.e., SARP), analysis of data, and development of a summary listing of common repair items for a ship class. The objective of the listing is to identify recurrent repair items, and provide certain vital planning data (e.g., cost and manpower requirements) relative to these items. The procedure has been applied to the DDG-2 (see ref. 1) and other destroyer classes. The attached figure illustrates the format of the baseline repair profile.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	___
Engineering Procedure	X	Procurement	___	Availability	___		
Management Procedure	___	Installation	___	Reliability	X	Technique Applied One Time	___
_____	___	Maintenance	X	Maintainability	X	Technique Applied Recurrently	X
_____	___	Operation	___	None	___		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	___	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**ROH Planning**
Hull Structure	___	Validation	___	**ROH Work Package Development**
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	P	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
Destroyers	X	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Develop Baseline Ship Repair Profile for DDG-2 Class Ships, Sept. 1975. (No publication number; request copies by title and reference to work order 1227-01.)**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
40 (Cont)	**Ship Class Baseline Repair Profile Development (Cont)**

DDG-2 CLASS RECOMMENDED ROUTINE REPAIR ITEM

SWBS Group 500 Title Auxiliary Systems

Proposed SWLIN	Recommended Routine Repair Item Description	Quantity on Ship	MD (est. avg.)	Matl $ (est. avg.)	Assign	Justification for Recommendation
531A03A	Repair both distiller brine overboard pumps	2	40	950	SY	7 of 8 SARPs reviewed
531A04A	Repair both distiller salt water heater drain pumps	2	25	700	SY	5 of 8 SARPs reviewed
531A05A	Class "B" overhaul both distiller distillate pumps	2	40	400	SY	6 of 8 SARPs reviewed
533A01A	Repair both portable water pumps and associated priming pumps	2 each	60	1,150	SY	5 of 8 SARPs reviewed
534A01A	Repair H.P. drain system including, but not limited to (a) Class "B: overhaul relief and stop valves (b) Repair or replace piping	--	100	550	SY	5 of 8 SARPs reviewed
534A02A	Repair L.P. drain system including but not limited to: (a) Class "B" overhaul relief and stop valves (b) Repair or replace piping	--	260	3,400	SY	6 of 8 SARPs reviewed

Format of Baseline Repair Profile

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
41	**Preparation of Technical Repair Standards**

3. Description

This technique consists of engineering analysis and preparation of standards for repairing specific equipments, as identified by APL/CID No. A long range Navy objective is to develop TRSs for all maintenance-significant items.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**ROH Planning**
Hull Structure		Validation		**Maintenance Engineering Analysis**
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.	P	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	P			
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

Approximately 100 Technical Repair Standards for a variety of systems/equipments have been prepared by ARINC Research.

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
42	**Management Plan for Use in LOE Preparation**

3. Description

A management plan and milestones for use by ship's force in preparation for Light-Off Examination (LOE) was developed and applied in several destroyer-type ships, including DD, DDG, DLG, and DE. The plan outlines and describes a plan of action which includes the significant administrative, training, and material maintenance tasks essential to LOE preparation. The plan, while designed for application to destroyers having 1200-psi propulsion plants, is adaptable to other types of ships.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Light-Off Examination
Hull Structure		Validation		ROH Planning
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.		Operation	X	
Auxiliaries	X			
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Development of a Plan to Assist Ships in Preparing for the Propulsion Examination Board (PEB) Light-Off Examination (LOE), Pub. 1026-01-1-1291, Feb. 1974**
2. **DE-Type Management Plan and Program Outlines for Use in PEB/LOE Preparation, Pub. 1029-01-1-1311, July 1974**
3. **DD-Type Management Plan and Program Outlines for Use in PEB/LOE Preparation, 1230-01-1-1349, Jan. 1975**
4. **DDG-Type Management Plan and Program Outlines for Use in PEB/LOE Preparation, 1230-01-2-1350, Jan. 1975**
5. **DLG-Type Management Plan and Program Outlines for Use in PEB/LOE Preparation, Pub. 1230-01-2-1351, Jan. 1975**

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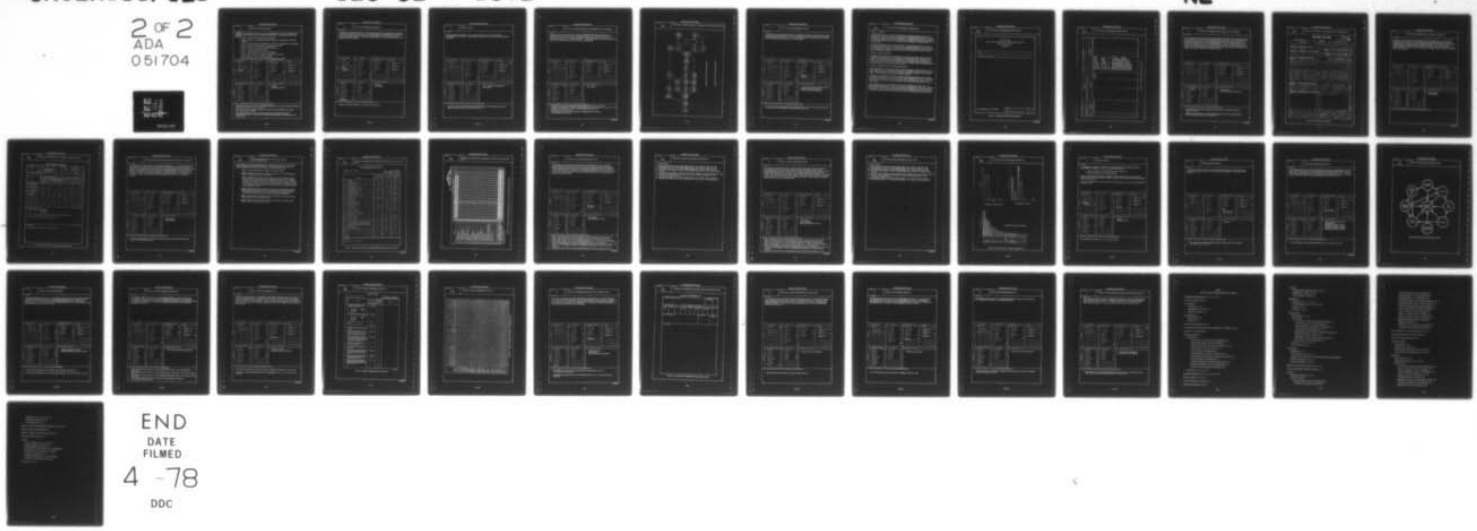

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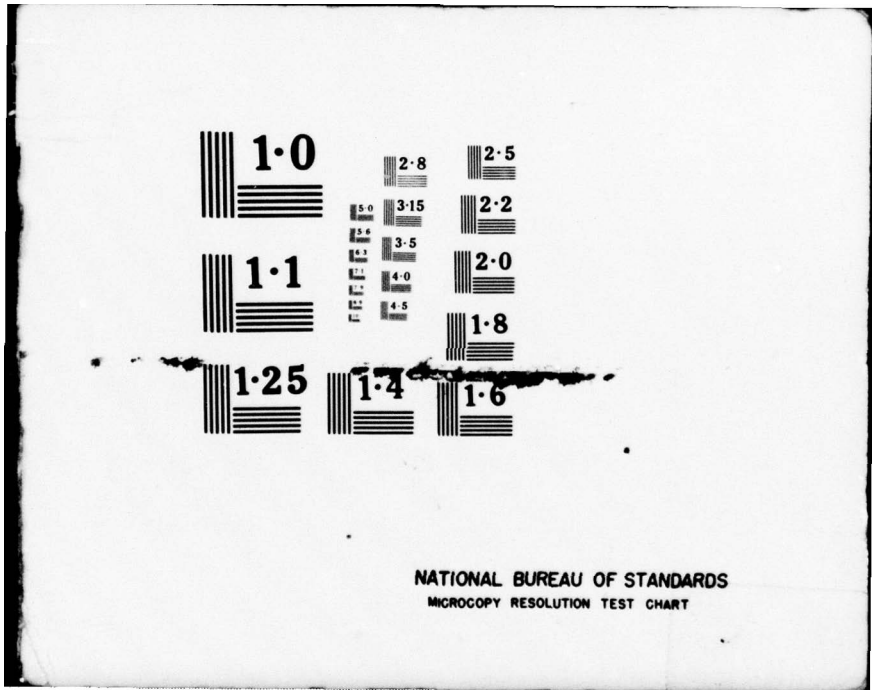
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NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
43	PEB/LOE Preparation Program

