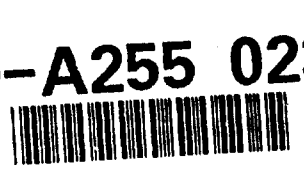

STRUCTURED ANALYSIS/DESIGN

LSA TASK 303
EVALUATION OF ALTERNATIVE AND TRADE-OFF ANALYSIS

SUBTASK 303.2.11
SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

APJ 966-230

APJ

MILITARY & SCIENTIFIC RESEARCH

AMERICAN POWER JET CO. RIDGEFIELD N.J.

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

This report consolidates the Structured Analysis and Structured Design for the Logistic Support Analysis (LSA) Tasks. Included are the Data Flow Diagrams (DFDs) for the LSA Subtask 303.2.11, "Survivability and Battlefield Damage Repair Characteristics", with the corresponding descriptions of the processes, data flows, data stores, and external entities identified on each DFD. The DFDs are further developed into procedures which identifies how to use the data to carry out the processes and accomplish the LSA Subtask. Venture Evaluation Review Technique (VERT) Batch Input files are also provided to assist, as tools, giving both technical and managerial aspects of a task.

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APJ 966-230

STRUCTURED ANALYSIS/DESIGN

LSA TASK 303

EVALUATION OF ALTERNATIVES AND TRADE-OFF ANALYSIS

SUBTASK 303.2.11

SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

under

CONTRACT DAAA21-86-D-0025

for

HQ US AMCCOM
INTEGRATED LOGISTIC SUPPORT OFFICE
AMSMC-LSP
ROCK ISLAND, IL

by

AMERICAN POWER JET COMPANY

RIDGEFIELD, NJ — FALLS CHURCH, VA

WILLIAMSBURG, VA — ST. LOUIS, MO

March 1991

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 full flexibility in selecting tasks and elements to be addressed at each life cycle stage. At the same time it will insure that the application of each task element is consistent with prescribed Army policies and procedures.

This report consolidates the Structured Analysis and Structured Design under one cover for the respective LSA Tasks. Structured Analysis provides a logical model of the method to perform an LSA Task. This logical model facilitates the development of a Structured Design that provides the detailed procedures to perform the analysis. Both the logical model and detailed procedures are used to develop the application software programs which will be provided to Government and contractor personnel to assist in the performance of the LSA Task.

Included in this report are the Data Flow Diagrams (DFDs) for LSA Subtask 303.2.11, "Survivability and Battlefield Damage Repair Characteristics" and the corresponding descriptions of the processes, data flows, data stores, and external entities identified on each DFD (Annex B). In addition the DFDs are further developed into step by step procedures (Annex C) which identifies how to use the data to carry out the processes which ultimately lead to accomplishing the LSA Subtask.

To assist managers in planning and controlling this task, Venture Evaluation Review Technique (VERT) Batch Input Files are provided (Annex D). These VERT tools provide government agencies with complete packages, that cover both technical and managerial aspects of a task, to give to contractors. This approach establishes a standardized form of communication and management between contractors performing the task and government personnel reviewing the task.

To view this work in context, Annex E of this report also presents a brief overview of Structured Analysis and its place in the overall systems development process. The overview, and certain portions of the introductory text are repeated verbatim in every report in this series so that each report is free standing.

EXECUTIVE SUMMARY

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LSA SUBTASK 303.2.11
SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

The American Power Jet Company (APJ) is under contract to the Army Armament Munitions and Chemical Command (AMCCOM) to provide "how to" procedures for selected ILS and LSA tasks. The results of this effort are a series of Structured System Analysis and Structured System Design reports.

The intent of this work is to be compatible with CALS, LOGPARS, and other similar efforts to enhance performance, training, and automation. Our basic structure facilitates the downstream application of Artificial Intelligence and streamlining of these critical functions.

STRUCTURED SYSTEM ANALYSIS

Excelerator, a Computer Aided Software Engineering (CASE) tool, was used to prepare the Structured System Analysis. Each LSA Task is modeled by a series of Data Flow Diagrams (DFDs), depicting activities and accompanying data flows needed to produce intermediate or final products. Complex activities are "broken down" or "exploded" into lower level data flow diagrams.

