STRUCTURED ANALYSIS
LSA TASK 303
EVALUATION OF ALTERNATIVES & TRADE-OFF ANALYSIS

SUBTASK 303.2.7
LEVEL OF REPAIR ANALYSIS

APJ 966-210

APJ

MILITARY & SCIENTIFIC RESEARCH

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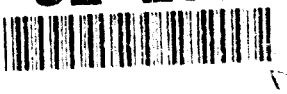

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report is one of a series presenting the Structured Analysis for the Logistic Support Analysis (LSA) Task and the Integrated Logistic Support (ILS) Element. Included is the System Analysis for the LSA Subtask 303.2.7, "Repair Level Analysis (RLA)" (sometimes referred to as "Level Of Repair Analysis (LORA)"), with the corresponding description of the processes, data flows, data stores, external entities involved on each. An overview of the Structured Analysis and its place in the overall systems development process, is also presented, as well as a guide to the overall RLA process of the LSA Task analysis procedures, and a brief working description of the Structured Systems Analysis fundamentals.

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APJ 966-210

STRUCTURED ANALYSIS
LSA TASK 303
EVALUATION OF ALTERNATIVES
& TRADE-OFF ANALYSIS

SUBTASK 303.2.7
LEVEL OF REPAIR ANALYSIS

under

CONTRACT DAAA21-86-D-0025

for

HQ, US AMCCOM
INTEGRATED LOGISTIC SUPPORT OFFICE
AMSMC-LSP
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FOREWORD

APJ, under contract to HQs, AMCCOM, has initiated the automation of the LSA Tasks (MIL-STD-1388-1) and the assessment of the ILS elements (AR 700-127). A major goal is to unify military and contractor approach to the performance of ILS and LSA.

Detailed to meet all requirements of ILS and LSA, the automated process will continue to provide the flexibility in selecting tasks and elements to be addressed at each life cycle stage. A major advantage of this approach is to insure that application of each task element is consistent with prescribed Army policies and procedures.

This report is one of a series presenting the Structured Analysis of each LSA Task and ILS Element. Structured Analysis comprises a description of the process being automated in terms which facilitate system design and subsequent programming. It is increasingly the preferred approach in both industry and Government.

This Technical Note reports on the Data Flow Diagrams (DFDs) of LSA Task 303.2.7, "Repair Level Analysis (RLA)" (sometimes referred to as "Level Of Repair Analysis (LORA)") and provides definitions of the processes, data flows, data stores, and external entities involved on each DFD (Annexes A and B). The report provides an overview of the LSA Task analysis procedures and a guide to the overall RLA process.

To view this work in context, this report also presents a brief overview of Structured Analysis and its place in the overall systems development process. Additionally, Annex C provides a brief working description of the Structured Systems Analysis fundamentals. The overview and certain portions of the introductory text are repeated verbatim in every report in this series so that each one can stand alone.

STRUCTURED ANALYSIS - LSA SUBTASK 303.2.7
RAPAIR LEVEL ANALYSIS

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STRUCTURED ANALYSIS - LSA SUBTASK 303.2.7

RAPAIR LEVEL ANALYSIS

INTRODUCTION

PURPOSE

The purpose of this report series is to present the results of the APJ efforts under Contract DAAA21-86-D-0025 for coordination with the AMCCOM Program Manager prior to in-depth structured design of ILS and LSA functions and processes. "Repair Level Analysis (RLA)" (LSA Subtask 303.2.7) is addressed in this report.

BACKGROUND

The Department of the Army has a requirement for management control over contractor and Government agency response to the requirements of AR 700-127, "Integrated Logistic Support", and MIL-STD-1388-1, "Logistic Support Analysis". HQs AMCCOM has initiated action to structure each of the LSA tasks, the assessment of each ILS element, the form of the results, and the detailed processes to insure consistency with current Army policies, procedures, and techniques.

This approach (undertaken by AMCCOM and APJ) will insure uniformity in efforts and products, reproducibility of analyses, and a well-defined structure which can be coordinated among all participants in the logistic process to arrive at common understanding and procedures.

SCOPE

This report summarizes the results of the Structured/Analysis of the Repair Level Analysis (RLA), LSA Subtask 303.2.7 and presents the associated Data Flow Diagrams (DFDs) developed from the Structured Analysis. The portions of the Data Dictionary relating to labels, names, descriptions, processes, data flows, data stores, and external entities are included in their present degree of completeness. (The Data Dictionary is a "living document" that evolves through the analysis and design process).

To place this work in context, this report presents a brief overview of Structured Analysis and its place in the overall systems design process to assist the reader who may not be fully briefed on the symbols and conventions used. It is supported by Annex C, which defines each element in structured analysis, and a glossary.

LSA SUBTASK 303.2.7 DESCRIPTION

LSA Subtask 303.2.7 concerns the development of a Repair Level Analysis (RLA) for a specific equipment or system and all of its major assemblies, subassemblies, and parts.

The Repair Level Analysis (RLA) is a decision-making process which determines the most cost-effective actions dealing with a failed item. The decisions that are required include whether to repair the failed equipment, assembles, subassemblies, or parts or to discard them and purchase replacements. If the decision is to repair, then a further decision must be made regarding the echelon at which each maintenance function should be performed.

To assist in making these decisions, two computer programs have been made available: The Interactive Palman Model (IPM) and the Optimum Supply And Maintenance Model (OSAMM).

The Palman Model evaluates the breakeven purchase cost between a repair and discard concept. The program calculates the breakeven point based on various cost factors impacted by the range of expected deployments. If the actual or expected cost of procuring an item exceeds the model output, the assembly is considered a candidate for repair; if the procuring cost is less, then discard should be considered.

The evaluation performed by the model provides the analyst with the following:

- A table of values for breakeven cost vs. number of end items
- An analysis of repair policy cost per failure with breakdown of the elements and their percentage contribution to the overall cost (reveals cost "drivers")
- A sensitivity analysis to isolate critical, significantly impacting decision variables.

The OSAMM aids in determining at which maintenance level (organization, intermediate forward, intermediate rear, or depot) various repair actions should be performed. The two major factors influencing the repair level decision are maintenance and supply requirements. Maintenance requirements include test equipments and specially trained repairmen that must be deployed to support repair. Supply is concerned with the placement of spares in the field to achieve the operational readiness objective. The OSAMM determines the optimal maintenance/support task distribution.

The RLA task definitions from MIL-STD 1388-1A are presented as Annex A.

APPROACH

The APJ approach to structured design of the LSA is:

1. Scope the process defined in MIL-STD-1388-1A in the context of the other LSA tasks.

2. Review the guidance provided in AMC PAM 700-11, "Logistics Support Analysis Review Team Guide".

3. Review the applicable Data Item Descriptions (DIDs) from the Acquisition Management Systems and Data Requirements Control List (AMSDL) published by the Department of Defense.

4. Review all source documents referenced in the AMSDL as applicable to the referenced DIDs of interest.

5. Apply staff experience in logistics support analysis to assure that the intent of the task has been addressed.

6. Validate results in discussions with Army activities and personnel directly involved in the applicable or related LSA tasks.

The Structured Analysis and preparation of Data Flow Diagrams (DFDs) were further assisted by the application of Structured Analysis software. Licensed by Index Technology Corporation, Excelerator provides for automated tracking of names, labels, descriptions, multiple levels of detail in the data flow diagrams, and industry standards in symbols and diagramming practices.

Following completion of the draft DFDs, the diagrams and data dictionary were made available to working Army logisticians currently (or recently) directly involved in the

application of the same LSA tasks in current Army development programs. Comments were solicited relative to the logic of the processes described, the scope and details of the indicated approaches, and the outputs implied by the LSA task requirements.

Draft products were well received by the external reviewers, and requests have been made for copies of the DFDs for in-house use in organizing ILS and LSA efforts. Comment was also received that the DFDs will be a useful training tool for apprentice logisticians, since they provide an overall picture of the total task and a uniform approach to its fulfillment.

STRUCTURED ANALYSIS AND DESIGN

Structured Analysis and Structured Systems Design evolved from the need to define and demonstrate the underlying logical functions and requirements of large systems. The concept of Structured Analysis involves building a logical (non-physical) model of a system, using graphic techniques which enable users, analysts, and designers to get a clear and common picture of the system and how its parts fit together to meet the user's needs. It is followed by structured design, and then by programming, and test and validation. Annex C provides a brief description and guide to the fundamentals of a Structured Systems Analysis.

The Structured Analysis and Structured Systems Design process, sometimes referred to as "Structured Systems Analysis and Design (SSAD)", is well documented and widely utilized in Government and industry.

As stated in "The Practical Guide to Structured Systems Design" (Meilir Page-Jones, Prentice-Hall, Englewood Cliffs, NJ, 1980):

..."Structured Design is disciplined approach to computer system design, an activity that in the past has been notoriously haphazard and fraught with problems.

"1. Structured Design allows the form of the problem to guide the form of the solution.

"2. Structured Design seeks to conquer the complexity of large systems by means of partitioning the system into "black boxes," and by organizing the black boxes into hierarchies suitable for computer implementation.

"3. Structured Design uses tools, especially graphic ones, to render systems readily understandable.

"4. Structured Design offers a set of strategies for developing a design solution from a well defined statement of a problem.

"5. Structured Design offers a set of criteria for evaluating the quality of a given design solution with respect to the problem to be solved.

"Structured Design produces systems that are easy to understand, reliable, flexible, long lasting, smoothly developed, and efficient to operate - and that WORK...."

The organization of Structured Analysis and its relationship to Structured System Design is shown on Figure 1.

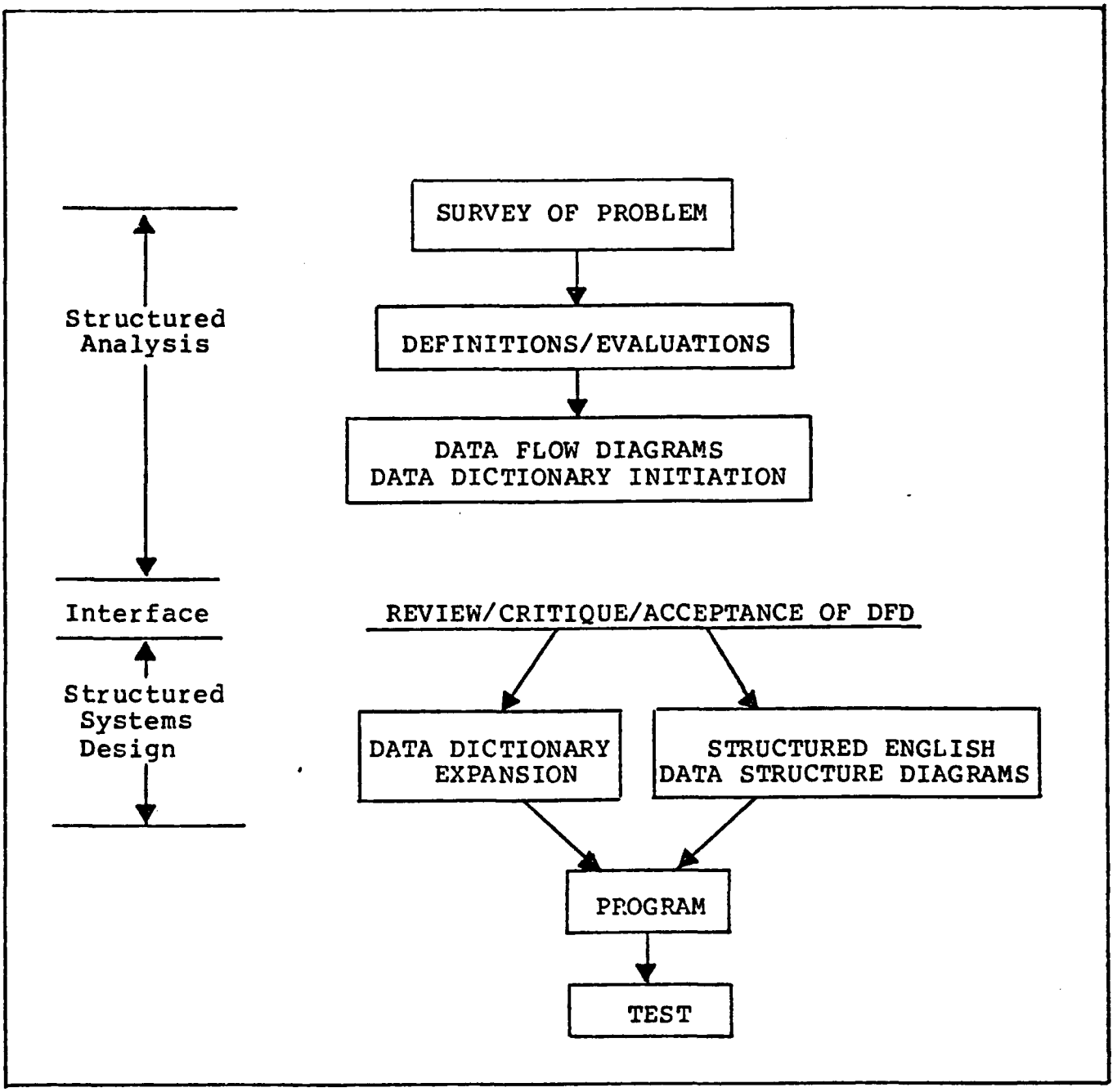


Figure 1. Structured Analysis and Structured Systems Design Organization

LSA SUBTASK 303.2.7 - DATA FLOW DIAGRAMS

The Data Flow Diagram is a tool that shows flow of data, i.e., data flows from sources and is processed by activities to produce intermediate or final products.