3. Description

A technique for providing assistance to ship's force in preparing for LOE has been developed and applied to a variety of destroyer ROH programs (see references). The program consists of the following:

a. Task 1: Assist SF in review of SARP for LOE items.

b. Task 2: Assist SF in establishing specific milestones for accomplishment of Plan and Outlines

c. Task 3: Review SFOMS data entry forms for LOE items, completeness, and correctness.

d. Task 4: Instruct SF in implementation and utilization of SFOMS.

e. Task 5: Instruct SF in data entry of SFOMS information.

f. Task 6: Provide weekly SFOMS reports.

g. Task 7: Provide assistance to SF in LOE preparation.

h. Task 8: Monitor progress in meeting LOE preparation milestones.

i. Task 9: Make revisions to the Plan and Outlines.

j. Task 10: Establish baseline for evaluation of the assistance program.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
Training	X	Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Training
Hull Structure		Validation		Light-Off Examination
Propulsion	X	Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. PEB/LOE Assistance Program for USS FRANCIS HAMMOND (DE-1067) and USS MARVIN SHIELDS (DE-1066), Pub. 1224-01-1-1416, June 1975

2. PEB/LOE Assistance Program for USS OUELLET (FF-1077) and USS SAMPLE (FF-1048), Pub. 1228-01-1-1426, July 1975

3. PEB/LOE Assistance Program for USS DECATUR (DDG-31) USS SOMERS (DDG-34), USS BUCHANAN (DDG-14), USS MORTON (DD-948) and USS RICHARD S. EDWARDS (DD-950); being prepared

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
44	Pre-Overhaul Training of Ship Personnel

3. Description

A procedure for indoctrinating ship's force personnel during initial ROH planning has been developed and applied to destroyer ROH programs. The procedure consists of briefing ship's force personnel using a script, slides, and handout material. Separate packages were developed for naval and commercial shipyard situations. The procedure, while specific to destroyer ROH programs, can be adapted for other types of ship.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
Training		Maintenance		Maintainability			
Procedure	X	Operation		None	X	Technique Applied Recurrently	X
		Mgt/Tech Service					
		Modification	X				
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Training
Hull Structure		Validation		ROH Planning
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				
Destroyers	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. Ship's Pre-Overhaul Briefing, Pub. 1226-01-1-1346, Jan. 1975

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
45	**Shipcheck Planning**

3. Description

Shipcheck planning encompasses a set of actions, listed in their order of recommended accomplishment, to be considered when planning a program of pre-overhaul material inspections/ shipchecks.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	X
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	___
Engineering Procedure	___	Procurement	___	Availability	___		
Management Procedure	X	Installation	___	Reliability	___	Technique Applied One Time	___
_____	___	Maintenance	___	Maintainability	___		
_____	___	Operation	___	None	X	Technique Applied Recurrently	___
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**Pre-Overhaul Test and Inspection**
Hull Structure	___	Validation	___	**ROH Planning**
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Guide for Overhaul Planning Term Accomplishment of Pre-Overhaul Material Inspections, Shipchecks and Tests, Pub. W3-006-TN02, Jan. 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
46	**ROH Advance Planning Using Network of Significant Activities/Milestones**

3. Description

An approach to ROH planning utilizing a network of planning activities has been developed and applied to various Service Force ships. The planning network, while varying from case to case, is of the general form illustrated by the attached figure. Specific applications of the generalized network can be found in ref. 4, appendixes A and B. These examples show how the illustrated planning network can be extended by inclusion of schedule and responsibility.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability			
		Operation		None	X	Technique Applied Recurrently	X
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**ROH Planning**
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

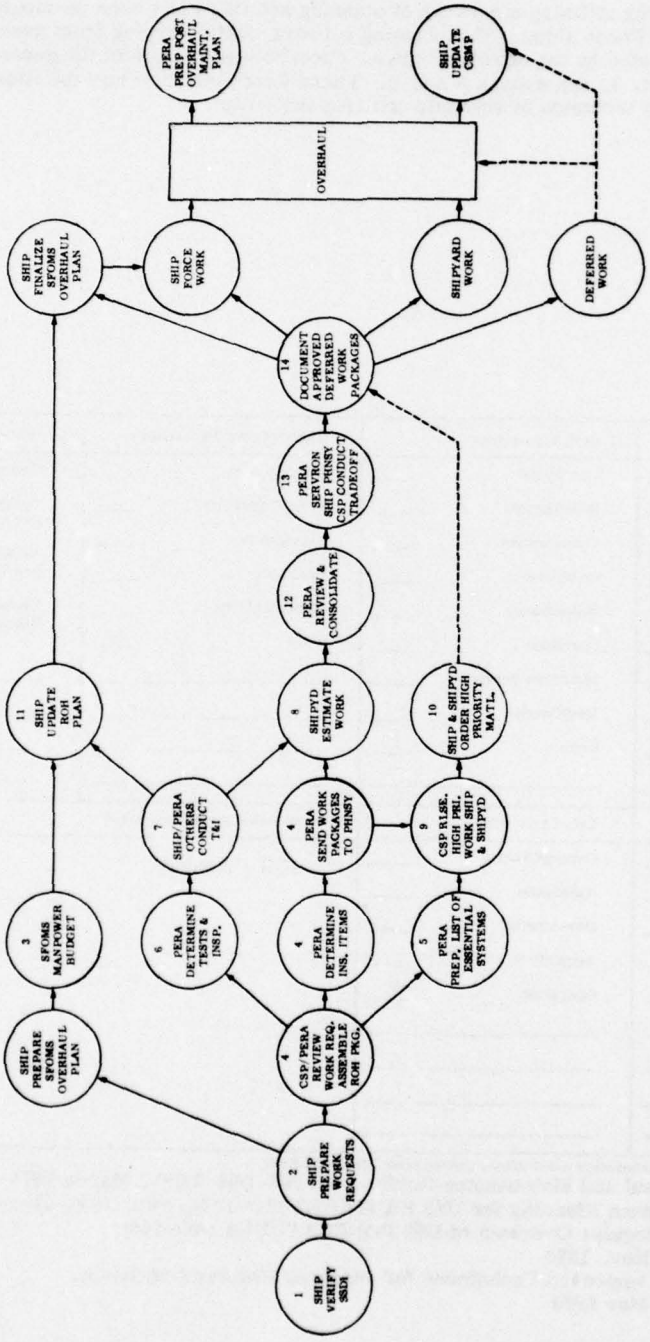
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. COMSERVPAC Overhaul and Maintenance Guide, Pub. W3-D06-TN07, March 1973
2. Overhaul and Maintenance Planning for USS KAWISHIWI (AO-146), Pub. 1600-01-1-1269, Dec. 1973
3. Analysis of FY 1974 Regular Overhaul of USS PONCHATOULA (AO-148), Pub 1605-01-1-1340, Nov. 1974
4. Recommendations for Improved Techniques for Planning Regular Overhauls, Pub. 626-32-3-1395, May 1975

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
46 (Cont)	ROH Advance Planning Using Network of Significant Activities/Milestones (Cont)



GENERAL TASK CHART, KAWISHIWI OVERHAUL PLANNING

General Form of ROH Planning Network

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
47	Pre-Overhaul Test and Inspection Procedure