Each DFD can contain four types of objects:

- **Processes** or activities
- **Data Flows** - inputs to a process or data output generated from a process
- **Data Stores** - identifies sources for the data
- **External Entities** - indicates who to contact for guidance.

Each object is described either by developing detailed procedures or identifying its data content. The object descriptions are placed in a Data Dictionary which is built-up as the Data Flow Diagrams are expanded, detailed, and eventually completed.

STRUCTURED SYSTEM DESIGN

The Structured Design amplifies the processes and data flows developed in the Structured Analysis into procedures used to accomplish the LSA Tasks and Subtasks. The Analysis provides the method and the Design implements it.

In addition to the narrative portions of the Structured Design, "Input Screens" are developed for each process or set of processes. The charts structure and organize the data needed to perform a LSA task and make decisions on Weapon System supportability. By formalizing the data requirements in this manner, a standard set of output reports can be specified.

AUTOMATION

The Structured Design material can of course be used in a manual fashion. However, automation of the task achieves several objectives:

The analyst performing the LSA Task is taken through a series of automated steps leading to a successful result. More time is spent actually doing the work instead of determining what must be done next. Help is available at every step to guide the analyst through the task.

The information is organized so that productivity improves because more time is spent gathering, analyzing, and interpreting the data instead of tedious record keeping.

All data is structured and stored by the software so it can be easily retrieved, edited, and added to.

Output reports are standardized through a report generation facility using preprogrammed report formats. Efficiency improves since the analyst is relieved of the burden of writing and formatting reports. Decision makers receive reports in familiar formats so the most significant sections can be quickly found.

A large volume of data will be captured and stored over a period of time, creating a large "knowledge base". This knowledge base provides a body of procedures, sources, data, and lessons learned for an analyst to query and apply against a new or update analysis effort. This available information forms the of basis an Artificial Intelligence (AI) expert system.

Automation of selected LSA subtasks are being prototyped to demonstrate the principles involved and gain user experience. Although fully general, all prototypes are designed for ready development and adaptation to specific weapon systems.

LSA SUBTASK 303.2.11 DESCRIPTION

The concept of Survivability and Battle Damage Assessment and Repair is to develop wartime procedures that return disabled equipment to an operational commander expeditiously. The task is designed to allow key weapon and materiel systems to be restored to partial, if not full, functional capability or at least be capable of self-recovery when they are damaged or fail on the battlefield.

It isolates components that are design deficient in areas of survivability and repairability from those that allow expeditions repair procedures to be developed. It also recommends design modifications that improve the components survivability and battle resilience characteristics. For components that allow expeditious repair in the battlefield environment, the task develops simple, speedy and effective repair procedures. These procedures may be temporary and may not restore the full performance capability of the system/subsystem.

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INTRODUCTION

PURPOSE

The purpose of this report series is to present the results of the APJ Structured Analysis/Design under Contract DAAA21-86-D-0025 for coordination with the AMCCOM Program Manager prior to in-depth programming of ILS and LSA functions and processes. LSA Task 303 "Evaluation of Alternatives & Trade-Off Analysis", ("LSA Subtask 303.2.11, "Survivability & Battlefield Damage Repair Characteristics") 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 identification of LSA Task 303 "Evaluation of Alternatives & Trade-Off Analysis", LSA Subtask 303.2.11, "Survivability & Battlefield Damage Repair Characteristics", and presents the associated Data Flow Diagrams (DFDs) developed from the Structured Analysis and the corresponding procedures developed in the Structured Design. The portions of the Data Dictionary relating to the DFDs for this LSA Subtask includes the labels, names, descriptions, Processes, Data Flows, Data Stores, and External Entities. (The Data Dictionary is a "living document" that evolves through the analysis and design process). The Structured Design portion of this report develops the Processes and Data Flows developed in the DFDs into procedures which are used to accomplish the LSA Tasks. The DFDs provide the method and the Design implements it, by formulating a guide for programmers to write software applications.