The DFD provides a useful and meaningful partitioning of a system from the viewpoint of identification and separation of all functions, actions, or processes so that each can be introduced, changed, added, or deleted with minimal disruption of the overall program, i.e., it emphasizes the underlying concept of modularity and identifiable transformations of data into actionable products.

A series of four (4) DFDs have been developed to structure the RLA LSA subtasks:

1.	303.2.7	RLA Overview
2.	303.2.7.2A	Preparation of Palman Database
3.	303.2.7.3A	Application of Palman Model
4.	303.2.7.5A	Application of OSAMM

Each DFD makes reference to the basic LSA task it addresses through the identification number assigned in the lower right hand box, as well as the level of indenture (explosion) of the DFD. For example, the first or top level DFD, "303.2.7", refers to the paragraph in MIL-STD-1388-1A which describes the task. One of the processes (bubbles) on the top level diagram (303.2.7.2) is expanded and identified as "303.2.7.2A", (Alpha "A" identifies the expansion).

The Alpha codes indicate the level of indenture or explosion below the top level, e.g.,:

Top Level.....LSA DFD 303.2.7

First Indenture.....LSA DFD 303.2.7.2A

Four standard symbols are used in the DFD drawing (see Figure 2).

A copy of each DFD is presented in Annex B, accompanied by the Data Dictionary process elements. Each entry made in the DFDs has a corresponding entry in the Data Dictionary, immediately following each of the DFDs.

This Technical Note presents the Data Dictionary entries necessary for the coordination of the overall concept and details of the processes. These include data flow identifications, process, external entities and data store descriptions are provided. As noted above, they will continue to evolve and be expanded in the System Design phase.

As the DFDs progress through Structured System Design, the Data Dictionary will continue to be expanded and completed. Since they are working documents rather than final submissions, only minimum effort has been devoted to editorial niceties, e.g., spelling, typography, etc.

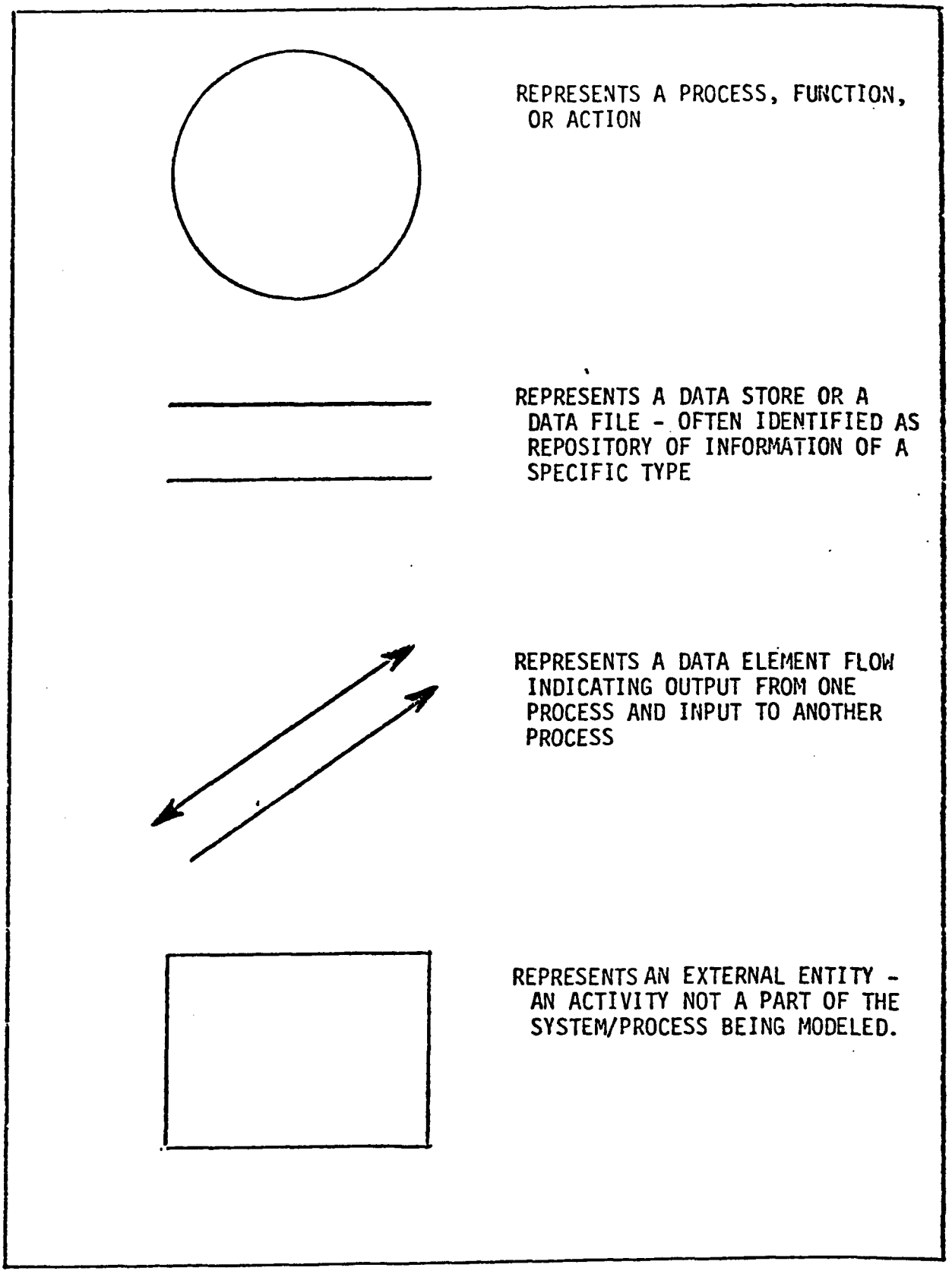


Figure 2. STANDARD DFD SYMBOL DEFINITIONS

ANNEX A

LSA SUBTASK 303.2.7

REPAIR LEVEL ANALYSIS

(RLA)

ANNEX A
LSA TASK 303
EVALUATION OF ALTERNATIVES AND TRADEOFF ANALYSIS 1/

303.1 PURPOSE: To determine the preferred support system alternative(s) for each system/equipment alternative and to participate in alternative system tradeoffs to determine the best approach (support, design, and operation) which satisfies the need with the best balance between cost, schedule, performance, readiness, and supportability.

303.2 TASK DESCRIPTION:

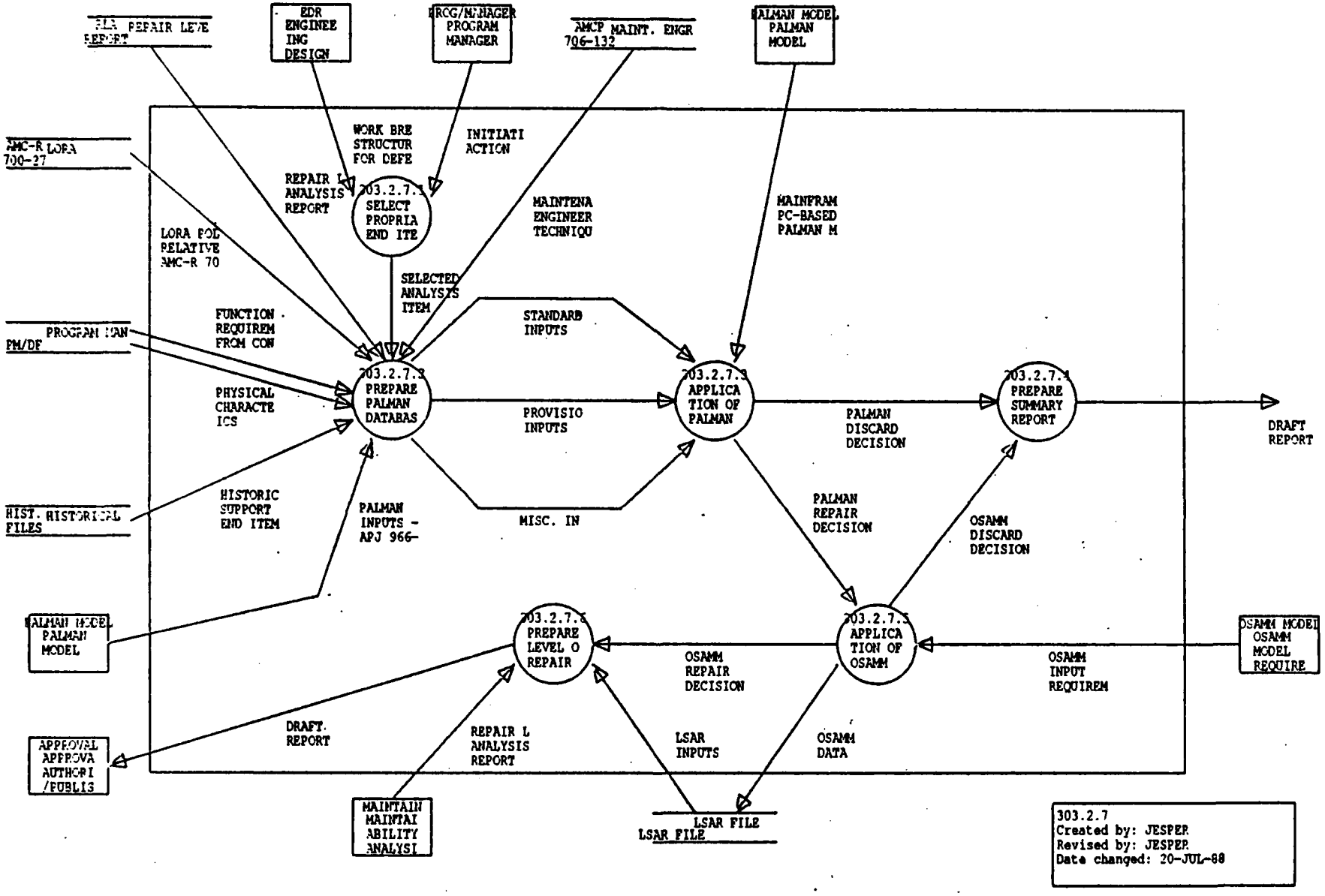
303.2.7 - Conduct repair level analysis (RLA) commensurate with the level of design, operation, and support data available.