3. Description

This technique is a three-phased procedure for conducting Pre-Overhaul Test and Inspection (POT&I) of shipboard systems/equipments. The procedure is described in the attached sheet, and applicable forms are illustrated in the attached figures. The POT&I procedure is illustrated in ref. 1 relative to the fire and tank cleaning system for AO-143 class ships.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	X
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service		Material			
		Modification		Condition	X		
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Pre-Overhaul Test and Inspection (POT&I)
Hull Structure	P	Validation		Material Condition Assessment
Propulsion	P	Development		ROH Work Package Development
Electric Plant	P	Acquisition	P	
Command & Surv.	P	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	P			
Armament	P			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. A Procedure for Determining Overhaul Work Requirements for Fire and Tank Cleaning System in Fire Room of AO-143 Class Ships, Pub. W3-006-TN01, Jan. 1973

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
47 (Cont)	Pre-Overhaul Test and Inspection Procedure (Cont)

PHASE I: CRITIQUE

The first phase of POT&I is a critique of the subsystem of interest with cognizant ship's force personnel. The critique will normally be performed by overhaul planning personnel from the overhaul activity or PERA responsible for putting together the overhaul repair package. The objective is to determine the general status of the subsystem and its interfaces, thus permitting the emphasis in more detailed inspections to be placed upon those areas suspected of requiring overhaul or extensive repair.

The critique will include 1) discussions of the condition of the subsystem with respect to past performance, operating hours, corrective and preventive maintenance performed, and isolated and recurring problems/malfunctions or failures; and 2) an attempt to establish if gradual deterioration has been taking place. Information obtained during these discussions is to be recorded on the Phase 1 data sheet (see Figure 1).

PHASE II: VISUAL INSPECTION

A systematic visual inspection will be performed, utilizing the Pre-Overhaul Test and Inspection Evaluation Form (see Figure 2) specifically tailored to the subsystem under investigation. This inspection will normally be performed by shipboard personnel as part of the overhaul planning process. If properly performed, the visual inspection will provide the status information needed for realistic evaluations of the need for partial or complete overhauls, and for estimating the cost of parts and man-hours required to perform the overhaul.

PHASE III: OPERATIONAL AND/OR SPECIALIZED TESTS

If the visual inspection conducted during Phase II indicates marginal or doubtful conditions as far as determining overhaul work requirements is concerned, operational or specialized tests will be conducted. These tests (Phase III) may require additional detailed test procedures, but will usually consist of observing normal operations and recording conditions.

The purposes of the Phase III tests are to 1) demonstrate the operating condition of the machinery and the nature of its defects, and 2) afford a means of judging the full extent of repairs or alterations necessary to improve efficiency, or to restore the system to a condition fit for further service. During these tests, those areas defined as marginal in the detailed visual inspection of Phase II will be reevaluated.

Where indicated, Phase III tests designed for each specific subsystem will be performed. The detailed inspection and testing for Phase III will consist of the performance of those major preventive maintenance actions that will either restore the equipment to satisfactory performance or indicate that complete overhaul or replacement is required. Results of the Phase III trials and tests will be incorporated in the applicable Remarks column of the Phase II POT&I Evaluation Form (Figure 2).

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
47 (Cont)	Pre-Overhaul Test and Inspection Procedure (Cont)

AO-143 CLASS

PRE-OVERHAUL SHIP CHECK, INSPECTIONS AND TESTS

PHASE I DATA SHEET

CRITIQUE

SHIP: _____

SYSTEM: _____

NOTES AND REMARKS: _____

(Use additional sheets if required)

Observer _____ Page ___

DATE _____ of ___

Figure 1. Example of POT&I Phase I Data Sheet

Continued

1. Item No. 47 (Cont)

2. Title: Pre-Overhaul Test and Inspection Procedure (Cont)

Ship: KAWISHIWI AO-146 Date: _____ System/Equipment: Fire and Flushing Pump

Observer: _____

Applicable Documents: AO 143-S4805-H123364-E, 635-D, 636-E, 637-E

Item No.	Nomenclature or Service	Ship's Part No.	Material List Mark No.	Location	Inspection Criteria/Notes	Inspected		Results/Remarks
						Yes	No	
10.0	Fire and flushing pump			Fireroom, hold, stbd.	1. Casing: Check for leaks around the casing flange, loose or stripped casing studs, general preservation. 2. Suction Nozzle: Check for leaks around flange, loose or stripped flange studs/nuts, general preservation. 3. Discharge Nozzle: Same as 2. 4. Bedplate support brackets and foundation (ship frame): Check rigidity of pump mounting. Look for worn, loose, stripped or corroded mounting bolts and brackets. Check ship frame for weakness caused by rust and corrosion. Perform MR F-17 (A-1) during this check, i.e., sound and tighten foundation bolts. Record in Remarks the general condition of preservation.			

Figure 2. Example of POT&I Evaluation Form

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
48	**Development of Standardized Work Requests for ATF/ARS Ships**

3. Description

A set of standardized work requests applicable to high recurrency jobs normally accomplished during regular overhaul of ATF/ARS ships was developed based on prior history. The objectives of the set is to increase the accuracy of certain key data items essential for ROH planning, and reduce the administrative burden of ship's force during ROH planning. The set consists of 225 items covering yard, tender, and ship's force work. The attached figure is a sample of the standardized work request. The package has been applied in ROH planning for an ATF class ship. While the package itself is limited in applicability to this one type of ship, the approach is considered applicable to ROH planning for any type of ship having a reasonable population.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	___
Engineering Procedure	X	Procurement	___	Availability	___		
Management Procedure	___	Installation	___	Reliability	___	Technique Applied One Time	X
_____	___	Maintenance	___	Maintainability	___	Technique Applied Recurrently	___
_____	___	Operation	___	None	X		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship (ATF/ARS)	X	Concept Form.	___	**ROH Planning** **ROH Work Packages Development**
Hull Structure	___	Validation	___	
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **ATF/ARS ROH Planning Study, informational briefing (copies available from Ships & Ordnance Division)**
2. **Regular Overhaul Work Book for ATF/ARS Type Ships, Oct. 1974, informal publication; copies available from Ships & Ordnance Division**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
48 (Cont)	Development of Standardized Work Requests for ATF/ARS Ships (Cont)

MAINTENANCE DATA FORM

CHECK ONE — MAINTENANCE ACTION: COMPL | DEFER | XXX

SHIP NAME HULL NUMBER / JOB CONTROL NUMBER

SECTION I

AS DISCOVERED INFORMATION

E M Ø 2 T 1 Ø C

SECTION II – COMPLETED ACTION

SECTION III – DEFERRAL ACTION PLANNING

3

SECTION IV – REMARKS/DESCRIPTION

INJURY BOARD USE

R E P C N D S C O O L E R

F O L L O W I N G C O N D I T I O N S R E Q U I R E

M N T N C E A C T I O N

X X X D I S A S S E M B L E C L E A N C O N D U C T

H Y D R O S T A T I C T E S T A N D A N D R E P A I

R / R E P L A C E D E F E C T I V E T U B E S / P A R T

S A N D P R E S E R V E X S H I P S F O R C E I

N S T A L L A N D T E S T

CONT SHEET

1ST CONTACT MAINT. MAN A | 2ND CONTACT SUPERVISOR NAME B | CO SIGNATURE C

SECTION V – FAILED PARTS/COMPONENT

SECTION VI – SUPPLEMENTARY INFORMATION

AVAILABLE ON BOARD YES NO

SHOP

EST # M

DOC # M

Sample of Standardized Work Request

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
49	**Scoping and Estimating Ship's Force Regular Overhaul Work**

3. Description

A procedure and a set of guidelines was developed as an aid to ship's force for (1) identifying key operations associated with recurring ship's force jobs, (2) estimating the manpower required to accomplish each key operation, and (3) scheduling key operations. The guidelines, consolidated into manual format, are specifically intended to support preparation of Ship's Force Overhaul Management System (SFOMS) input data for destroyer-type ships. However, the approach, and to a extent the guidelines, can apply to other types of ship. The attached figure illustrates the format and content of the guidelines.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	X
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**ROH Planning**
Hull Structure	X	Validation		**SFOMS Planning**
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
49 (Cont)	Scoping and Estimating Ship's Force Regular Overhaul Work (Cont)