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 E, which defines each element in Structured Analysis.

LSA SUBTASK 303.2.11 DESCRIPTION

The "Survivability and Battlefield Damage Repair Characteristics" Trade-Off Analysis identifies critical components for each system/subsystem during operation on the Battlefield. This subtask identifies systems that are deficient in terms of battle survivability and resilience and display poor battlefield repair characteristics.

A case in point is to differentiate between combat resilience and regular maintainability. The two features that distinguish combat resilience from maintainability are location and time. Combat resilience is a characteristic that is designed into equipment to allow partial, if not full, restoration of functional capability quickly when an item fails or is damaged on the battlefield. Repairs must be made quickly, preferably at the location of the breakdown, so that the equipment can continue its original mission or undertake a more limited mission which may be self recovery.

The approach to this task categorizes system components as either candidates for design change to improve their survivability and battle resilience characteristics or for the establishment of expedient maintenance/repair techniques in the battlefield environment. Components requiring redesign are identified where the design is deficient due to inability to develop expedient maintenance/repair procedures. The other aspect of this task relates to the recommendation of the optimum repair method to be adopted in the battlefield in order to restore the System/Subsystem to its full operational capability.

This task provides the processes and methods required to develop and extract the data and information needed - including the testing requirements and source data used to develop documents for use in the field.

The LSA Task Description with associated task inputs and outputs is extracted from MIL-STD-1388-1A and is included as Annex A.

APPROACH

The APJ approach to Structured Analysis and Structured Design of an LSA Subtask is:

1. Scope the Subtask defined in MIL-STD-1388-1A with the overall task and determine its relationship with other LSA Tasks.

2. Review all pertinent documentation (e.g., AR's, MIL-STDs, etc.) applicable to the specific topic.

3. Prepare the Top Level DFDs in context of the Subtask, and develop lower level DFDs to further elaborate any complex process identified in the top level DFD.

4. Complete the Data Dictionary portion of the Analysis by describing all Processes, Data Flows, Data Stores and External Entities.

5. Apply staff experience in Logistic Support Analysis to assure that the topic has been exhaustively addressed.

6. From the completed DFDs prepare the step by step procedures that form the structured design.

7. Review Data Item Description and other applicable material to develop output reports.

8. If required revise DFDs and Data Dictionary based on preparation of detailed procedures.

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

NOTE: Structured Analysis and preparation of Data Flow Diagrams (DFDs) was 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.

LSA SUBTASK 303.2.11 - SURVIVABILITY AND BATTLEFIELD DAMAGE REPAIR CHARACTERISTICS

The Data Flow Diagram is a tool that shows the 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 results.

A series of three (3) DFDs have been developed to structure the LSA subtask relative to operations and other support functions:

1. 303.2.11 Survivability and Battle Damage Repair Characteristics

2. 303.2.11.2A Evaluate Critical Components

3. 303.2.11.5A Recommend Repair Method

Each DFD is keyed to the specific task through the identification number assigned in the lower right hand box. The Alpha codes indicate the level of indenture or explosion below the top level, i.e.,:

Top Level.....LSA DFD 303.2.11
First Indenture.....LSA DFD 303.2.11.2A

Each DFD makes reference to the basic LSA task it addresses, as well as the level of indenture (explosion) of the DFD. For example, the first or top level DFD, "303.2.11", refers to the section in MIL-STD-1388-1A which describes the review items. One of the processes (bubbles) on the top level diagram (303.2.11.2) is expanded and identified as "303.2.11.2A", a second level of "303.2.11.2" (Alpha "A" indicates the second level).

Four standard symbols are used in the drawing of a DFD (see Annex E - Figure 1).

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

This presents only those Data Dictionary entries necessary for the coordination of the overall concept and details of the processes. To facilitate review of the Data Flow Diagrams, a description of all the entities within them (i.e. Processes, Data Flows, Data Stores and External Entities) is provided. As noted above, they will continue to evolve and be expanded in the System Design phase.