1/ Abstracted verbatim from MIL-STD-1388-1A, April 11, 1983, Pages 36-37.

ANNEX B

SUBTASK 303.2.7

DATA FLOW DIAGRAMS AND DATA DICTIONARY


EDR ENGINEERING DESIGN
PROG/MANAGER PROGRAM MANAGER
AMCP MAINT. ENGR 706-132
PALMAN MODEL PALMAN MODEL
AMC-R LORA 700-27
WORK BRE STRUCTUR FOR DEFE
INITIATI ACTION
REPAIR L ANALYSIS REPORT
703.2.7.1 SELECT PROPRIA END ITE
MAINTENA ENGINEER TECHNIQU
MAINFRAM PC-BASED PALMAN M
LORA POL RELATIVE AMC-R 70
SELECTED ANALYSIS ITEM
FUNCTION REQUIREM FROM CON
STANDARD INPUTS
PROGRAM PLAN PM/DF
703.2.7.2 PREPARE PALMAN DATABAS
703.2.7.3 APPLICATION OF PALMAN
703.2.7.4 PREPARE SUMMARY REPORT
PHYSICAL CHARACTERISTICS
PROVISIO INPUTS
PALMAN DISCARD DECISION
DRAFT REPORT
HIST. HISTORICAL FILES
HISTORIC SUPPORT END ITEM
PALMAN INPUTS - APJ 966-
MISC. IN
PALMAN REPAIR DECISION
OSAMM DISCARD DECISION
PALMAN MODEL PALMAN MODEL
703.2.7.6 PREPARE LEVEL O REPAIR
703.2.7.5 APPLICATION OF OSAMM
OSAMM MODEL OSAMM MODEL REQUIRE
OSAMM REPAIR DECISION
OSAMM INPUT REQUIREM
APPROVAL APPROVA AUTHORI /PUBLIS
DRAFT REPORT
REPAIR L ANALYSIS REPORT
LSAR INPUTS
OSAMM DATA
MAINTAIN MAINTAI ABILITY ANALYSI
LSAR FILE
LSAR FILE
303.2.7
Created by: JESPER
Revised by: JESPER
Date changed: 20-JUL-88

Name	Label	Description
303.2.7.1	SELECT APPROPRIATE END ITEM, COMPONENT, OR MODULE	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model LOR - Level Of Repair WBS - Work Breakdown Structure LRU - Lowest Repairable Unit PROCESS: The process of developing an End Item LOR decision for Army materiel follows two serial processes: 1. First, a decision is made for Repair or Discard/Replace with the application of the Palman model. 2. If a decision is made for repair, a further decision is made for the optimum maintenance level for the repair to be effected. This task is accomplished with the application of the OSAMM model. These decisions are made for all three indenture levels of the WBS from the top down. The levels of the end item are components, modules, and the LRU. If a discard decision is made at any level for any branches of the WBS, all lower level decisions in the same branch would not be meaningful. This specific process is iterative in that the initial selection is the top level item (such as end item). Next iteration (or selection) will be the second indenture components assuming that the end item decision was to repair. The third iteration would be at the module level for each component rated as repairable. This iterative process continues until each potentially repairable item has been considered. DATA SOURCES: Interactive Palman Model User's Guide OSAMM User's Guide Version 2.0

Name	Label	Description
303.2.7.2	PREPARE PALMAN DATABASE	ACRONYMS: IPM - Interactive Palman Model DA - Department of the Army PAM - Pamphlet PROCESS: The IPM as described in DA PAM 700-4, is an interactive tool to assess repair versus discard decisions and perform sensitivities on key factors. The IPM requires the development/formatting of three sets of variables: 1. 14 standard variables 2. 13 provisioning variables 3. 13 miscellaneous variables The specific data elements are listed under the three data flows into the Application of the Palman model. These variables may be arranged by: 1. Supply 2. Test equipment and facilities 3. Personnel 4. Maintenance 5. End item 6. Initial provisioning The key sources of data for the elements are: 1. Functional requirements from concept development and documentation 2. Physical characteristics from engineering reports 3. Other types of information from historical data bases The data inputs for the Palman Model must relate to the specific item (at the appropriate indenture levels) selected in subtask 303.2.7.1 and be prepared in a form which can be readily applied to the computer input requirements. These data formats are set forth in the Palman documentation, "Interactive Palman Model User's Guide, June 21, 1984." There are two types of data files which are used by the Palman program: Standard Input Data Files and General Input Data Files. The Standard file, which may be created by the program, is used to initialize a new analysis. After the standard data have been entered, either by keyboard or from the standard file, then the peculiar data are entered by keyboard. The program now prepares the general file(s). To view the process of the Preparation of the Palman Database in more detail, explode this process to Subtask 303.2.7.2A. DATA SOURCES: DA PAM 700-4, Logistic Support Analysis Techniques Guide, March 31, 1987 Interactive Palman Model User's Guide, June 21, 1984 Palman Model User Guide, August 14, 1987

Name	Label	Description
303.2.7.3	APPLICATION OF PALMAN MODEL	ACRONYMS: LRU - Lowest Repairable Unit WBS - Work Breakdown Structure R/D - Repair/Discard PROCESS: With the application of the Palman model, a repair or discard/replace decision can be made on the end item and for each of the lower level items (components, modules, LRU's, etc.) as set forth in the WBS. The Palman program calculates R/D break-even cost over a range of expected deployment densities given the standard, provisioning, and miscellaneous inputs. In this analysis, if the life cycle cost of the end item exceeds the break-even cost value, the end item should be repaired. Similarly, when the life cycle cost of the end item is less than the break-even point, that item should be discarded. The program also outputs the cost and percentage cost contribution of individual variables to repair cost. After making the R/D analysis, the Palman program can be used to perform a sensitivity analysis. This analysis reveals the amount that the various model parameters that are selected can be in error without changing the overall R/D decision. The parameters with the highest percentage cost contribution are usually selected for sensitivity analyses. For a detailed description of the necessary procedures to apply the model and run it, explode this process to Subtask 303.2.7.3A. DATA SOURCES: Interactive Palman Model User's Guide, June 21, 1984 Palman User's Manual, August 14, 1987
303.2.7.4	PREPARE SUMMARY REPORT - DISCARDS	ACRONYMS: PROCESS: Preparation of a summary report of those items, components, or modules of the end item for which the Palman Model has indicated discard decision - that is, it would be economically beneficial to discard and replace with new like items rather than provide for the end item's repair. DATA SOURCES:
303.2.7.5	APPLICATION OF OSAMM PROCESS	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model LORA - Level Of Repair Analysis PROCESS: The OSAMM is applied to simultaneously optimize supply and maintenance policies while achieving a given operational availability target. To see the OSAMM in more detail, explode this process to Subtask 303.2.7.5A. DATA SOURCE: OSAMM Program

Name	Label	Description
303.2.7.6	PREPARE LEVEL OF REPAIR REPORT	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model PROCESS: The Level of Repair Report contains the results of the application of the Palman and OSAMM models to the equipment/system and its complete Work Breakdown Structure. This report contains all the recommendations and supporting rationale for system/equipment maintenance and logistics support planning decisions. DATA SOURCES:

Name	Label	Description
AMCP 706-132	MAINTENANCE ENGINEERING TECHNIQUES	Maintenance Engineering Techniques are the activities of equipment maintenance which develop concepts, criteria, and technical requirements during the conceptual and acquisition phases to be applied and maintained in a current status during the operational phase to assure timely and adequate economic maintenance support of weapons and equipments.
DRAFT	DRAFT RLA REPORT	A draft report of the results of the equipment/system Level of Repair Analysis in accordance with DI-R-3549A, DI-R-3549/R-117-2, or DI-S-6169, the most appropriate for the specific analysis performed.
FUNC	FUNCTIONAL REQUIREMENTS SELECTED ITEM	Identification of the operations and support functions that must be performed for each system/equipment alternative under consideration and then identification of the tasks that must be performed in order to operate and maintain the new system/equipment in its intended environment. These functions shall be identified to a level commensurate with design and operational scenario development, and shall include both peacetime and wartime functions. These data will be available from the Concept Formulation Package which will include a Feasibility Study as well as Advance Product Planning. The Feasibility Study from the Concept Formulation Package will consist of a Needs Analysis, the System Operational Requirements, and the System Maintenance Concept. Advance Product Planning is concerned with Plans and specifications of the equipment/system.
HIST	HISTORICAL SUPPORT DATA END ITEM LOGISTICAL EQUIVALENTS	Prior to the actual test and field use of the end item, it will be necessary to develop various reliability, maintainability, and availability parameters which are required to support the data base for application to the Palman Model. These quantifications of the availability parameters may be derived from an analysis of logistically equivalent systems, operating in similar environmental and operating conditions. These data will be extracted from the historical files and used in the development of the model inputs for the end item and for each of its lower indenture components, modules, or parts.
INIT	INITIATING ACTION	The initiating action would be the signed task order by APJ and the HQ, AMCCOM contraction officer representative.
LORA POLICY	LORA POLICY RELATIVE TO AMC-R 700-27	In the selection of the parameters for application to the Palman Model, it will be necessary to transfer the policy and guidance of AMC-R 700-27 to the analyst and programs assigned to the application of the Palman Model to the end item and its lower indentures of the Work Breakdown Structure.
LSAR INPUTS	LSAR INPUTS	The data which are entered into the end item LSAR are made available for preparation of the report to be generated as item No. 1 from the Contract Data Requirements List. (DD Form 1423)

Name	Label	Description
MISC/INPUTS	MISC. INPUTS	The Miscellaneous variables (system peculiar parameters) are: 1. REPHRS : average direct labor corrective maintenance repair time required to repair an assembly 2. COSTRP : average cost of repair part(s) required to repair an assembly 3. UNIQUE : number of new NSN repair parts that must be added to the federal supply system 4. COSTFD : development cost of all special test equipment and facilities required over and above that required for the throwaway concept 5. COSTFP : procurement cost of all special test equipment and facilities required over and above that required for the throwaway concept 6. FAILUR : expected number of failures of the assembly per million hours of constant operation 7. PAGES : number of technical publication pages over and above that required for the throwaway concept 8. HT : hours of training required to perform maintenance on the particular assembly 9. Q : total number of this particular assembly per end item 10. FRACOP : fraction of calender time that the end item is operated 11. PT : number of personnel trained per year to repair the assemblies 12. EN(1) : the expected low number of end items to be failed 13. EN(11) : the expected high number of end items to be failed
OSAMM DATA	OSAMM DATA	The data output by the OSAMM model to the LSAR includes: 1. Maintenance policies by application 2. Maintenance Task Distributions (MTD's) 3. Replacement Task Distributions (RTD's) 4. Quantity required of each test equipment/repairman at each echelon 5. Number of spares of each component/module allowed at each echelon. initial spares cost, and consumption spares over the life of the system 6. Total cost of each component/module for holding, transportation, requisition, cataloging, bin, and repair 7. Total logistics cost and achieved operational availability
OSAMM INPUTS	OSAMM INPUT REQUIREMENTS	A specification of the inputs required of the system/item being evaluated from the view point of Level of Repair. These inputs must conform to the requirements of OSAMM as spelled out in the OSAMM User's Manual.
OSAMM/DISC/DEC	OSAMM DISCARD DECISION	The OSAMM decision regarding the Level Of Repair Analysis is no repair at all. The failed equipment/system is discarded.