SFOMS PLANNING GUIDELINES

1. ITEM NO.	2. TITLE	3. WBS	4. EIC
514-2	Long: Repair/Overhaul Air Conditioning Compressor Short: AIR COND CPRSR	514	T404
		5. ORIG. WK CNTR: EA	6. RECURRENCY: MED

7. APPLICABLE SHIP TYPE: DD _____ DDG X CG X FF _____ FFG _____

8. KEY OP	9. MANPOWER GUIDELINES				10. SCHEDULE GUIDELINES		
	ACCOMPL. WORK CENTER	ESTIMATED MANHOURS AVG.	LOWER LIMIT	UPPER LIMIT	CALENDAR TIME (WEEKS)	WHEN START	WHEN COMPLETE
A. REPL SHOCK MTS	EA	17	12	22	1	2Q	
or							
A. REPL OIL SEAL	EA	10			1	2Q	
or							
A. REPL VLV PLTS	EA	16			1	2Q	
or							
A. OVERHAUL	EA	74	48	100	3	2Q	

11. MATERIAL GUIDELINES

1. Material Required: Shock Mounts
   Oil Seals
   Valve Plates
2. Material requirements can usually be determined from maintenance manual.
3. Material ordering data can often be found in APL.

12. REMARKS

1. Manpower guidelines shown are for each compressor.

Format and Typical Content of SFOMS Planning Guidelines

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
50	**Estimating Nonindustrial Labor Requirements for Ship's Force During ROH**

3. Description

A procedure and associated guidelines for estimating nonindustrial (i.e., leave, administrative tasks, military duties, etc.) labor requirements for ship's force during ROH was developed for destroyer-type ships. The estimating factors were derived from review and analysis of prior ROH history. The purpose of the procedure is to assist ship's force in estimating the quantity of manpower that will be available during ROH for performance of maintenance. The attached figure 1 is a sample of the guidelines. A unique set of estimating factors was established for each type of work center and each type of ship. Figure 2 describes the procedure and shows the format to be used in making the estimates.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	X
Engineering Procedure	X	Procurement	___	Availability	___		
Management Procedure	___	Installation	___	Reliability	___	Technique Applied One Time	___
_____	___	Maintenance	___	Maintainability	___	Technique Applied Recurrently	___
_____	___	Operation	___	None	X		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Ship	X	Concept Form.	___	**ROH Planning**
Hull Structure	___	Validation	___	**SFOMS Planning**
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Guidelines for Estimating Ship's Force Non-Industrial Manpower Requirements During ROH, Pub. TN W5-1231-TN03, Aug. 1975.**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
50 (Cont)	Estimating Nonindustrial Labor Requirements for Ship's Force During ROH (Cont)

The procedure for estimating nonindustrial labor requirements for ship's force during regular overhaul comprises the six steps described below. The circled numbers (e.g., ①) in Figure 2 identify the specific blocks of information associated with each step.

a. Step 1 – Fill in ship name and hull number, work center, and date.

b. Step 2 – Identify each week (e.g., February 1, February 8, etc.), starting with the first and ending with the last week of the ROH.

c. Step 3 – Compute and record in line 27 the number of man-hours assigned for each week of the ROH. This is determined by multiplying the number of men assigned to the work center by the number of normal working hours in that week (i.e., exclusive of holidays). For example, if there are 10 men assigned to a work center, four work days in the week, and seven work hours per day, the number of man-hours available is 280. Appendix G of the manual identifies the normal number of workdays for each calendar week through 1980.

d. Step 4 – Estimate the number of man-hours required for each nonindustrial function. This quantity is based on the percentage of total manpower expected to be assigned for each function during each week. The guidelines contained in Appendixes A through E of the manual provide assistance in formulating these estimates.

e. Step 5 – Add the man-hours computed for lines 1 through 25, and enter the total nonindustrial manpower requirements in line 26.

f. Step 6 – Subtract line 26 from line 27 to determine the number of productive man-hours available during each week of the ROH.

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
50 (Cont)	**Estimating Nonindustrial Labor Requirements for Ship's Force During ROH (Cont)**

SFOMS ESTIMATING GUIDELINES FOR
NONINDUSTRIAL FUNCTIONS

Type(s) of Ship DDG

Work Center(s) (EB01, EB02) FIREROOM

Function	Percentage (%) of Assigned Manpower		
	Average	Lower	Upper
1. Leave	7	4	10.5
2. Military Watches	3.5	2	8
3. Fire Watches	3.5	0	8.5
4. Training (On-board)	6	1.5	14
5. Compartment Cleaning	4.5	1	10
6. Food Preparation	-	-	-
7. Administration	5	0	14.5
8. Supply Office/Storerooms	-	-	-
9. SOAP Team	3.5	0	8.5
10. Supervision	5	4	10
11. Personal Services	5	0.5	8.5
12. Working Parties	1	0	2
13. PMS/PMDO	4.5	0	15
14. School (Off-ship)	4.5	2.5	10.5
15. Cleanup (General)	-	-	-
16. Sick Bay (Hospitalmen)	-	-	-
17. Trouble Calls	1	0	2.5
18. Special Liberty	6	0	6.5
19. Mess Cooks	3	0	5
20. Offices (Ships/Post/Disbursing)	-	-	-
21. Laundry/Ships Store/Barber Shop*	-	-	-
22. Duty Driver	1	0	2
23. Shore Patrol/Brig	1	0	2
24.			
25.			
TOTAL	65		

Remarks:

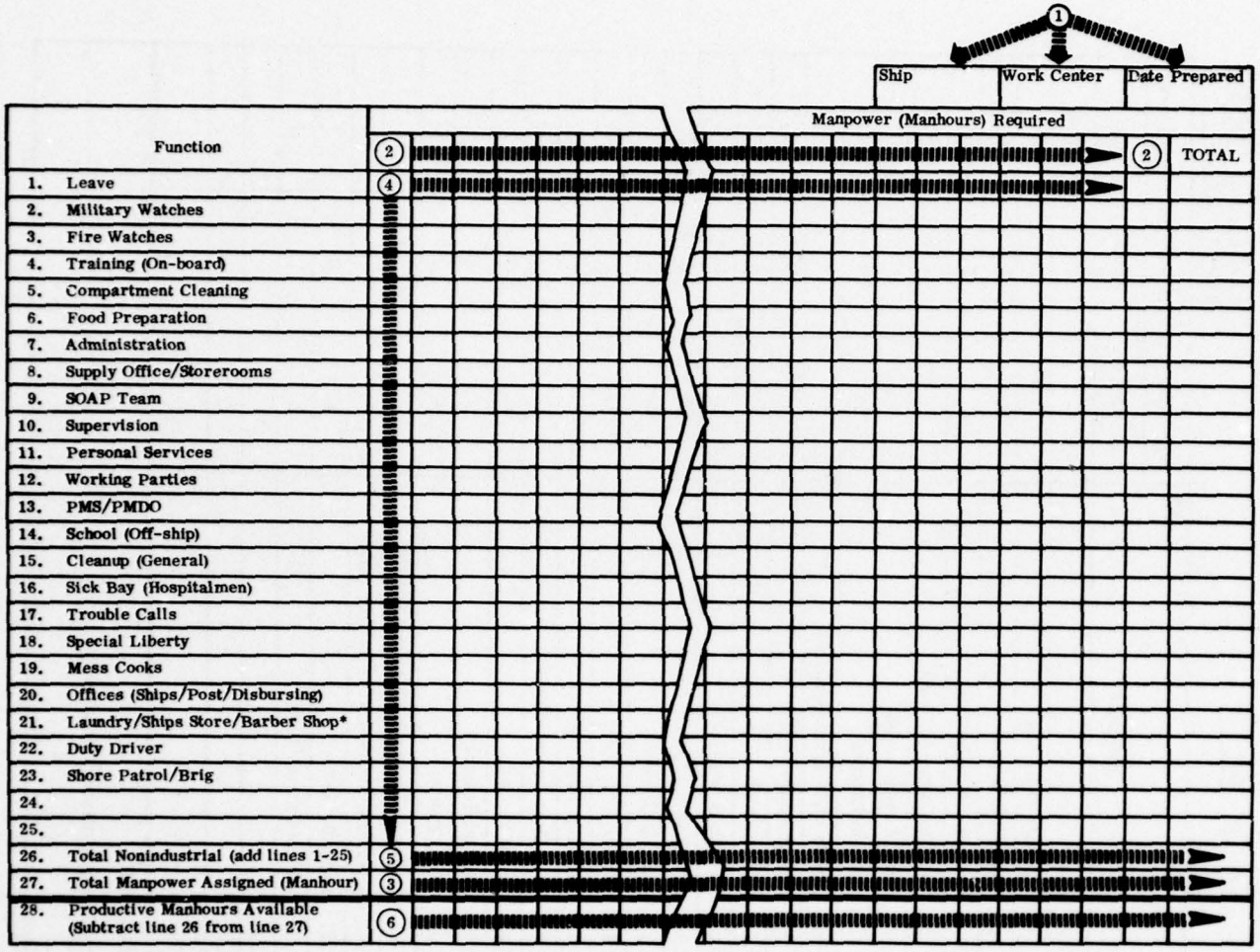
*Ships Servicemen functions.