VERT DIAGRAMS

The Venture Evaluation Review Technique (VERT) was developed as a network analysis technique to facilitate management decision making. It allows systematic planning and control of the program and enables managers to find solutions to real life managerial problems. The VERT Diagrams and Batch Input Files for this task can be found in Annex D. In order to understand how these Input Files were developed, a brief discussion of the methodology used is provided. The same explanation is repeated verbatim in every report.

ANNEX A

LSA TASK 303
EVALUATION OF ALTERNATIVE AND TRADE-OFF ANALYSIS

ANNEX A
LSA TASK 303
EVALUATION OF ALTERNATIVES AND TRADE-OFF ANALYSIS 1/

303.1 PURPOSE To determine the preferred support system alternative(s) for each system/equipment alternative and to participate in alternative system trade-offs 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

303.2.11 Conduct evaluations and trade-offs between system/equipment alternatives and survivability and battle damage repair characteristics in a combat environment.

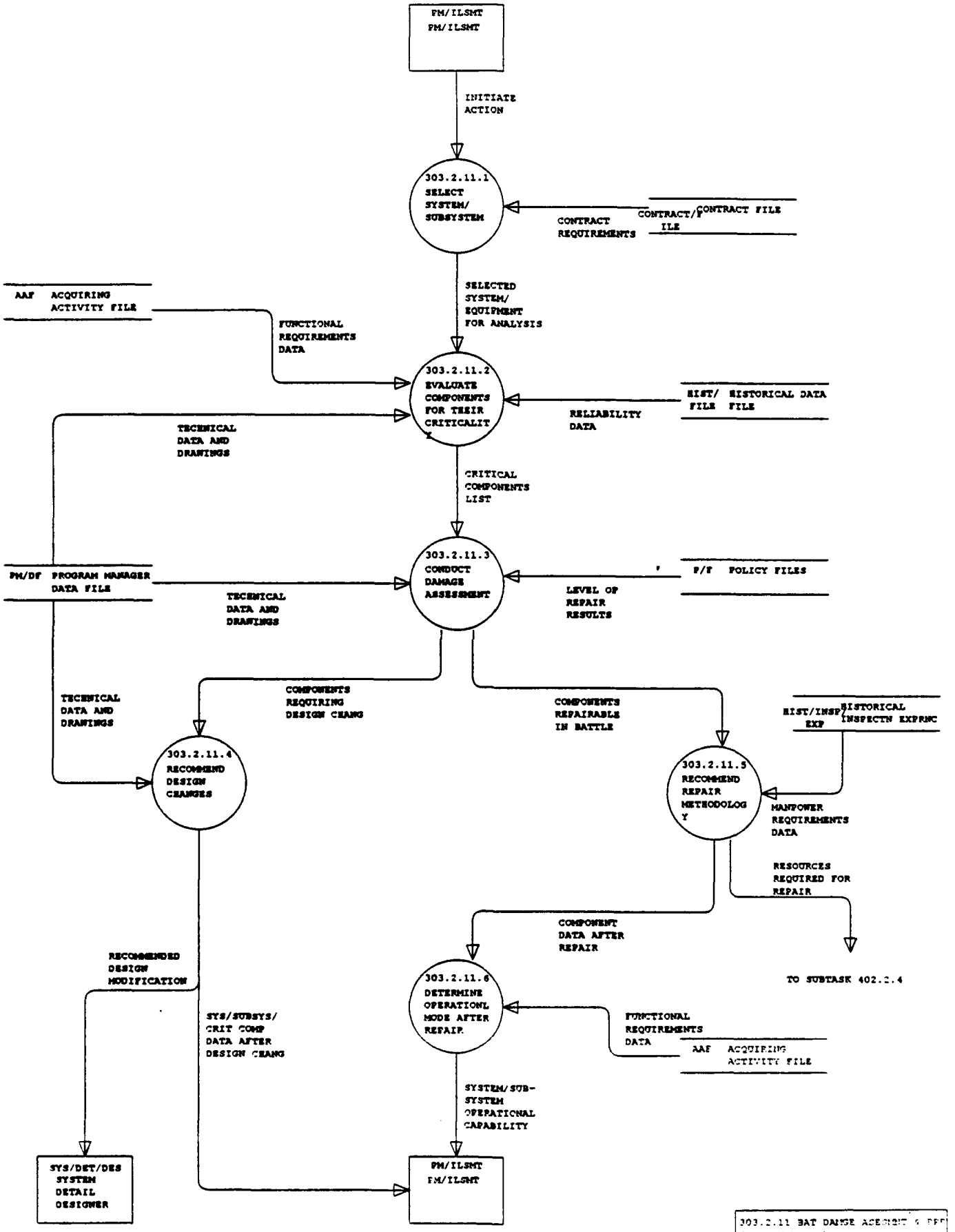
1/ Abstracted verbatim from MIL-STD-1388-1A, April 11, 1983, Pages 36-37.