Name	Label	Description
OSAMM/REP/DEC	OSAMM REPAIR DECISION	Repair level decisions made by the model are output by application. The model will describe what should be done when the end item fails due to the failure of a certain module in a certain component. The model will also determine which components and modules should be discarded instead of repaired. This set of repair level decisions is commonly referred to as the "maintenance concept" for the equipment.
PAL/LINE	MAINFRAME OR PC-BASED PALMAN MODEL ON LINE	An "on line" Palman Model run from either a mainframe or personal computer is applied to the Repair/Discard analysis.
PALMAN INPUTS	PALMAN INPUTS - APJ 966-309	These inputs conform to the specific requirements as set forth in APJ report 966-309, "Palman Model User's Manual," as applicable to the physical and operational characteristics of the end item.
PALMAN/DISC/DEC	PALMAN DISCARD DECISION	The Palman Model has demonstrated that discarding the failed end item and replacing it with a new equipment/system is the most economical decision.
PALMAN/REP/DEC	PALMAN REPAIR DECISION	The Palman program has shown that the most economical decision is Repair rather than Discard for selected end items, components, parts, or modules. These decisions constitute the major input to the next decision concerning the ideal maintenance level for the repair to be effected. Using the Optimum Supply and Maintenance Model (OSAMM), one can determine at which echelon each maintenance function should be performed, or whether the maintenance function should be eliminated altogether.
PHYS	PHYSICAL CHARACTERISTICS SELECTED ITEM	The physical characteristics of the selected item generally include such features as size, weight, material, shape, and volume. This data will be developed from the engineering drawings that are available from the Program Manager Data Files

Name	Label	Description
PROV/INPUTS	PROVISIONING INPUTS	The Provisioning variables (supply related parameters) are: 1. OST(1) : Order and Ship Time in days between equipment and Direct Exchange (DX) 2. OST(2) : OST in days between DX to Maintenance Level Supply (MLS) 3. OST(3) : OST in days between MLS and Depot 4. OST(4) : OST in days between Depot and Factory 5. OST(5) : OST in days for parts to be obtained by maintenance facility 6. TAT : Turn Around Time in days for assemblies at maintenance facility 7. CKK : Safety Stock Coefficient (decimal %), percent of stock above demand to cover delays 8. RPNSTD : Perecnt of repair parts that are non-standard, requiring new NSN's 9. INIPA : Minimum number of days of authorized assembly stockage 10. INIPP : Minimum number of days of authorized parts stockage 11. DXN : Number of DX supply locations 12. MXN : Number of Maintenance Level Supply locations 13. PNFAIL : Percent of non-operational failures due to obsolescence, shelf life, etc.
RLA/RQMNTS	REPAIR LEVEL ANALYSIS REPORT REQUIREMENTS	DI-L-2085A states the requirements of a report which are to be addressed in the End Item Level of Repair Analysis. The specific requirments are abstracted and forwarded to the process to establish the Palman database to insure that these requirements are met.
SELECT	SELECTED ANALYSIS ITEM	This data flow will represent the iteration of the selection of items for the Palman Model evaluation. The first selection will be the equipment/system as an end item. Following iterations will include major components, modules, and LRU as set forth in the WBS.

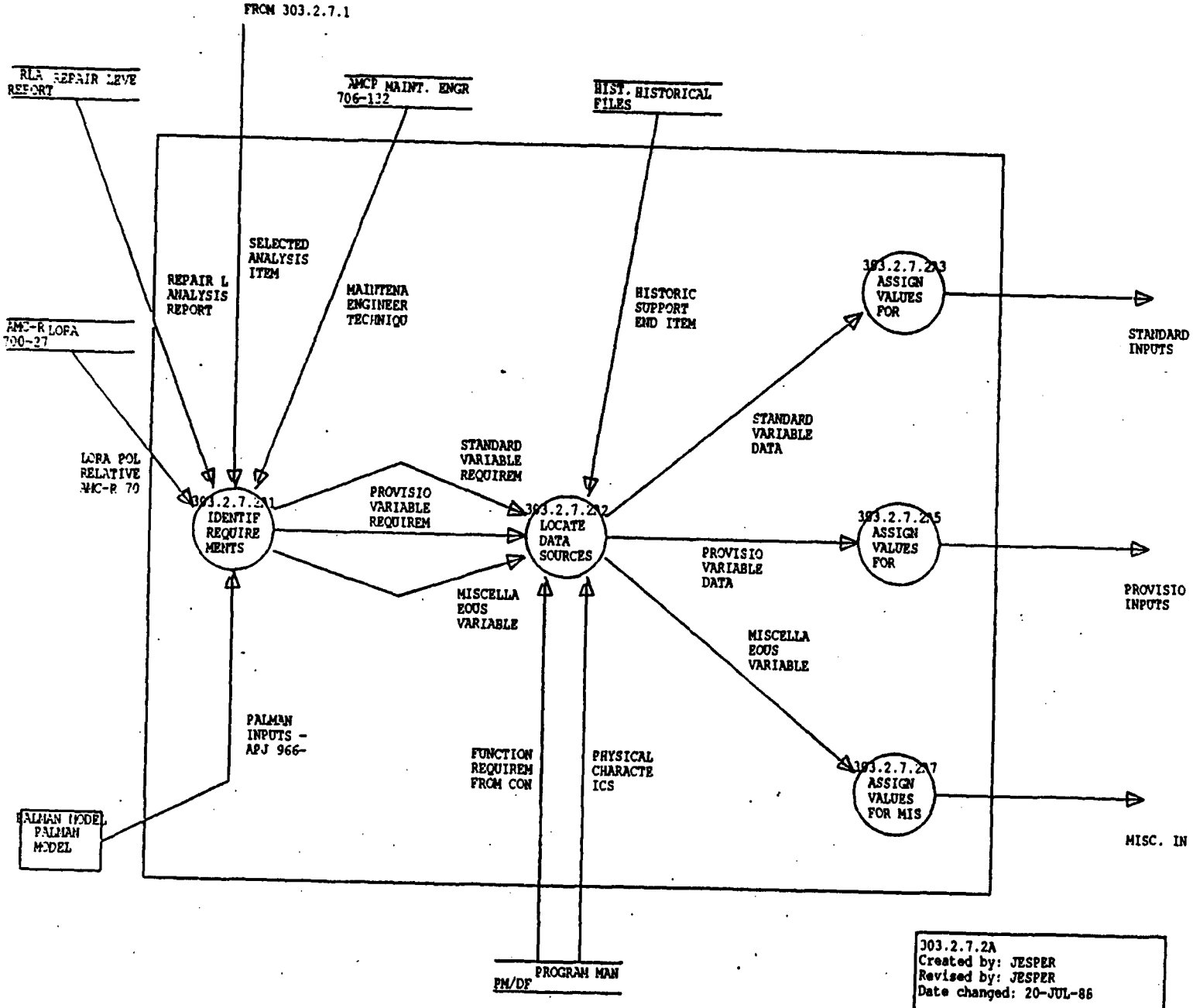
Name	Label	Description
STD/INPUTS	STANDARD INPUTS	The Standard variables (standard input parameters) are: 1. COSTH : Inventory holding cost factor per year (% of purchase) 2. COSTLH : Labor cost per hour including O/H 3. COSTMF : Facility cost per hour for maintenance 4. COSTR : Repair parts requisition cost 5. COSTTH : Transportation and handling cost per assembly 6. FSNI : Cost to enter a line item number in the federal supply system per unique line item 7. FSNR : Yearly cost to maintain a line item - National Stock number (NSN) - in the supply system 8. PROCUR : Administration and engineering support cost for each unique repair part procurement 9. PAGESC : Technical manual per page cost 10. REPNOT : Percentage of assemblies arriving at the repair facility of which repair is attempted but is unsuccessful 11. RETURN : Percentage of failed assemblies returned and received at repair location 12. SQUAP : Cost of preparing a supplemental quality assurance plan for unique reapir parts 13. TFMAIN : Maintenance facilities cost as a percent of facilities and test equipment procurement cost 14. YEARS : Length of time in years that the end item is expected to be in the inventory

Name	Label	Description
WBS	WORK BREAKDN STRUCTURES FOR DEFENSE MATER'L ITEM	To aid the analyst by providing guidance in the preparation of a standard Work Breakdown Structure. The data comes in the form of a Military Standard pamphlet under the title "Work Breakdown Structures for Defense Materiel Items." The MIL-STD identifies Army materiel by general classifications: 1. Aircraft system 2. Electronics system 3. Missile system 4. Ordnance system 5. Ship system 6. Space system 7. Surface vehicle system Each of the major categories (known as level 1 items) is further stratified into major systems (known as level 2 items). As an example, aircraft systems are broken down into the following major systems: 1. Air vehicle 2. Training 3. Peculiar support equipment 4. Systems test and evaluation 5. System/project management 6. Data 7. Operational/site activation 8. Common support equipment 9. Industrial facilities 10. Initial spares and intitial repair parts Level 3 items contain the last indenture for which guidance is provided. This level addresses such items as airframe, propulsion units, communications, etc. However, guidance in the MIL-STD states that "...The project summary WBS will be tailored to the project objectives..."

Name	Label	Description
AMC-R 700-27	LORA	AMC-R 700-27, "Level of Repair Analysis (LORA) Program," prepared by HQ, U.S. Army Materiel Command (March '85) establishes AMC objectives and policies, and assigns responsibilities for a LORA program throughout all phases of a materiel systems life cycle. Appendix C to this AMC regulation establishes policy on level of repair models. It identifies the Palman model as applicable to specific aspects of repair analysis and can be used for the repair/discard decision. OSAMM is considered applicable to system/end item analysis.
AMCP 706-132	MAINT. ENGR. TECHNIQUES	AMCP 706-132 will provide the maintenance engineering techniques applicable to the development of the variables for application of the Palman Model, the end item, and its major components, items, and parts.
HIST. FILES	HISTORICAL FILES	This data store contains data previously acquired on the system/equipment under investigation or some similar system and may address the following areas: 1. Reliability Data 2. Failure Rate Data 3. Spares and Spares Funding Data The availability, accuracy, and relevancy of experience of historical databases on similar existing systems is crucial for accomplishment of the task in question, namely Repair Level Analysis.
LSAR FILE	LSAR FILE	This file or records holding area contains: 1. The equipment/system LSA Task reports or their equivalent. 2. The equipment/system LSAR master records sheet information. 3. The equipment/system LSAR reports when system is automated. It contains logistics data which can be used to assess the ILS elements set forth in MIL-STD 1388-1A and conforms to the records/files prescribed in MIL-STD 1388-2A.
RLA REPORT	REPAIR LEVEL ANALYSIS REPORT	Data Item Descriptions DID-R-3549/R-117-2 and DID-S-6169 specify the type of detailed data required in a report on the Optimum Repair Level of Analysis (ORLA). Although the DIDs leave the format of the report to the discretion of the contractor, the data details required as adequate to establish a baseline for the reassessment of the ORLA as more detailed design data are obtained. DID-R-3549A specifies the type of data required in a report of the repair level analysis (RLA) reports. As noted for the DIDs above, an extensive data base is required. In this case, the report requires a rational for each action proposed, the numerical data used to determine the level of repair, sensitivity analysis performed and the results, rationale to support the R&M parameters used, interface considerations used, and recommendations for updating planning factors for maintenance and logistic support.

Name	Label	Description
APPROVAL	APPROVAL AUTHORITY /PUBLISH-ER	Final approval and publication for distribution will be made by the HQ, AMCCOM technical representative or the contracting officer.
CONCEPT	CONCEPT DEVELOP-MENT	The Concept Development involves a Feasibility Study as well as Advance Product Planning. The Feasibility Study consists of a Needs Analysis, the System Operational Requirements, and the System Maintenance Concept. Advance Product Planning is concerned with plans and specifications of the equipment/system.
EDR	ENGINEER-ING DESIGN REPORTS	The Engineering Design Reports show the assembly and construction of the equipment/system in question.
ENGR.	ENGINEER-ING DRAWINGS	The Engineering Drawings show the physical characteristics of the equipment/system in question.
MAINTAIN	MAINTAIN-ABILITY ANALYSIS SUMMARY	Maintainability Analysis Summary - Level of Repair Report This report yields the projected workload resulting from the Failure Modes Effects and Criticality Analysis. The report details the Level of Repair to be performed on an item for all maintenance levels. It will also be used to review reliability and maintainability factors for the repair time of an item. (From DI-L-7177, LSA-053, MIL-STD-1388-2A)
OSAMM MODEL	OSAMM MODEL REQUIRE-MENTS	CECOM-TR-87-3, "Optimum Supply and Maintenance Model Release 2.0 User's Guide," is used to identify the specific inputs required for the equipment/system to run the repair level decision model.
PALMAN MODEL	PALMAN MODEL	The Palman Model has been developed to evaluate the breakeven purchase cost for a weapons system component or assembly and to let the user make a decision to either repair the component/assembly or discard it. The operation and specification of the inputs required for the Palman Model are described in the APJ Report 966-309, "Palman Model User's Manual." The Palman Model is written in FORTRAN IV so that is easily portable to most computer systems with a keyboard, monitor, file system, and printer.