Figure 1. Sample of Guidelines for Estimating Nonindustrial Labor Requirements

Continued

1. Item No. 50 (Cont)

2. Title Estimating Nonindustrial Labor Requirements for Ship's Force During ROH (Cont)



*Ships Servicemen functions.

Figure 2. Procedure for Estimating Nonindustrial Labor Requirements (See Discussion)

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
51	**Effectiveness Analysis of Ship Regular Overhaul**

3. Description

This technique involves tracking scheduled and actual accomplishment of regular overhaul to determine and assess effectiveness of the ROH in terms of schedule adherence, assessment of material condition problems encountered, and various other significant effectiveness parameters. Principal data sources used include the ROH work package generated by ship's force, departure reports, and other related documentation. The technique has been applied to a variety of AO, ATF, AE, AOG and ARS types of ships (see references), and resulted in sets of recommendations for application in subsequent ROHs.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service		ROH Effectiveness			
		Modification			X		
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**ROH Planning**
Hull Structure	X	Validation		**ROH Effectiveness Analysis**
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Study of USS MISPILLION (AO-105) 1970 Regular Overhaul, Pub. 693-01-1-1075, Sept. 1970**
2. **Study of USS VESUVIUS (AE-15) 1970 Regular Overhaul, Pub. 696-01-1-1092, Dec. 1970**
3. **Study of USS COCOPA (ATF-101) 1970-71 Regular Overhaul, Pub. D02-01-1-1109, April 1971**
4. **Study of USS CALIENTE (AO-53) 1971 Regular Overhaul, Vol. V, Pub. D03-01-1-1115, June 1971**
5. **Study of USS GENESEE (AOG-8) Regular Overhaul, Pub. D05-01-1-1122, July 1971**
6. **Overhaul and Maintenance Planning for USS KAWISHIWI (AO-106), Pub. 1600-01-1-1269, Dec. 1973**
7. **Analysis of FY 1974 Regular Overhaul of USS SAFEGUARD (ARS-25), Pub. 1609-01-1-1308, July 1974**
8. **USS MOLALA (ATF-106) Post Overhaul Analysis Report, Pub. 1020-01-1-1303C, Oct. 1974**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
51 (Cont)	Effectiveness Analysis of Ship Regular Overhaul (Cont)

References (Cont)

9. USS APACHE (ATF-67) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct, 1974
10. USS COCOPA (ATF-101) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct. 1974
11. USS QUAPAW (ATF-110) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct. 1974
12. Analysis of FY 1974 Regular Overhaul of USS PONCHATOULA (AO-148), Pub. 1605-01-1-1340, Nov. 1974
13. Analysis of FY 1974 Regular Overhaul of USS DELIVER (ARS-23), Pub. 1614-01-1-1337, Nov. 1974
14. Advanced Overhaul Planning for USS ABNAKI (ATF-96) and USS CHOWANOC (ATF-100), Pub. 1618-01-1-1354, Dec. 1974
15. USS GRAPPLE (ARS-7) Post-Overhaul Analysis Report, Pub. 1620-01-3-1375, Apirl 1975
16. USS BOLSTER (ARS-38) Post Overhaul Analysis Report, Pub. 1620-01-3-1375B, August 1975

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
52	Economic Analysis of Ship Regular Overhaul

3. Description

This technique entails post-ROH review of departure reports and related cost data, summarizing this information on the basis of SWBS/EIC, and analysis in consideration of factors such as accomplishing activity, priority and other factors. The purpose of the analysis is to identify and rank systems/equipments in terms of cost burden, and to compare estimated and actual costs. In a broader sense, an objective of the procedure is to accumulate a data bank of cost data that can be used to support more effective planning of future overhauls. The technique has been applied to a variety of overhauls involving AO, ATF, ARS, and AE types (see references). Typical results of an economic analysis of ROH are shown in the attached figure.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability		Technique Applied One Time	
Management Procedure		Installation		Reliability			
		Maintenance	X	Maintainability		Technique Applied Recurrently	X
		Operation		None	X		
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		ROH Planning
Hull Structure	X	Validation		ROH Cost Analysis
Propulsion	X	Development		Maintenance Manpower Analysis
Electric Plant	X	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.	X			
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. Study of USS MISPILLION (AO-105) 1970 Regular Overhaul, Pub. 693-01-1-1075, Sept. 1970
2. Study of USS VESUVIUS (AE-15) 1970 Regular Overhaul, Pub. 696-01-1-1092, Dec. 1970
3. Study of USS COCOPA (ATF-101) 1970-71 Regular Overhaul, Pub. D02-01-1-1109, April 1971
4. Study of USS CALIENTE (AO-53) 1971 Regular Overhaul, Vol. V, Pub. D03-01-1-1115, June 1971
5. Study of USS GENESEE (AOG-8) Regular Overhaul, Pub. D05-01-1-1122, July 1971
6. Overhaul and Maintenance Planning for USS KAWISHIWI (AO-106), Pub. 1600-01-1-1269, Dec. 1973
7. Analysis of FY 1974 Regular Overhaul of USS SAFEGUARD (ARS-25), Pub. 1609-01-1-1308, July 1974
8. USS MOLALA (ATF-106) Post Overhaul Analysis Report, Pub. 1020-01-1-1303C, Oct. 1974

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
52 (Cont)	Economic Analysis of Ship Regular Overhaul (Cont)

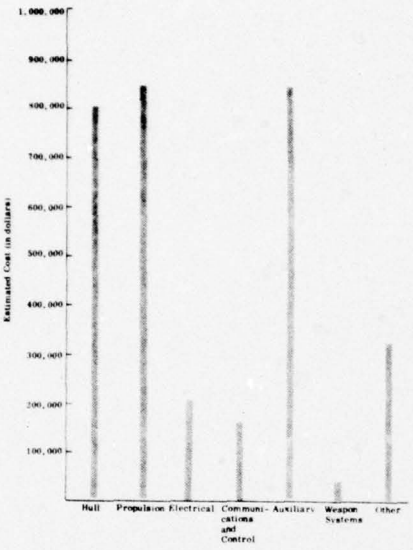
References (Cont)