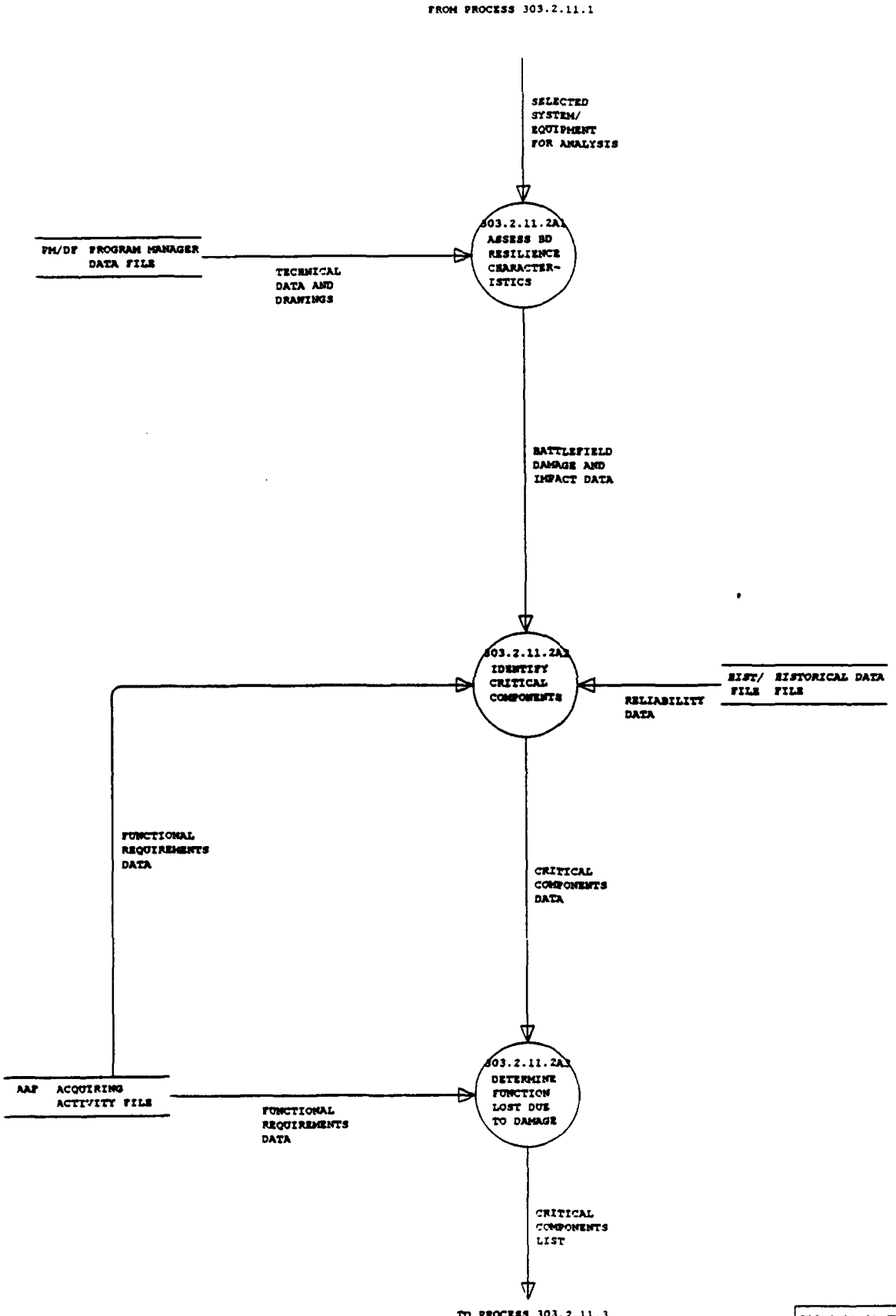
ANNEX B

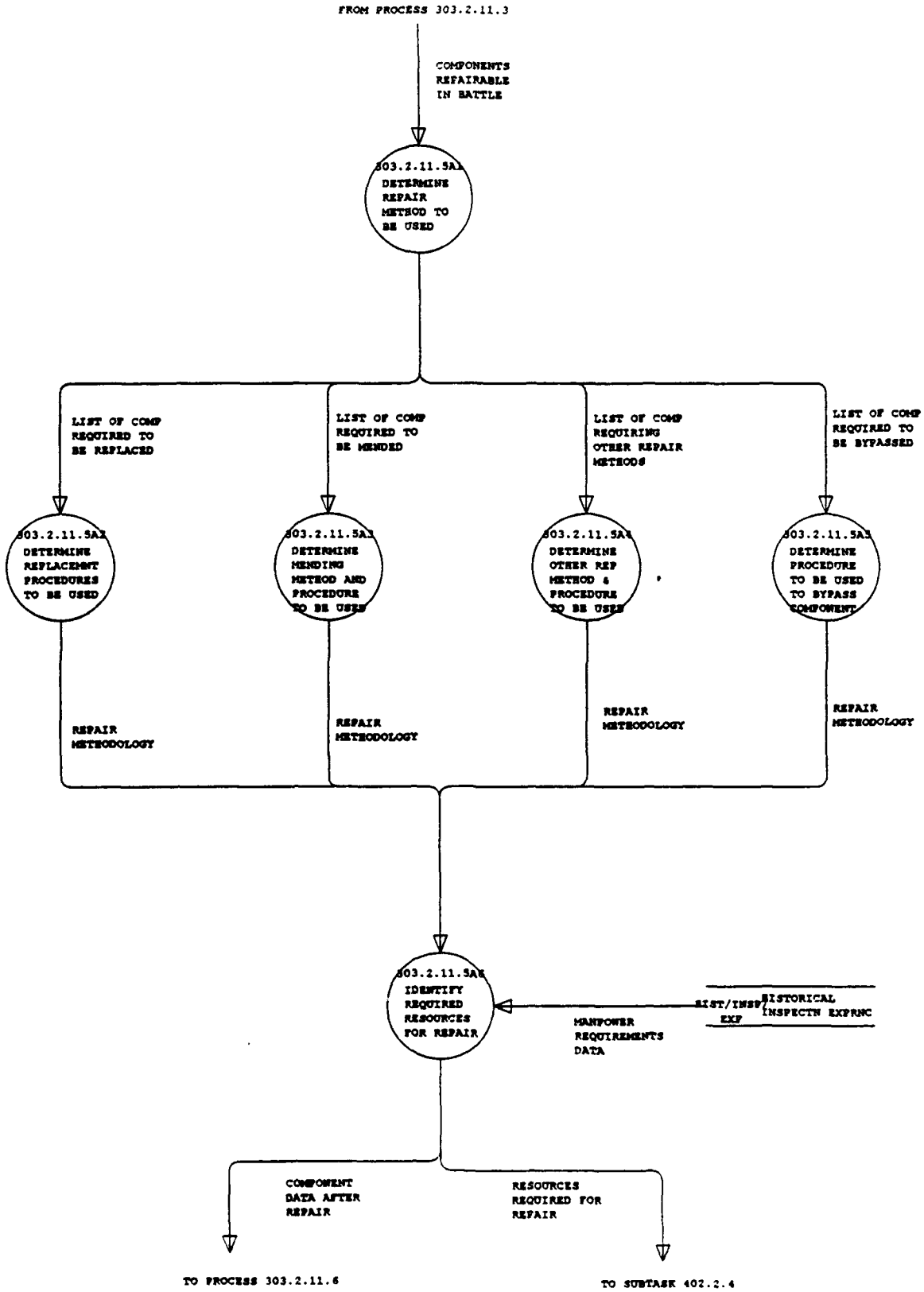
SUBTASK 303.2.11

SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

DATA FLOW DIAGRAMS AND PROCESS DATA DICTIONARY


PM/ILSMT
PM/ILSMT
INITIATE ACTION
303.2.11.1
SELECT SYSTEM/ SUBSYSTEM
CONTRACT REQUIREMENTS
CONTRACT/P ILE
CONTRACT FILE
SELECTED SYSTEM/ EQUIPMENT FOR ANALYSIS
AAF ACQUIRING ACTIVITY FILE
FUNCTIONAL REQUIREMENTS DATA
303.2.11.2
EVALUATE COMPONENTS FOR THEIR CRITICALIT Y
HIST/ FILE
HISTORICAL DATA FILE
RELIABILITY DATA
TECHNICAL DATA AND DRAWINGS
CRITICAL COMPONENTS LIST
303.2.11.3
CONDUCT DAMAGE ASSESSMENT
PM/DF PROGRAM MANAGER DATA FILE
P/F POLICY FILES