Name	Label	Description
PROGRAM MANAGER	PROGRAM MANAGER	The Program Manager seeks to conduct a Repair Level Analysis commensurate with the level of design, operation, and support data available. For the Integrated Logistics Support Program associated with the acquisition life cycle of system/equipment, a logistics support analysis is to be made. To decide whether the failed component should be either repaired or replaced, the Interactive Palman Model (IPM) will be employed to determine the most cost-effective action.


FROM 303.2.7.1
RLA REPAIR LEVE REPORT
AMCP MAINT. ENGR 706-132
HIST. HISTORICAL FILES
SELECTED ANALYSIS ITEM
REPAIR L ANALYSIS REPORT
MAINTENA ENGINEER TECHNIQU
HISTORIC SUPPORT END ITEM
AMC-R LORA 700-27
LORA POL RELATIVE AMC-R 70
303.2.7.2A1 IDENTIF REQUIRE MENTS
303.2.7.2A2 LOCATE DATA SOURCES
303.2.7.2A3 ASSIGN VALUES FOR
303.2.7.2A5 ASSIGN VALUES FOR
303.2.7.2A7 ASSIGN VALUES FOR MIS
STANDARD VARIABLE REQUIREM
PROVISIO VARIABLE REQUIREM
MISCELLA EOUS VARIABLE
STANDARD VARIABLE DATA
PROVISIO VARIABLE DATA
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STANDARD INPUTS
PROVISIO INPUTS
MISC. IN
PALMAN INPUTS - APJ 966-
PALMAN MODEL PALMAN MODEL
FUNCTION REQUIREM FROM CON
PHYSICAL CHARACTE ICS
PROGRAM MAN PM/DF
303.2.7.2A
Created by: JESPER
Revised by: JESPER
Date changed: 20-JUL-86

Name	Label	Description
303.2.7.2A1	IDENTIFY REQUIRE-MENTS	ACRONYMS: MRSA - Materiel Readiness Support Activity LSAT - Logistics Support Analysis Techniques PROCESS: Examine the parameters needed to run the Palman Model, and identify the data needed to satisfy the input requirements. DATA SOURCES: Interactive Palman User's Guide, June 21, 1984 Technical Review and Analysis of Palman Repair vs. Discard Model, MRSA LSAT 84-06

Name	Label	Description
303.2.7.2A2	LOCATE DATA SOURCES - STANDARD DATA	ACRONYMS: LSA - Logistic Support Analysis RIPCUS - Retail Inventory Cost Parameter Update Study CCSSOI - Commodity Command Standard System Operating Instructions MMD - Materiel Management Decision LPL - Logistic Parameters Library POC - Point Of Contact N/A - Not Available PROCESS: The Standard Inputs are those standard variables which are based on historical records and usually do not change between runs of the model. Default values for these parameters are provided by the program. In the event that the standard input values provided are not accurate, the user must change those standard inputs. Input data can originate in the LSA records or may originate from external sources. For the Standard variables, the sources are described: COSTH - Commodity Command Standard System (CCSS) Material Management Division (MMD) supply file at the 5A level COSTLH - MSG, DACA-FAA, 281305Z, Feb. '85 Subject: Composite Standard Rates for Costing Personnel Services, FY '86 COSTMF - N/A COSTR - RIPCUS, Nov. '81 COSTTH - Packaging - Army Master Data File (AMDF), USA Catalog Data Activity, ATTN: AMXCA-DL, New Cumberland Army Depot, New Cumberland, PA 17070, AV 977-6741, com (717) 770-6741 FSNI - RIPCUS, Nov. '81 FSNR - RIPCUS, Nov. '81 (Note: FSNI and FSNR values must be adjusted to current year dollars using inflation indices referenced in U.S. Army OMA & MPA Cost Factors Handbook, Vol. 1:Factors, U.S. Army Cost and Economic Analysis Center, ATTN: CACC-FDF, Washington, DC 20310-2080) PROCUR - Parameters are defined by the CCSSOI 18-1-33. The value provided in the LPL is calculated by averaging the eight Procurement values taken from the CCSS MMD File at each commodity command. This value should be updated quarterly PAGESC - Technical Publications Branch at the appropriate commodity command RETURN - Palman Default Value SQUAP - Analytics Technical Report 1958-TR-06, Determining the Cost of Acquisition Data Packages Methodology Handbook, June 28, '85, USAF, Business Research Management Center, (CPT Smith), WPAFB, OH 45433 The following parameters are dependent on the system under analysis. The appropriate Project Management Office can provide pertinent data; or at least provide a POC that can supply the necessary information. REPNOT TFMAIN

Name	Label	Description
303.2.7.2A3	ASSIGN VALUES FOR STANDARD INPUTS	ACRONYMS: PROCESS: The Standard data are usually assigned values from the Standard Input file. Should these values need to be changed, however, they are assigned values which are derived from the appropriate data sources. DATA SOURCES:
303.2.7.2A4	LOCATE DATA SOURCES - PROVISION DATA	ACRONYMS: POC - Point Of Contact PROCESS: PROVISIONING INPUTS; The data for the Provisioning Inputs is dependent on the system under analysis. To locate the data sources for these variables, one must contact the appropriate Project Management Office. The office can provide the pertinent data; or at least provide a POC that can supply the necessary information. DATA SOURCES:
303.2.7.2A5	ASSIGN VALUES FOR PROVISION-ING INPUTS	ACRONYMS: PROCESS: The Provisioning Inputs are assigned values which are derived from the appropriate data sources. DATA SOURCES:
303.2.7.2A6	LOCATE DATA SOURCES - MISC. DATA	ACRONYMS: POC - Point Of Contact PROCESS: The data for the Miscellaneous Inputs can be found at the appropriate Project Management Office. This office can provide the pertinent data; or at least provide a POC that can supply the necessary information. DATA SOURCES:
303.2.7.2A7	ASSIGN VALUES FOR MISC. INPUTS	ACRONYMS: PROCESS: The Miscellaneous Inputs are assigned values which are derived from the appropriate data sources. DATA SOURCES:

Name	Label	Description
AMCP 706-132	MAINTENANCE ENGINEERING TECHNIQUES	Maintenance Engineering Techniques are the activities of equipment maintenance which develop concepts, criteria, and technical requirements during the conceptual and acquisition phases to be applied and maintained in a current status during the operational phase to assure timely and adequate economic maintenance support of weapons and equipments.
FUNC	FUNCTIONAL REQUIREMENTS SELECTED ITEM	Identification of the operations and support functions that must be performed for each system/equipment alternative under consideration and then identification of the tasks that must be performed in order to operate and maintain the new system/equipment in its intended environment. These functions shall be identified to a level commensurate with design and operational scenario development, and shall include both peacetime and wartime functions. These data will be available from the Concept Formulation Package which will include a Feasibility Study as well as Advance Product Planning. The Feasibility Study from the Concept Formulation Package will consist of a Needs Analysis, the System Operational Requirements, and the System Maintenance Concept. Advance Product Planning is concerned with Plans and specifications of the equipment/system.
HIST	HISTORICAL SUPPORT DATA END ITEM LOGISTICAL EQUIVALENTS	Prior to the actual test and field use of the end item, it will be necessary to develop various reliability, maintainability, and availability parameters which are required to support the data base for application to the Palman Model. These quantifications of the availability parameters may be derived from an analysis of logistically equivalent systems, operating in similar environmental and operating conditions. These data will be extracted from the historical files and used in the development of the model inputs for the end item and for each of its lower indenture components, modules, or parts.
LORA POLICY	LORA POLICY RELATIVE TO AMC-R 700-27	In the selection of the parameters for application to the Palman Model, it will be necessary to transfer the policy and guidance of AMC-R 700-27 to the analyst and programs assigned to the application of the Palman Model to the end item and its lower indentures of the Work Breakdown Structure.
MISC/DATA	MISCELLANEOUS VARIABLES DATA	The Miscellaneous Data is used to assign values to the Miscellaneous Inputs. The data is supplied by the user, in the form of input file, to the inputs of the Palman Model.

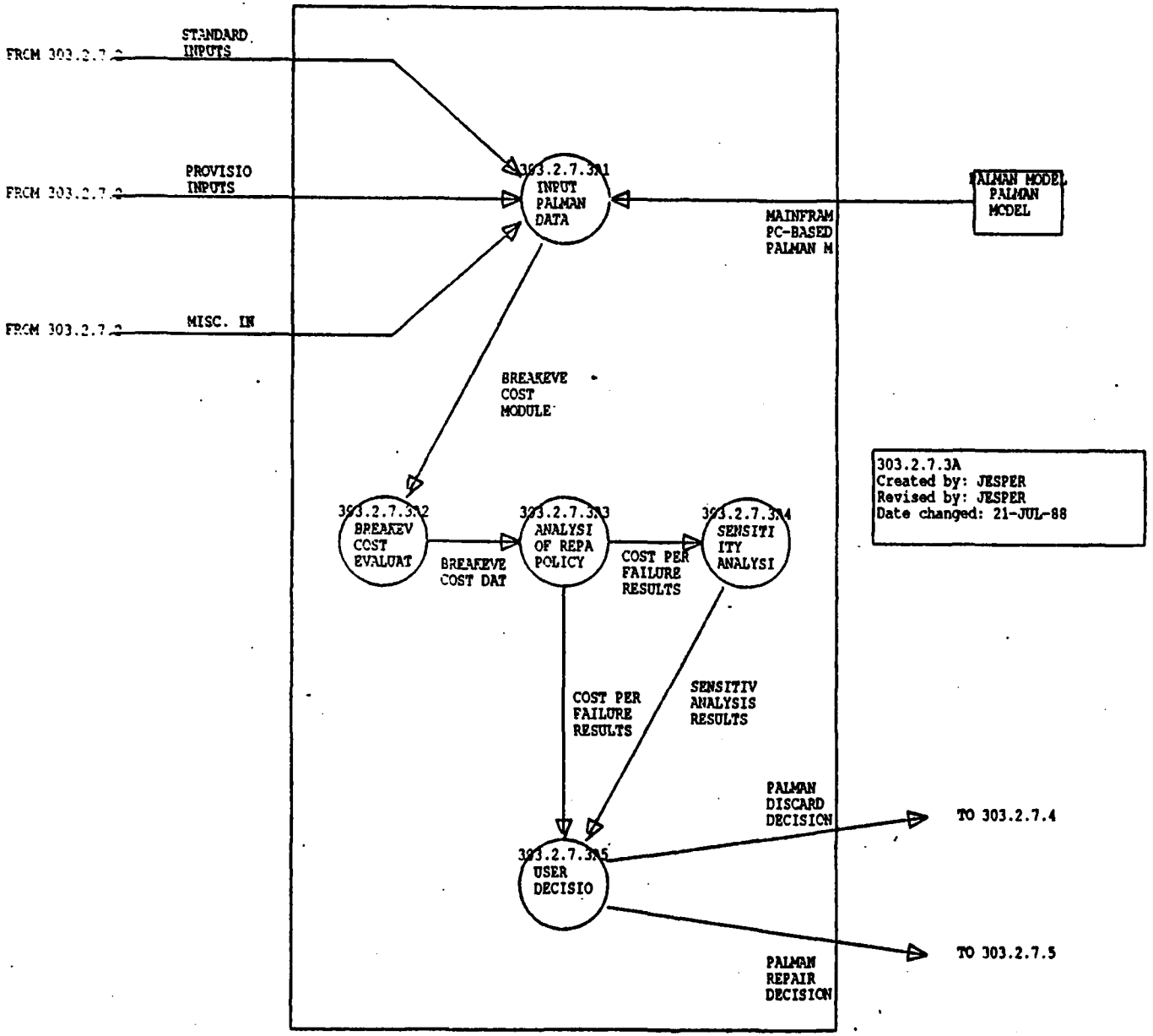
Name	Label	Description
MISC/INPUTS	MISC. INPUTS	The Miscellaneous variables (system peculiar parameters) are: 1. REPHRS : average direct labor corrective maintenance repair time required to repair an assembly 2. COSTRP : average cost of repair part(s) required to repair an assembly 3. UNIQUE : number of new NSN repair parts that must be added to the federal supply system 4. COSTFD : development cost of all special test equipment and facilities required over and above that required for the throwaway concept 5. COSTFP : procurement cost of all special test equipment and facilities required over and above that required for the throwaway concept 6. FAILUR : expected number of failures of the assembly per million hours of constant operation 7. PAGES : number of technical publication pages over and above that required for the throwaway concept 8. HT : hours of training required to perform maintenance on the particular assembly 9. Q : total number of this particular assembly per end item 10. FRACOP : fraction of calender time that the end item is operated 11. PT : number of personnel trained per year to repair the assemblies 12. EN(1) : the expected low number of end items to be failed 13. EN(11) : the expected high number of end items to be failed
MISC/REQ	MISCELLANEOUS VARIABLES REQUIREMENTS	The Miscellaneous Requirements are used to locate the data sources for the Miscellaneous Inputs. These requirements detail the necessary data needed to satisfy the equations within the Palman Model.
PALMAN INPUTS	PALMAN INPUTS - APJ 966-309	These inputs conform to the specific requirements as set forth in APJ report 966-309, "Palman Model User's Manual," as applicable to the physical and operational characteristics of the end item.
PHYS	PHYSICAL CHARACTERISTICS SELECTED ITEM	The physical characteristics of the selected item generally include such features as size, weight, material, shape, and volume. This data will be developed from the engineering drawings that are available from the Program Manager Data Files
PROV/DATA	PROVISIONING VARIABLES DATA	The Provisioning Data is used to assign values to the Provisioning Inputs. The data is supplied by the user, in the form of an input file, to the inputs of the Palman Model.