9. USS APACHE (ATF-67) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct. 1974
10. USS COCOPA (ATF-101) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct. 1974
11. USS QUAPAW (ATF-110) Post Overhaul Analysis Report, Pub. 1020-01-1-1303, Oct. 1974
12. Analysis of FY 1974 Regular Overhaul of USS PONCHATOULA (AO-148), Pub. 1605-01-1-1340, Nov. 1974
13. Analysis of FY 1974 Regular Overhaul of USS DELIVER (ARS-23), Pub. 1614-01-1-1337, Nov. 1974
14. Advanced Overhaul Planning for USS ABNAKI (ATF-96) and USS CHOWANOC (ATF-100), Pub. 1618-01-1-1354, Dec. 1974
15. USS GRAPPLE (ARS-7) Post-Overhaul Analysis Report, Pub. 1620-01-3-1375, Apirl 1975
16. USS BOLSTER (ARS-38) Post Overhaul Analysis Report, Pub. 1620-01-3-1375B, August 1975

Continued

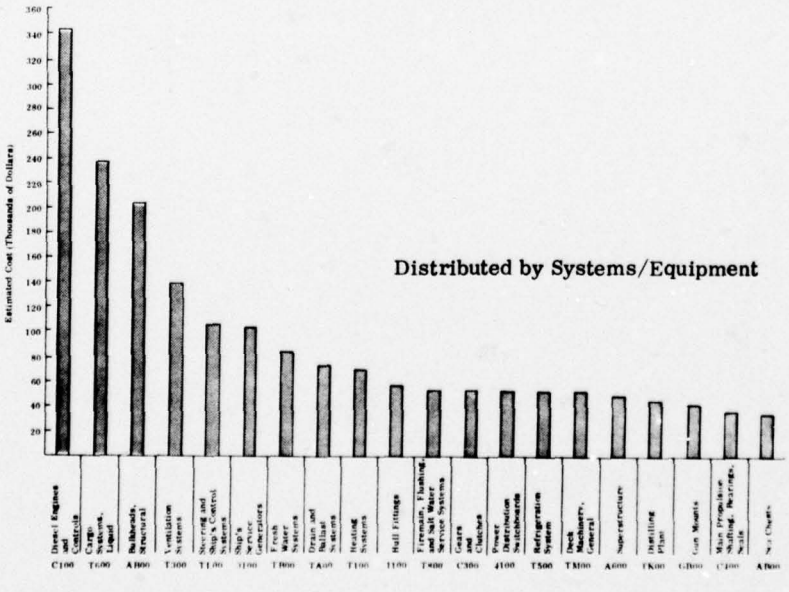
TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
52 (Cont)	Economic Analysis of Ship Regular Overhaul (Cont)



Distributed by Major System

Distributed by Priority



Distributed by Systems/Equipment

Sample Results of Analysis of Regular Overhaul Costs

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
53	EMC/EMI Instruction

3. Description

This technique is a two-part presentation of a course of instruction to shipboard personnel on electromagnetic compatibility. The two-part presentation consists of:

a. A general description of EMI and the four types of hazard, and

b. Means of detecting and reducing these factors.

Topics covered include electromagnetic interference (EMI), RF burn hazard, radiation hazard (RADHAZ), hazards of electromagnetic radiation to ordnance (HERO), and hazards of electromagnetic radiation to fuel (HERF).

The course of instruction was developed for Service Force ships; however, it is potentially applicable to any type of ship.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	X
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	
Training		Maintenance		Maintainability			
Procedure	X	Operation		None		Technique Applied Recurrently	
		Mgt/Tech Service		EMC/EMI	X		
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Training
Hull Structure		Validation		EMI/EMC Program
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. EMC Instructional Program, Vol. II, Pub. 1627-01-2-1410

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
54	**EMI-Susceptibility Evaluation**

3. Description

This procedure consists of an engineering investigation of the potential effects of EMI on the operation of electronic equipment. The procedure has been applied to a shipboard gun mount (see ref. 1).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability		Technique Applied One Time	X
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service		EMI			
		Modification		Susceptibility	X		
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**EMI/EMC**
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.	P	Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Final Report on the EMI-Susceptibility Evaluation of the Mark 45 Mod 0 Gun Mount, Pub. 978-03-5-1184, July 1972**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
55	Logistics Management Information System

3. Description

This technique includes a set of procedures, guidelines, forms, and formats designed to provide the inputs, analyses, and outputs essential to performance of Navy logistics management. While the technique was designed primarily to support the navy of the Republic of South Viet Nam, the general concepts are considered applicable to any moderately sized naval logistics program. The attached figure illustrates the logistics functions supported by the system described in ref. 1.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	X
Engineering Procedure	X	Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service		Logistic Support	X		
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		Logistics Management Program
Hull Structure		Validation		ROH Planning
Propulsion		Development		Maintenance Manpower Analysis
Electric Plant		Acquisition		Production Planning and Control
Command & Surv.		Operation	X	Maintenance Program Budgeting
Auxiliaries				Management Information System
Outfit/Furnish.				
Armament				

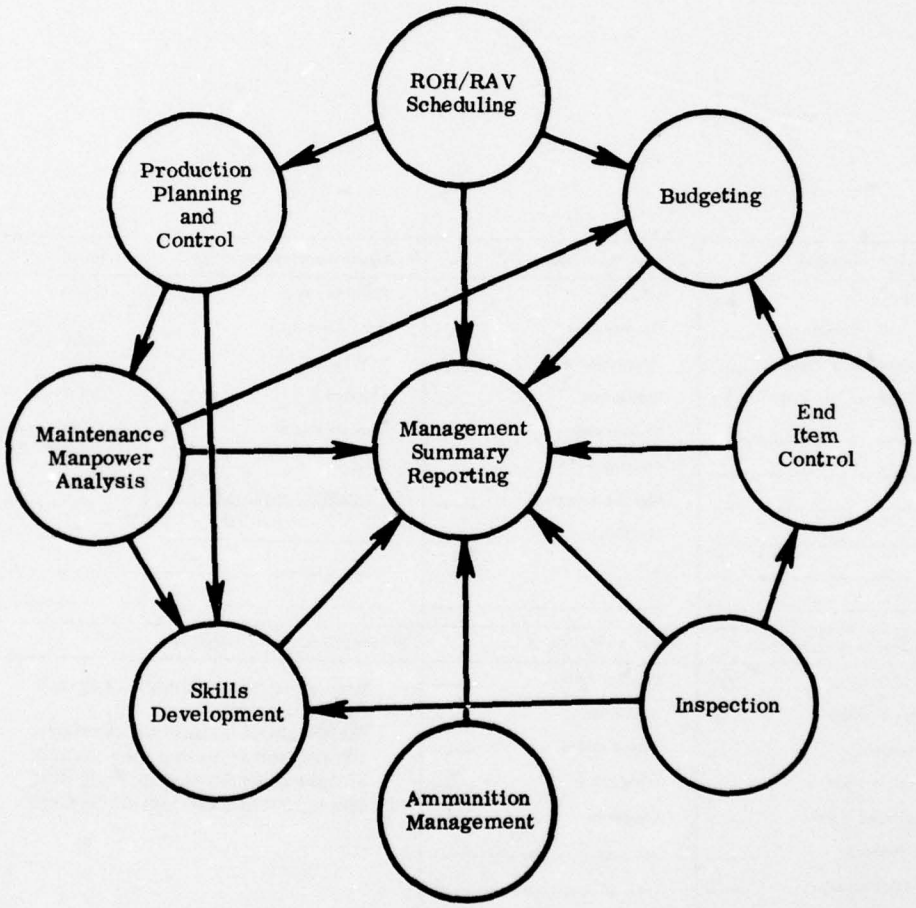
11. References (ARINC Research Corporation publications unless otherwise indicated)

1. Logistics Management Information System Manual, Vol. III, Pub. 1607-01-1-1283

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
55 (Cont)	Logistics Management Information System (Cont)



Interrelationship of Applications Supported by MIS

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
56	Logistic Management Data Program