LEVEL OF REPAIR RESULTS
TECHNICAL DATA AND DRAWINGS
TECHNICAL DATA AND DRAWINGS
COMPONENTS REQUIRING DESIGN CHANG
COMPONENTS REPAIRABLE IN BATTLE
HIST/INSP EXP
HISTORICAL INSPECTN EXPRNC
303.2.11.4
RECOMMEND DESIGN CHANGES
303.2.11.5
RECOMMEND REPAIR METHODOLOG Y
MANPOWER REQUIREMENTS DATA
RESOURCES REQUIRED FOR REPAIR
COMPONENT DATA AFTER REPAIR
TO SUBTASK 402.2.4
RECOMMENDED DESIGN MODIFICATION
303.2.11.6
DETERMINE OPERATIONL MODE AFTER REPAIR
FUNCTIONAL REQUIREMENTS DATA
AAF ACQUIRING ACTIVITY FILE
SYS/SUBSYS/ CRIT COMP DATA AFTER DESIGN CHANG
SYSTEM/SUB-SYSTEM OPERATIONAL CAPABILITY
SYS/DET/DES SYSTEM DETAIL DESIGNER
PM/ILSMT
PM/ILSMT
303.2.11 BAT DAMGE ASSESSMT & REP
Created by: chau
Revised by: chau
Date changed: 22-FEB-91


FROM PROCESS 303.2.11.1
SELECTED SYSTEM/ EQUIPMENT FOR ANALYSIS
303.2.11.2A1 ASSESS BD RESILIENCE CHARACTER-ISTICS
PM/DF PROGRAM MANAGER DATA FILE
TECHNICAL DATA AND DRAWINGS
BATTLEFIELD DAMAGE AND IMPACT DATA
303.2.11.2A2 IDENTIFY CRITICAL COMPONENTS
HIST/ FILE HISTORICAL DATA FILE
RELIABILITY DATA
FUNCTIONAL REQUIREMENTS DATA
CRITICAL COMPONENTS DATA
303.2.11.2A3 DETERMINE FUNCTION LOST DUE TO DAMAGE
AAF ACQUIRING ACTIVITY FILE
FUNCTIONAL REQUIREMENTS DATA
CRITICAL COMPONENTS LIST
TO PROCESS 303.2.11.3
303.2.11.2A EVAL CRIT COMPONENTS
Created by: chau
Revised by: chau
Date changed: 22-FEB-91