Name	Label	Description
PROV/INPUTS	PROVISIONING INPUTS	The Provisioning variables (supply related parameters) are: 1. OST(1) : Order and Ship Time between equipment and direct exchange 2. OST(2) : OST in days between DX to Maintenance Level Supply (MLS) 3. OST(3) : OST in days between MLS and Depot 4. OST(4) : OST in days between Depot and Factory 5. OST(5) : OST in days for parts to be obtained by maintenance facility 6. TAT : Turn Around Time in days for assemblies at maintenance facility 7. CKK : Safety Stock Coefficient (decimal %), percent of stock above demand to cover delays 8. RPNSTD : Perecnt of repair parts that are non-standard, requiring new NSN's 9. INIPA : Minimum number of days of authorized assembly stockage 10. INIPP : Minimum number of days of authorized parts stockage 11. DXN : Number of DX supply locations 12. MXN : Number of Maintenance Level Supply locations 13. PNFAIL : Percent of non-operational failures due to obsolescence, shelf life, etc.
PROV/REQ	PROVISIONING VARIABLES REQUIREMENTS	The Provisioning Requirements are used to locate the data sources for the Provisioning Inputs. These requirements detail the necessary data needed to satisfy the equations within the Palman Model.
RLA/RQMNTS	REPAIR LEVEL ANALYSIS REPORT , REQUIREMENTS	DI-R-3549A (sequence 1) states the requirements of a report which are to be addressed in the End Item Level of Repair Analysis. The specific requirments are abstracted and forwarded to the process to establish the Palman database to insure that these requirements are met.
SELECT	SELECTED ANALYSIS ITEM	This data flow will represent the iteration of the selection of items for the Palman Model evaluation. The first selection will be the equipment/system as an end item. Following iterations will include major components, modules, and LRU as set forth in the WBS.
STD/DATA	STANDARD VARIABLES DATA	The Standard Data is used to assign values to the Standard Inputs. The data is supplied by the user, in the form of an input file, to the inputs of the Palman Model.

Name	Label	Description
STD/INPUTS	STANDARD INPUTS	The Standard variables (standard input paramsters) are: 1. COSTH : Inventory holding cost factor per year (% of purchase) 2. COSTLH : Labor cost per hour including O/H 3. COSTMF : Facility cost per hour for maintenance 4. COSTR : Repair parts requisition cost 5. COSTTH : Transportation and handling cost per assembly 6. FSNI : Cost to enter a line item number in the federal supply system per unique line item 7. FSNR : Yearly cost to maintain a line item - National Stock number (NSN) - in the supply system 8. PROCUR : Administration and engineering support cost for each unique repair part procurement 9. PAGESC : Technical manual per page cost 10. REPNOT : Percentage of assemblies arriving at the repair facility of which repair is attempted but is unsuccessful 11. RETURN : Percentage of failed assemblies returned and received at repair location 12. SQUAP : Cost of preparing a supplemental quality assurance plan for unique reapir parts 13. TFMAIN : Maintenance facilities cost as a percent of facilities and test equipment procurement cost 14. YEARS : Length of time in years that the end item is expected to be in the inventory
STD/REQ	STANDARD VARIABLES REQUIREMENTS	The Standard Requirements are used to locate the data sources for the Standard Inputs. These requirements detail the necessary data needed to satisfy the equations within the Palman Model.

Name	Label	Description
AMC-R 700-27	LORA	AMC-R 700-27, "Level of Repair Analysis (LORA) Program," prepared by HQ, U.S. Army Materiel Command (March '85) sets forth the responsibilities and products required of a Level of Repair Analysis. Appendix C identifies Palman as applicable to specific aspects of repair analysis, while OSAMM is considered applicable to system/end item analysis.
AMCP 706-132	MAINT. ENGR. TECHNIQUES	AMCP 706-132 will provide the maintenance engineering techniques applicable to the development of the variables for application of the Palman Model, the end item, and its major components, items, and parts.
HIST. FILES	HISTORICAL FILES	This data store contains data previously acquired on the system/equipment under investigation or some similar system and may address the following areas: 1. Reliability Data 2. Failure Rate Data 3. Spares and Spares Funding Data The availability, accuracy, and relevancy of experience of historical databases on similar existing systems is crucial for accomplishment of the task in question, namely Repair Level Analysis.
PM/DF	PROGRAM MANAGER DATA FILE	CONTAINS THOSE FILES AND DATA WHICH ARE NORMALLY DEVELOPED BY AND/OR RETAINED BY THE PROGRAM MANAGER FOR PROPER MANAGEMENT OF THE DEVELOPMENT PROGRAM. THESE FILES INCLUDE: 1. ENGINEERING DRAWINGS 2. ENGINEERING CHARACTERISTICS 3. DT/OT RESULTS 4. CONCEPT FORMULATION PACKAGE (CFP) 5. DESIGN CONCEPT PAPER (DCP) 6. TYPE TECHNICAL REVIEWS REQUIRED 7. MILESTONE SCHEDULES 8. FUNDING PROFILES 9. REQUIRED OPERATIONAL CAPABILITIES (ROC) 10. ITEM/EQUIPMENT SPECIFICATIONS 11. ITEM/EQUIPMENT MISSIONS & FUNCTIONS 12. EQUIPMENT, MANPOWER, AND TECHNICAL RISK ASSESSMENTS (FROM LSA TASK 301.2.3 13. TRADE OFF DETERMINATION ANALYSIS (TOD) 14. TRADE OFF ANALYSIS (TOA) 15.BEST TECHNICAL APPROACH ANALYSIS (BTA) 16. COST AND OPERATIONAL-EFFECTIVENESS ANALYSIS (COEA)
RLA REPORT	REPAIR LEVEL ANALYSIS REPORT	This Data Item Description (DID) contains the details required in a report on the optimum Repair Level of Analysis. Although the DID makes reference to an Air Force application, sequence 1 of this DID states the reporting requirement for the end item Level of Repair Analysis (LORA).

Name	Label	Description
PALMAN MODEL	PALMAN MODEL	The Palman Model has been developed to evaluate the breakeven purchase cost for a weapons system component or assembly and to let the user make a decision to either repair the component/assembly or discard it. The operation and specification of the inputs required for the Palman Model are described in the APJ Report 966-309, "Palman Model User's Manual." The Palman Model is written in FORTRAN IV so that is easily portable to most computer systems with a keyboard, monitor, file system, and printer.


STANDARD INPUTS
FROM 303.2.7.2
PROVISIO INPUTS
FROM 303.2.7.2
MISC. IN
FROM 303.2.7.2
INPUT PALMAN DATA
PALMAN MODEL PALMAN MODEL
MAINFRAM PC-BASED PALMAN M
BREAKEVE COST MODULE
BREAKEV COST EVALUAT
ANALYSI OF REPA POLICY
SENSITI ITY ANALYSI
BREAKEVE COST DAT
COST PER FAILURE RESULTS
COST PER FAILURE RESULTS
SENSITIV ANALYSIS RESULTS
USER DECISIO
PALMAN DISCARD DECISION
TO 303.2.7.4
TO 303.2.7.5
PALMAN REPAIR DECISION
303.2.7.3A
Created by: JESPER
Revised by: JESPER
Date changed: 21-JUL-88

Name	Label	Description
303.2.7.3A1	INPUT PALMAN DATA	ACRONYMS: PURPOSE: To provide the algorithms of the Palman Model with the necessary data to perform the required calculations. DATA SOURCES: Standard Input File, Provisioning Input File, Miscellaneous Input File
303.2.7.3A2	BREAKEVEN COST EVALUATION	ACRONYMS: PURPOSE: This process is the primary feature of the Palman Model. It calculates the breakeven point where repair cost and throwaway cost are equal. The user then makes the Repair/Discard decision based on the results of this process. DATA SOURCES:
303.2.7.3A3	ANALYSIS OF REPAIR POLICY - COST PER FAILURE	ACRONYMS: PROCESS: This process provides an analysis of repair policy cost per failure. For each cost element, the cost per failure and the percentage cost contribution is output. DATA SOURCES:
303.2.7.3A4	SENSITIVITY ANALYSIS	ACRONYMS: PURPOSE: The Sensitivity Analysis provides the user with information regarding the variables that most influence the breakeven cost value. This analysis shows how the breakeven cost value changes as a particular variable is changed. Two types of sensitivity analyses exist within the Palman Model: Standard and Unique. If the Standard analysis is selected, the program automatically chooses the variables to be considered. If the Unique analysis is selected, the user selects a variable to be considered and then enters the low value and the high value for the sensitivity range. DATA SOURCES:

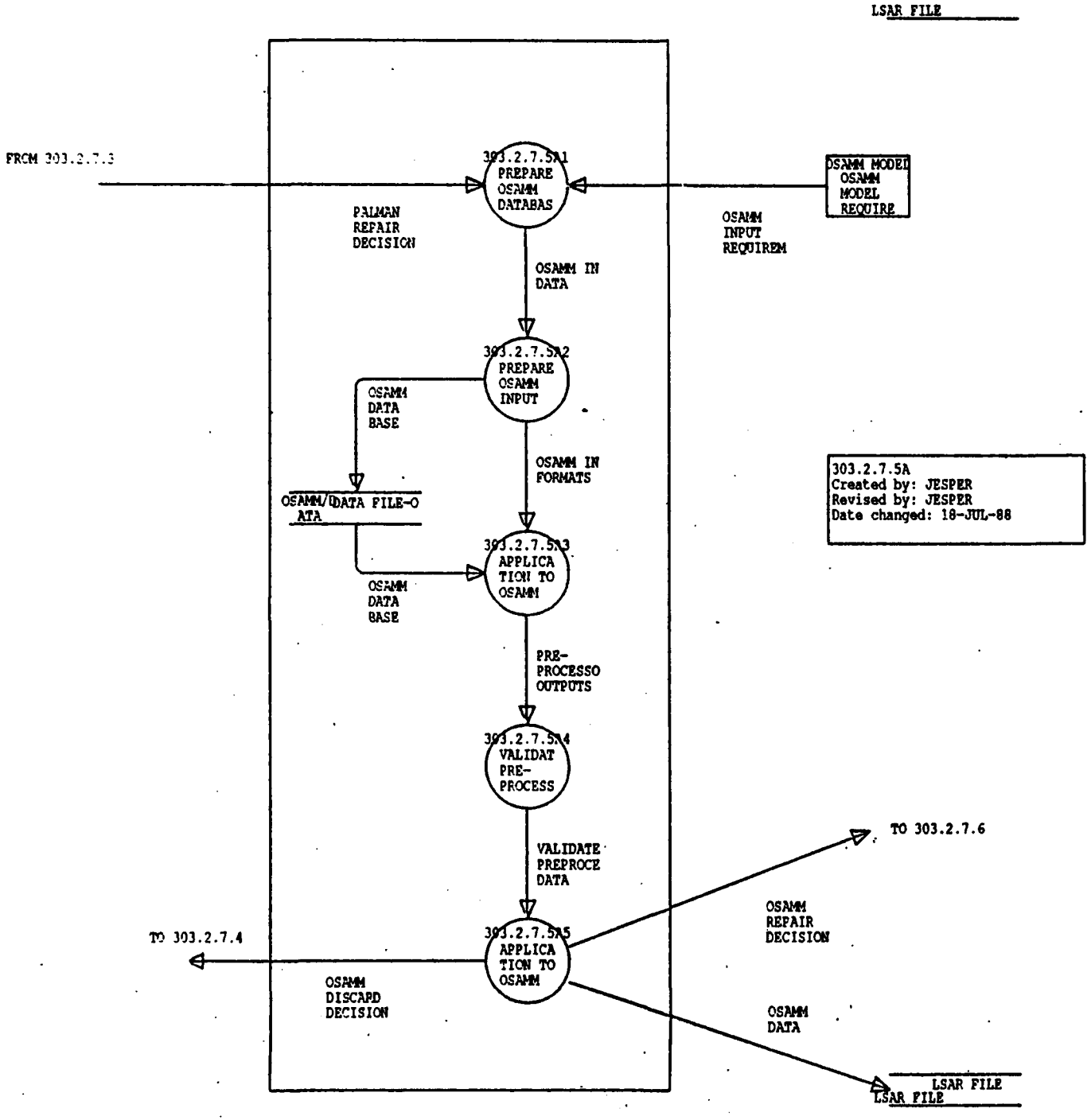
Name	Label	Description
303.2.7.3A5	USER DECISION	ACRONYMS: PROCESS: Based primarily on the results from the Breakeven Cost Evaluation, along with information provided by the Sensitivity Analysis and the Analyis of Repair Policy - Cost Per Failure, the user makes the Repair/ Discard decision. If the replacement cost is less than the breakeven cost, the decision should be Discard. If the replacement cost is greater than the breakeven cost, the decision should be Repair. However, if the replacement cost is close to the breakeven cost, the user should scrutinize the values of those variables deemed critical by the sensitivity analysis. Then the model should be re-run, and the results re-examined. DATA SOURCES:

Name	Label	Description
BE/COST/DATA	BREAKEVEN COST DATA	The Breakeven Cost Data is the primary source of information used in the Repair/Discard decision. Additionally, data from the Breakeven cost analysis is used in the subsequent operations made by the model.
MISC/INPUTS	MISC. INPUTS	The Miscellaneous variables (system peculiar parameters) are: 1. REPHRS : average direct labor corrective maintenance repair time required to repair an assembly 2. COSTRP : average cost of repair part(s) required to repair an assembly 3. UNIQUE : number of new NSN repair parts that must be added to the federal supply system 4. COSTFD : development cost of all special test equipment and facilities required over and above that required for the throwaway concept 5. COSTFP : procurement cost of all special test equipment and facilities required over and above that required for the throwaway concept 6. FAILUR : expected number of failures of the assembly per million hours of constant operation 7. PAGES : number of technical publication pages over and above that required for the throwaway concept 8. HT : hours of training required to perform maintenance on the particular assembly 9. Q : total number of this particular assembly per end item 10. FRACOP : fraction of calender time that the end item is operated 11. PT : number of personnel trained per year to repair the assemblies 12. EN(1) : the expected low number of end items to be failed 13. EN(11) : the expected high number of end items to be failed
PAL/INPUT/DATA	PALMAN INPUT DATA	The Palman Input Data (Standard, Provisioning, and Miscellaneous) is used by the model to perform the necessary calculations.
PAL/LINE	MAINFRAME OR PC-BASED PALMAN MODEL ON LINE	An "on line" Palman Model run from either a mainframe or personal computer is applied to the Repair/Discard analysis.
PALMAN/DISC/DEC	PALMAN DISCARD DECISION	The Palman Model has demonstrated that discarding the failed end item and replacing it with a new equipment/system is the most economical decision.
PALMAN/REP/DEC	PALMAN REPAIR DECISION	The Palman program has shown that the most economical decision is Repair rather than Discard for selected end items, components, parts, or modules. These decisions constitute the major input to the next decision concerning the ideal maintenance level for the repair to be effected. Using the Optimum Supply and Maintenance Model (OSAM), one can determine at which echelon each maintenance function should be performed, or whether the maintenance function should be eliminated altogether.

Name	Label	Description
PROV/INPUTS	PROVISIONING INPUTS	The Provisioning variables (supply related parameters) are: 1. OST(1) : Order and Ship Time between equipment and direct exchange 2. OST(2) : OST in days between DX to Maintenance Level Supply (MLS) 3. OST(3) : OST in days between MLS and Depot 4. OST(4) : OST in days between Depot and Factory 5. OST(5) : OST in days for parts to be obtained by maintenance facility 6. TAT : Turn Around Time in days for assemblies at maintenance facility 7. CKK : Safety Stock Coefficient (decimal %), percent of stock above demand to cover delays 8. RPNSTD : Perecnt of repair parts that are non-standard, requiring new NSN's 9. INIPA : Minimum number of days of authorized assembly stockage 10. INIPP : Minimum number of days of authorized parts stockage 11. DXN : Number of DX supply locations 12. MXN : Number of Maintenance Level Supply locations 13. PNFAIL : Percent of non-operational failures due to obsolescence, shelf life, etc.
REPAIR/POLICY/COST	COST PER FAILURE RESULTS	A breakdown of the cost per failure as well as the percent contribution to the total cost per failure for each cost element.
SENS/ANAL/RESULTS	SENSITIVITY ANALYSIS RESULTS	The results of the Sensitivity Analysis reveal those variables which have the greatest influence on the breakeven cost.

Name	Label	Description
STD/INPUTS	STANDARD INPUTS	The Standard variables (standard input parameters) are: 1. COSTH : Inventory holding cost factor per year (% of purchase) 2. COSTLH : Labor cost per hour including O/H 3. COSTMF : Facility cost per hour for maintenance 4. COSTR : Repair parts requisition cost 5. COSTTH : Transportation and handling cost per assembly 6. FSNI : Cost to enter a line item number in the federal supply system per unique line item 7. FSNR : Yearly cost to maintain a line item - National Stock number (NSN) - in the supply system 8. PROCUR : Administration and engineering support cost for each unique repair part procurement 9. PAGESC : Technical manual per page cost 10. REPNOT : Percentage of assemblies arriving at the repair facility of which repair is attempted but is unsuccessful 11. RETURN : Percentage of failed assemblies returned and received at repair location 12. SQUAP : Cost of preparing a supplemental quality assurance plan for unique reapir parts 13. TFMAIN : Maintenance facilities cost as a percent of facilities and test equipment procurement cost 14. YEARS : Length of time in years that the end item is expected to be in the inventory

Name	Label	Description
PALMAN MODEL	PALMAN MODEL	The Palman Model has been developed to evaluate the breakeven purchase cost for a weapons system component or assembly and to let the user make a decision to either repair the component/assembly or discard it. The operation and specification of the inputs required for the Palman Model are described in the APJ Report 966-309, "Palman Model User's Manual." The Palman Model is written in FORTRAN IV so that is easily portable to most computer systems with a keyboard, monitor, file system, and printer.


LSAR FILE
FROM 303.2.7.3
303.2.7.5A1
PREPARE OSAMM DATABAS
OSAMM MODEL
OSAMM MODEL REQUIRE
PALMAN REPAIR DECISION
OSAMM INPUT REQUIREM
OSAMM IN DATA
303.2.7.5A2
PREPARE OSAMM INPUT
OSAMM DATA BASE
OSAMM IN FORMATS
OSAMM/DATA FILE-O ATA
303.2.7.5A3
APPLICA TION TO OSAMM
OSAMM DATA BASE
PRE-PROCESSO OUTPUTS
303.2.7.5A4
VALIDAT PRE-PROCESS
303.2.7.5A
Created by: JESPER
Revised by: JESPER
Date changed: 18-JUL-88
TO 303.2.7.6
VALIDATE PREPROCE DATA
OSAMM REPAIR DECISION
TO 303.2.7.4
303.2.7.5A5
APPLICA TION TO OSAMM
OSAMM DISCARD DECISION
OSAMM DATA
LSAR FILE
LSAR FILE

Name	Label	Description
303.2.7.5A1	PREPARE OSAMM DATABASE	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model. PROCESS: The preparation of the OSAMM database involves gathering information on the following: 1. End item data Equipment breakdown structure into indenture levels of components, modules, and piece parts. 2. Deployment information The identification of the quantity of equipment, personnel, facilities, etc. and the expected geographical location to include transportation and mobility requirements. 3. Maintenance policies to be considered The established requirements for the overall support of the system throughout its life cycle. 4. Echelon parameters 5. Cost parameters Cost factors can include personnel labor, transportation, training, facilities, inventory, data, and consumables. 6. Test equipment data Includes all tools, condition monitoring equipment, diagnostic and checkout equipment, metrology and calibration equipment, maintenance stands, and handling equipment required to support scheduled and unscheduled maintenance actions associated with the system or product. 7. Repairmen data Either common or special repairmen may be needed for equipment/system repair. 8. Component data 9. Pseudo-component data 10. Module data 11. Pseudo-module data 12. Application data This information lists a module, the component to which it belongs, and the Mean Time Between Failure. DATA SOURCES: AMC-P 700-4 Logistic Support Analysis Techniques Guide

Name	Label	Description
303.2.7.5A2	PREPARE OSAMM INPUT DATA FORMATS	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model CECOM - Communications Electronics Command TR - Technical Report PROCESS: The equipment/system physical characteristics and operational data developed in subtask 303.2.7.1 for application to the OSAMM must be stored on a file consisting of 80 column records. All records are mandatory except where noted. Some of the variables have default values which will be used if a zero is input or if the data field for that variable is left blank. These values should be used only when better data is not available. The correct values for these variables may change, but the defaults may not reflect the change for some time. All data entries should be right justified in their fields except for alphanumeric variables which should be left justified. The decimal point will automatically be placed so that the entry has the number of decimal places indicated. The user may insert his own decimal point which will override the assumed decimal point, however. DATA SOURCES: CECOM-TR-87-3, "Optimum Supply and Maintenance Model," Release 2.0, User's Guide, Sept. '87
303.2.7.5A3	APPLICATION TO OSAMM PREPROCESSOR	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model PROCESS: The input data file is read by the OSAMM preprocessor program. The preprocessor reformats user inputs and computes data required by the main program. It also performs several edit checks and produces a variety of error messages. By reviewing the preprocessor output the user can detect errors in his or her inputs and correct them before expending the resources to run the full model only to find that there is an error in the input data. DATA SOURCES:
303.2.7.5A4	VALIDATE PREPROCESSOR INPUTS/ OUTPUTS	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model PROCESS: The OSAMM user must now inspect the output from the preprocessor. If any errors or discrepancies exist, the user must reconcile them before the basic OSAMM is applied. DATA SOURCES:

Name	Label	Description
303.2.7.5A5	APPLICATION TO OSAMM MODEL	ACRONYMS: OSAMM - Optimum Supply And Maintenance Model PROCESS: The OSAMM can be run in either an Optimization Mode or an Evaluation Mode. In the full Optimization Mode a maintenance concept which minimizes cost is chosen by the model and evaluated. In the Evaluation Mode, the costs associated with a maintenance concept chosen by the user are computed. The Evaluation Mode is useful for performing sensitivity analysis and answering "what if" type questions. Except for a message which describes the performance of the optimization, the model's output is the same in either case. DATA SOURCES:

Name	Label	Description
OSAMM DATA	OSAMM DATA	The data output by the OSAMM model to the LSAR includes: 1. Maintenance policies by application 2. Maintenance Task Distributions (MTD's) 3. Replacement Task Distributions (RTD's) 4. Quantity required of each test equipment/repairman at each echelon 5. Number of spares of each component/module allowed at each echelon, initial spares cost, and consumption spares over the life of the system 6. Total cost of each component/module for holding, transportation, requisition, cataloging, bin, and repair 7. Total logistics cost and achieved operational availability
OSAMM DATA BASE	OSAMM DATA BASE	Data inputs required for application of OSAMM to the system/equipment at each and every indenture level in its Work Breakdown Structure. The data have been set forth in 80-column format as described in the CECOM publication, OSAMM Release 2.0 User's Guide. (CECOM-TR-87-3)
OSAMM INPUT DATA	OSAMM INPUT DATA	PURPOSE OF DATA: The OSAMM input data is used to prepare the input data formats and then it is passed on to the Preprocessor. DATA SOURCE:

Name	Label	Description
OSAMM INPUT FORMS	OSAMM INPUT FORMATS	The specific OSAMM input data formats are as follows: 1. Control Parameters Run Mode Selector-Defines type of run; indicates type of input data. Policy Selector Variables-Limits the number of levels that are considered for certain types of repair or screening actions. 2. End Item Information MTBF (Mean Time Between Failure) Multiplier-All MTBF's input will be multiplied by this factor. The false removal rate default input on this record represents an overall average for the end item. 3. Turnaround Time (TAT) and End Item Repair Information This record contains default values for TAT's and the screening detection fraction which are used when specific data is not input with an individual component or module. 4. End Item Repair Alternatives These records define End Item Repair Alternatives and contain lists of test equipments and/or repairmen that are required to repair the End Item each time it fails. 5. End Item Repair Equip./Repairmen Associated with Specific Equip. These records contain lists of test equipments and/or repairmen that are needed to repair the end item when specific components fail. 6. Deployment Information This record contains SESAME (Selected Essential-Item Stockage Availability Method) model data concerning the supply structure which supports the end item. 7. Labor Rates and Transportation Information This record defines common repairmen at each maintenance level and data which is used to calculate transportation costs. 8. Cost Parameters The record is required even if all of its fields are blank. 9. Test Equipment Information The first record contains basic information and identification number. Parameters that may vary by maintenance level are listed on the second record. 10. Repairman Information The first record contains basic information, and the second contains parameters that may vary by echelon. 11. Component Information The first record is a 4 character, alphanumeric identification. The second record defines the first repair alternative for the component and contains the identification numbers of test equipments and/or special repairmen needed for every repair action. 12. Pseudo-Component Information This information follow regular components in the file. Only one record is required unless the pseudo-component is a candidate for screening. Since pseudo-components are non-repairable, no repair alternatives are needed. 13. Module Information Records arranged in the same manner as component information. 14. Pseudo-Module Information Records arranged in the same manner as pseudo-component information except no failure rate information is input. As with repairable modules, failure information is entered on the application records. 15. Application Information

Name	Label	Description
		belongs, and the MTBF of the module in this application. Multiple occurrences of a module in the same component should be entered as one application. Since each repairable component must contain at least one module, it must be listed with at least one application.
OSAMM INPUTS	OSAMM INPUT REQUIREMENTS	A specification of the inputs required of the system/item being evaluated from the view point of Level of Repair. These inputs must conform to the requirements of OSAMM as spelled out in the OSAMM User's Manual.
OSAMM/DISC/DEC	OSAMM DISCARD DECISION	The OSAMM decision regarding the Level Of Repair Analysis is no repair at all. The failed equipment/system is discarded.
OSAMM/REP/DEC	OSAMM REPAIR DECISION	Repair level decisions made by the model are output by application. The model will describe what should be done when the end item fails due to the failure of a certain module in a certain component. The model will also determine which components and modules should be discarded instead of repaired. This set of repair level decisions is commonly referred to as the "maintenance concept" for the equipment.
PALMAN/REP/DEC	PALMAN REPAIR DECISION	The Palman program has shown that the most economical decision is Repair rather than Discard for selected end items, components, parts, or modules. These decisions constitute the major input to the next decision concerning the ideal maintenance level for the repair to be effected. Using the Optimum Supply and Maintenance Model (OSAMM), one can determine at which echelon each maintenance function should be performed, or whether the maintenance function should be eliminated altogether.
PROC/OUTPUTS	PRE-PROCESSOR OUTPUTS	The Preprocessor outputs are used by the main program for computation as well as edit checks and error messages.
VAL/PREPROC/OUTPUTS	VALIDATED PREPROCESSOR DATA	The validated Preprocessor output data is used by the OSAMM main program to make the supply and maintenance decisions and produce the necessary LSAR data.

Name	Label	Description
DATA FILE - OSA	DATA FILE-OSAMM APPLICATION	A temporary storage of the 80 column cards containing the OSAMM inputs required of the equipment/system. This file may be retained for historical purposes (a baseline for updates) or destroyed at completion of its use.
LSAR FILE	LSAR FILE	This file or records holding area contains: 1. The equipment/system LSA Task reports or their equivalent. 2. The equipment/system LSAR master records sheet information. 3. The equipment/system LSAR reports when system is automated. It contains logistics data which can be used to assess the ILS elements set forth in MIL-STD 1388-1A and conforms to the records/files prescribed in MIL-STD 1388-2A.

Name	Label	Description
OSAMM MODEL	OSAMM MODEL REQUIRE-MENTS	CECOM-TR-87-3, "Optimum Supply and Maintenance Model Release 2.0 User's Guide," is used to identify the specific inputs required for the equipment/system to run the repair level decision model.

ANNEX C

STRUCTURED SYSTEMS ANALYSIS FUNDAMENTALS

ANNEX C
STRUCTURED SYSTEMS ANALYSIS

Fundamentals

Structured Systems Analysis (SSA) has recently become an industry standard for generating Data Flow Diagrams (replacing "logic diagrams" or "flow charts") to aid in coordinating the functions to be performed by a computer program and its associated Inputs/Outputs (I/O). During the SSA, each set of "flow charts" can be checked by the potential user to assure that there is complete agreement on what is to be done by the program, and how it is to be accomplished. It also provides considerable flexibility for updating or changing the program.

Six basic elements are used in SSA:

1. Process (PRC)
2. Data Flow (DAF)
3. Data Store (DAS)
4. External Entity (EXT)
5. Data Flow Diagram (DFD)
6. Data Dictionary (DCT)

PROCESS (Represented by a Circle):

A function or operation to be performed which can be explained by a set of instructions representing a single task, e.g., "calculate interest on a loan", "prepare a draft report". If the Process description is too complex to describe in a few steps, it may be necessary to develop a lower level description (see below).

DATA FLOW (Lines interconnecting Processes or I/Os):

Each function or Process cannot be a stand-alone in a complex network. To have any meaning in a program, each process must be initiated by a previous action and/or provided information on which to act. Furthermore, a Process must result in an output which is the input to the next logical Process. These inputs, outputs, or initiating actions are identified as Data Flows, and are represented by the Data Flow lines indicating its point of origin and the process to which it provides data.

DATA STORE (Represented by two parallel lines):

Although some Processes generate data used as input to a succeeding Process, there is often a need to "gather or collect" information from files in which it is stored. This information may come from an external source (such as a MIL-STD, Army regulation, historical experience files, etc.), or an internal source or file in which data is temporarily stored for use by succeeding processes. These Data Stores can be visualized as a "file cabinet", in which the data are stored for later retrieval).

EXTERNAL ENTITY (Represented by a Rectangle):

Each program or logical process must have an initiating action, a "point" of disposition of the results, and possibly input guidance or instructions. Each of these have authorities, functions, or applications which are independent of the program Process (although required by the program Process). Thus, these activities, agencies, or facilities are considered "External Entities" to the program.

DATA FLOW DIAGRAM:

The general arrangement of the above can be readily seen. First, the circle or Process describes what has to be done; the interconnecting lines represent the Data Flows, together with the specific description of all I/Os. The Data Stores identify the source and/or file designation of a data base, and the External Entities represent those activities remote from the Process, which are the source of guidance or the recipients of the program. This combination of Processes, Data Flows, Data Stores, and External Entities constitutes a "Data Flow Diagram". The unique feature of the Data Flow Diagram (DFD) is that each process can be considered independently, permitting a change to be made in one Process without a major change in the overall program.

DATA DICTIONARY:

The Data Dictionary consists of a complete description of each of the basic elements. For the Process, it contains a step-by-step description of what has to be performed. The description of the Data Flow identifies the nomenclature of the data, a detailed description of its content, and its source. The Data Stores and External Entities are described, including possible location.

The Data Dictionary (a living document) begins with a description of the first Process and is continually built-up as the Data Flow Diagrams are expanded, detailed, and eventually completed.

APPROACH TO PERFORMING STRUCTURED SYSTEM ANALYSIS:

The best approach to Structured Systems Analysis is to assume that the program consists of a series of processes, each of which are to be assigned to an inexperienced analyst. Each analyst is to be walked through the assigned process of the Program, explaining step-by-step what functions have to be performed or what actions have to be taken to accomplish the process. The analyst is also informed where the information is coming from (input Data Flow), what is to be generated by each process (output Data Flow), where the data base may to be found (Data Stores), and who to contact for guidance (External Entities).

The best way to initiate a SSA is to set down the point of origin of a program, its final goal(s), and the intermediate functions or actions needed to get from beginning to goal. Each step should be considered as a Process - some may be sequential and others parallel. Then, the steps needed to accomplish the Process should be described. If the description is complex and needs intermediate steps, the Process is then a candidate for an "explosion". That is, the top (or upper) level Process is considered as a "project" and its own Data Flow Diagram is prepared.

When writing the step-by-step procedures in the Process, certain elements of data (or information) must be made available for the procedure. Each element of data is considered as an input Data Flow, which is identified and described. The product (or result) of a Process is an output Data Flow element.

Each Data Flow to the Process must originate from:

1. an earlier Process
2. a Data Store (or file)
3. an External Entity.

These sources are also identified, described and put into the Data Dictionary. As soon as the last portion of the Data Flow Diagram has been described, the SSA is complete.

GLOSSARY

GLOSSARY

AMCCOM	Armament Munitions and Chemical Command
AMSDL	Acquisition Management Systems and Data Requirements Control List
APJ	American Power Jet Company
AR	Army Regulation
DAF	Data Flow
DAS	Data Store
DCT	Data Dictionary
DFD	Data Flow Diagram
DID	Data Item Description
EXT	External Entity
ILS	Integrated Logistic Support
IPM	Interactive Palman Model
LORA	Level Of Repair Analysis
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Report
MIL-STD	Military Standard
OSAMM	Optimum Supply And Maintenance Model
PAM	Pamphlet
PRC	Process
RLA	Repair Level Analysis
SSA	Structured System Analysis
SSAD	Structured Systems Analysis and Design