3. Description

A Logistic Management Data Program is one designed to provide each of the several levels of program management with the information needed to make decisions concerning the ILS management function. Such a program, the CAPTOR Logistics Management Data Program (CLDMP), is described in references 1 and 2. The CLMDP includes a set of logistics data sources, an integrated data base, data analyis procedures, and a set of data products.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation	X	Reliability	X	Technique Applied One Time	X
		Maintenance	X	Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service	X				
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Logistics Management Program Logistics Management Information System
Hull Structure		Validation	X	
Propulsion		Development	X	
Electric Plant		Acquisition	X	
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. CAPTOR Logistic Management Data Program, Pub. 1125-05-3-1299, May 1974

2. CAPTOR Logistic Management Data Program Support Contract, Pub. 1125-26-4-1313, Aug. 1974

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
57	Equipment Procurement Specification Development

3. Description

This technique consists of the data collection and analysis necessary to prepare equipment-level requirements, quality assurance provisions, and supplemental data in the form of procurement specifications. The procurement specifications are prepared to standard military specification format. The technique has been applied to ship armament equipment (see references), and is generally applicable to any end item.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability	X	Technique Developed, Not Applied	
Engineering Procedure	X	Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	X
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		Procurement Specification Development
Hull Structure		Validation		
Propulsion	P	Development		
Electric Plant	P	Acquisition	X	
Command & Surv.	P	Operation		
Auxiliaries	P			
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. NOSC Procurement Specification for Dummy Director MK 10, Mod 0, Pub. 1621-04-3-1366, March 1975
2. NOSC Procurement Specification for Remote Optical Director EX 35 Mod 1, Pub. 1625-01-1-1430, Aug. 1975
3. NOSC Procurement Specification for 30 MM Machine Gun Mount EX 74 Mod 1, Pub. 1625-01-1-1431, Aug. 1975
4. NOSC Procurement Specification for Radar Gun Fire Control System EX 93 Mod 1, Pub. 1625-01-1-1432, Aug. 1975

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
58	**Conduct of Shipboard Habitability Survey**

3. Description

A procedure and associated set of 31 checklists for conducting a habitability survey of an AO-22 class ship was developed and applied. The checklists, while unique to AO-22 class ships, can be easily refined for applicability to other ship types. The purpose of the procedure is to determine habitability deficiencies relative to existing standards. Figure 1 is a sample of the habitability survey checklist. Figure 2 lists the complete set of checklists, and illustrates the type of shipboard spaces to which the checklists apply.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	___
Engineering Procedure	X	Procurement	___	Availability	___		
Management Procedure	___	Installation	___	Reliability	___	Technique Applied One Time	X
_____	___	Maintenance	___	Maintainability	___	Technique Applied Recurrently	___
_____	___	Operation	___	None	___		
_____	___	Mgt/Tech Service	___	**Habitability**	X	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.	___	**Habitability of Ships** **Material Condition Assessment**
Hull Structure	___	Validation	___	
Propulsion	___	Development	___	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	X	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	___	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **COMSERVPAC Habitability Improvement Program, COMSERVPACINST 9330.1, 25 Apr 1973**
2. **Procedure for Conducting Habitability Surveys of Existing Ships, Vol. II, Pub. D03-01-1-1115, June 1971**

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
58 (Cont)	Conduct of Shipboard Habitability Survey (Cont)

HABITABILITY SURVEY

Ship _____ Checklist No. 9

Space _____ Title Living Spaces, Crew's Berthing

Item No.	Standard	Source of Standard		Does Ship Comply With Standard		Remarks
		Doc.	Paragraph	Yes	No	
9-1	Gross area (total area less area of large ventilation and access trunks) should be in accordance with the following: Ship Length (ft) — Gross Area (sq ft) Less than 300 ft — 16 Over 300 ft — 18	1 2	¶ 2.b.(2) 5.b.(1)(a)			
9-2	Net area (deck area that can actually be walked on) should be in accordance with the following: Ship Length (ft) — Net Area (sq ft) Less than 300 ft — 6 Over 300 ft — 7	1 2	¶ 2.b.(2) 5.b.(1)(a)			
9-3	Berths should be installed in fore and aft position.	1	¶ 2.c.(1)			
9-4	Tiers should not be more than 3 high.	1 2	¶ 2.c.(1) 5.b.(3)(a)			
9-5	Berths should be of the type shown in Dwg 805-1409485 with 3-in. mattresses (locker-under-bunk type).	1	¶ 2.c.(1)			
9-6	The clear vertical distance above mattresses should be not less than 18 inches on ships under 300 ft; not less than 20 inches on ships over 300 ft. Bottom of lower berth mattress should be at least 6 inches above the deck.	1 2	¶ 2.c.(3) 5.b.(3)(a)			
9-7	Adjacent tiers separated by a privacy divider from 7 in. above deck to 21 in. above frame of top berth (per NAVSHIPS Dwg 805-1646044). Divider extends from frame at head of berth to minimum of 36 in. Partitions at end should be in accordance with Dwg 805-2214469.	1 2	¶ 2.c.(4) 5.b.(3)(a)			
9-8	In living spaces located adjacent to noisy spaces, berths should be located as remotely as possible from noise source.	1	¶ 2.c.(5)			
9-9	Access should provide for free movement of men within space, with a minimum of men passing berth.	1	¶ 2.d.(1)			
9-10	Where practicable, crew berths should not be installed more than 2 tiers in tandem without a 24 in. athwartship passage at one end (not applicable for berths at longitudinal boundaries of space).	1 2	¶ 2.d.(1) 5.b.(3)(a)			
9-11	Access to berths from main passage should be avoided where possible. Lockers or partial lightweight joiner partitions should be used to shield berthed men from traffic.	1 2	¶ 2.d.(2) 5.b.(3)(a)			
9-12	Berths should be located as far from access ladders as possible. Recreation facilities should be located near access and lockers and partitions used as means of separation between recreation area and berths.	1	¶ 2.d.(3)			

Sheet 1 of 2

Figure 1. Sample of Habitability Survey Checklist

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
58 (Cont)	Conduct of Shipboard Habitability Survey (Cont)

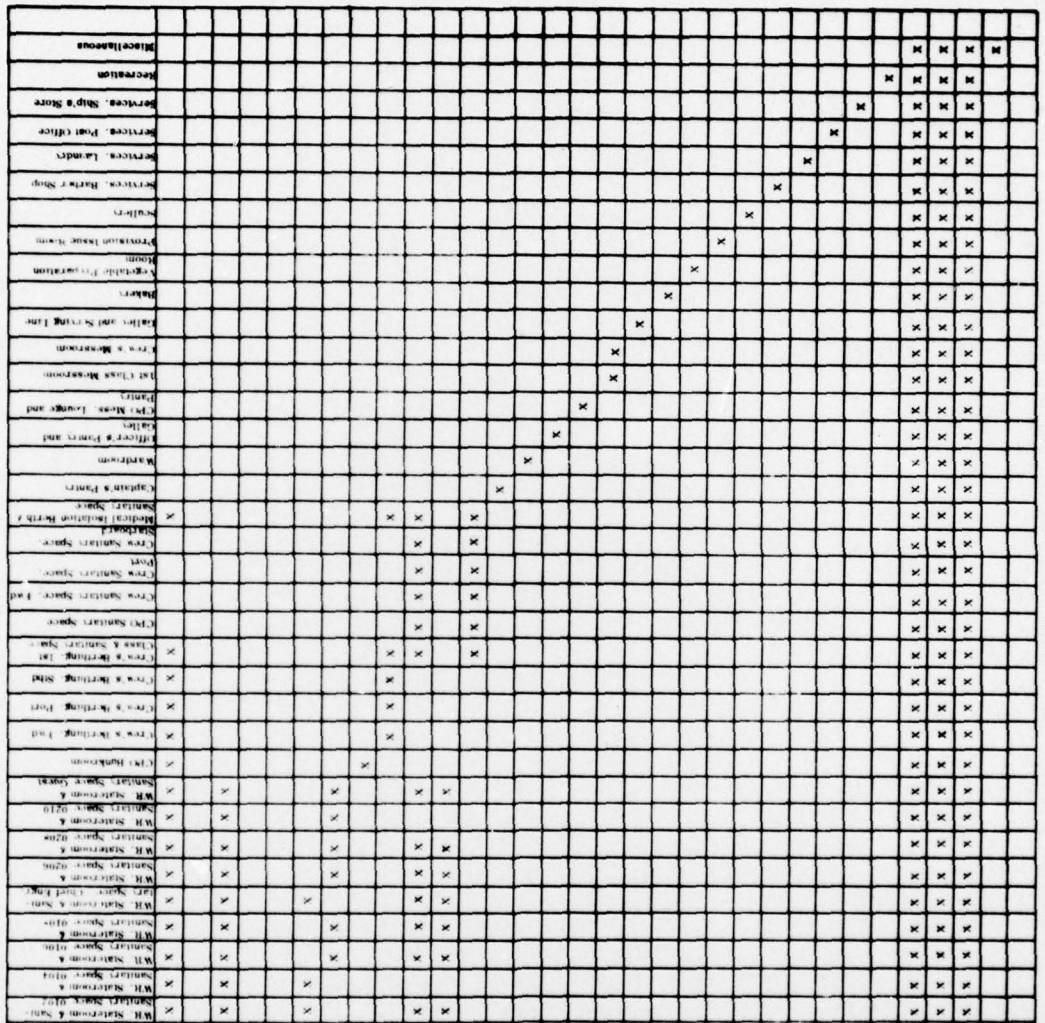


Figure 2. Matrix of Available Checklists for Habitability Survey

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
59	Development of Habitability Improvement Plans for Ships/Classes

3. Description

A procedure for developing class/ship Habitability Improvement Plans was developed and applied. The procedure consists of identifying a set of improvement projects based on conduct of a habitability survey (see item 58), and compiling descriptive, priority, schedule, responsibility and interface data using the format illustrated in the attached figure. The procedure, which has been applied to an AO-22 class ship, is applicable to any type of ship.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	*Installation*		Reliability		Technique Applied One Time	X
		Maintenance	X	Maintainability		*Technique* Applied Recurrently	
		Operation		None			
		Mgt/Tech Service		Habitability	X		
		Modification	X				
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		Habitability of Ships ROH Planning ROH Work Package Development
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition		
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament				
AO-22	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. Habitability Improvement Plan for Pacific Fleet AO-22 Class Ships, Vol. III, Pub. D03-01-1-1115, June 1971

2. Habitability Improvement Plan for USS CALIENTE (AO-53), Vol. IV, Pub. D03-01-1-1115, June 1971

Continued

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
59 (Cont)	Development of Habitability Improvement Plans for Ships/Classes (Cont)

HABITABILITY IMPROVEMENT ITEM

1. Habitability Item Number and Title								2. Applicable Class/Ship	3. Priority
4. Accomplishing Activity			**5. When to Accomplish**			**6. Estimates**			
Ship Force	Tender	Shipyard	Any Upkeep	ROH	Rehab	Prod. (M-D)	Prod. ($)	Design Services	Material	Total Cost

7. Interfaces/Constraints	8. References	9. Applicable Spaces

10. Description

Format for Compiling Data for Habitability Improvement Program

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
60	**Determination of Spare Parts Inventory for Weapon System**

3. Description

This technique consists of the calculation of spare parts requirements for a given shipboard weapon system, based on a given maintenance scenario. The technique is based on calculation of spare parts requirements in terms of either usage or failure rates, as appropriate. The technique was applied in calculation of a 2-year spares inventory requirement for a fleet of coastal patrol and interdiction craft (see ref. 1).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	
Computer Program	X	Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure		Installation		Reliability	X	Technique Applied One Time	X
		Maintenance	X	Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None					

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship		Concept Form.		**Spares Inventory Determination**
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition	X	
Command & Surv.		Operation	X	
Auxiliaries				
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Spare Parts Inventory Listing, Pub. 1625-01-2-1390, June 1975.**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
61	Logistic Support Planning for Ship Class

3. Description

This technique entails the development of a Logistic Support Plan (LSP) for a small ship class. The plan describes the actions that must be taken by appropriate authorities during the ship acquisition phase to ensure that all ships of the class are properly supported in all logistic areas after delivery. Ref. 1 illustrates an LSP developed for the T-ATF 166 class.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model		Life Cycle		Effectiveness		Concept	
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability			
Management Procedure	X	Installation		Reliability		Technique Applied One Time	X
		Maintenance		Maintainability		Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service		Logistics	X		
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		Logistic Support Planning
Hull Structure		Validation		
Propulsion		Development		
Electric Plant		Acquisition	X	
Command & Surv.		Operation		
Auxiliaries				
Outfit/Furnish.				
Armament				

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. T-ATF 166 Class Logistic Support Plan, Pub. 1092-01-1-1359, Jan. 1975

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
62	Specific Operational Requirement Review

3. Description

This technique consists of the review of a Specific Operational Requirements (SOR) document. Ref. 1 illustrates this technique for a shipboard gun system.

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	___	Life Cycle	___	Effectiveness	___	Concept	___
Computer Program	___	Development	___	Perf. Capability	___	Technique Developed, Not Applied	___
Engineering Procedure	___	Procurement	___	Availability	___		
Management Procedure	X	Installation	___	Reliability	___	Technique Applied One Time	X
_____	___	Maintenance	___	Maintainability	___	Technique Applied Recurrently	___
_____	___	Operation	___	None	X		
_____	___	Mgt/Tech Service	___	_____	___	_____	___
_____	___	Modification	___	_____	___	_____	___
_____	___	None	X	_____	___	_____	___
_____	___	_____	___	_____	___	_____	___

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	___	Concept Form.	___	**Specific Operational Requirements**
Hull Structure	___	Validation	___	
Propulsion	___	Development	X	
Electric Plant	___	Acquisition	___	
Command & Surv.	___	Operation	___	
Auxiliaries	___	_____	___	
Outfit/Furnish.	___	_____	___	
Armament	X	_____	___	
_____	___	_____	___	

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Review and Critique of Draft SOR 12-04R3 for the 5"/54 Caliber Mark 45 Mod 0 Gun Mount, Pub. 978-20-9-1260, July 1973**

TECHNIQUE DESCRIPTION SHEET

1. Item No.	2. Title
63	**Analysis of Relationships Between Mission Requirements and ROH Cycle**

3. Description

This technique involves the analysis of a ship's ability to perform a variety of mission categories (ASW, AAW, etc.) based on a number of significant variables such as equipment reliability and maintainability cruise duration, etc. The technique consists of a simulation model based on generic inputs and outputs. A preliminary model has been developed (see reference 1).

DESIGN

4. Type of Technique		5. Cost Parameters		6. Effectiveness Parameters		7. Status	
Math Model	X	Life Cycle		Effectiveness		Concept	X
Computer Program		Development		Perf. Capability		Technique Developed, Not Applied	
Engineering Procedure		Procurement		Availability	X		
Management Procedure		Installation		Reliability	X	Technique Applied One Time	
		Maintenance		Maintainability	X	Technique Applied Recurrently	
		Operation		None			
		Mgt/Tech Service					
		Modification					
		None	X				

APPLICATION

8. Type of System/Equipment		9. Life Cycle Phase		10. Functional Areas Supported
Total Ship	X	Concept Form.		**EOC Maintenance Management**
Hull Structure		Validation		**Maintenance Strategy Planning**
Propulsion	X	Development		
Electric Plant	X	Acquisition		
Command & Surv.	X	Operation	X	
Auxiliaries	X			
Outfit/Furnish.				
Armament	X			

11. References (ARINC Research Corporation publications unless otherwise indicated)

1. **Development of a Preliminary Simulation Model for Relating Mission Requirements to ROH Cycle, Letter Report #1 to Contract N00140-73-D-0074, June 1973**

INDEX

(By Technique Description Sheet Item Number)