FROM PROCESS 303.2.11.3
COMPONENTS REPAIRABLE IN BATTLE
303.2.11.5A1
DETERMINE REPAIR METHOD TO BE USED
LIST OF COMP REQUIRED TO BE REPLACED
LIST OF COMP REQUIRED TO BE MENDED
LIST OF COMP REQUIRING OTHER REPAIR METHODS
LIST OF COMP REQUIRED TO BE BYPASSED
303.2.11.5A2
DETERMINE REPLACEMNT PROCEDURES TO BE USED
303.2.11.5A3
DETERMINE MENDING METHOD AND PROCEDURE TO BE USED
303.2.11.5A4
DETERMINE OTHER REP METHOD & PROCEDURE TO BE USED
303.2.11.5A5
DETERMINE PROCEDURE TO BE USED TO BYPASS COMPONENT
REPAIR METHODOLOGY
REPAIR METHODOLOGY
REPAIR METHODOLOGY
REPAIR METHODOLOGY
303.2.11.5A6
IDENTIFY REQUIRED RESOURCES FOR REPAIR
HIST/INSP EXP
HISTORICAL INSPECTN EXPRNC
MANPOWER REQUIREMENTS DATA
COMPONENT DATA AFTER REPAIR
RESOURCES REQUIRED FOR REPAIR
TO PROCESS 303.2.11.6
TO SUBTASK 402.2.4
303.2.11.5A REPAIR METHODOLOGY
Created by: chau
Revised by: chau
Date changed: 22-FEB-91

	Name	Label	Description
	303.2.11.1	SELECT SYSTEM/ SUBSYSTEM	PURPOSE: To select System/Subsystem type to be analyzed in this iteration of the LSA Subtask. The System/Subsystem so selected must conform to the Work Breakdown Structure (WBS) set forth in MIL-STD-881. Source of Data: Approved or Unapproved RFP's Approved or Unapproved IFB's Progress Reports
	303.2.11.2	EVALUATE COMPONENTS FOR THEIR CRITICALIT Y	PURPOSE: To evaluate the components of the System/Subsystem for their criticality in performing the functional requirements. Source of Data: Required Operational Characteristics Functional Requirements Data Reliability Data Failure Rate Data Engineering Drawings Hardware Specifications Item/Equipment Specifications Item/Equipment Missions and Functions
	303.2.11.2A1	ASSESS BD RESILIENCE CHARACTER- ISTICS	PURPOSE: To review the survivability and vulnerability characteristics of the System/Subsystem and determine the extent to which its components are resilient to battlefield damage. Source of Data: Engineering Drawings Item/Equipment Specifications
	303.2.11.2A2	IDENTIFY CRITICAL COMPONENTS	PURPOSE: To determine the extent to which a component is critical to the operation of the Equipment/System/Subsystem. In doing so the analyst must take into account the survivability characteristics of the component and the functional requirements of the System/Subsystem. Source of Data: Required Operational Characteristics Functional Requirements Reliability Data Failure Rate Data
	303.2.11.2A3	DETERMINE FUNCTION LOST DUE TO DAMAGE	PURPOSE: This process determines the functions that would be lost due to the various types of damage that could occur to the System/Subsystem/Component when operating in the battlefield environment. This process further exemplifies the criticality of the component in the performance of its operational functions. Source of Data: Required Operational Characteristics Functional rqeuirements Data

	Name	Label	Description
	303.2.11.3	CONDUCT DAMAGE ASSESSMENT	PURPOSE: This process assesses the possible types of damage that could be caused to the critical components. The damage assessment must segregate Systems/Subsytems/Critical Components that are poorly designed for survivability and/or battlefield repair from those that are resilient to battle damage and capable of being repaired on the battlefield. Source of Data: Engineering Drawings Item/Equipment Specifications Item/Equipment Missions and Functions AMC-R-700-27 Level of Repair Analysis Program (LORA)
	303.2.11.4	RECOMMEND DESIGN CHANGES	PURPOSE: To recommend design changes that must be implemented to make the System/Subsystem/Component resilient to battle damage and make it repairable on the battlefield. Source of Data: Engineering Drawings Item/Equipment Specifications Item/Equipment Missions and Functions
	303.2.11.5	RECOMMEND REPAIR METHODOLOGY	PURPOSE: This process evaluates the available repair alternatives to restore as much of the System/Subsystem/Critical Component's operational capabilities as possible. Having evaluated the various alternatives the analyst is to recommend the optimum method of repair for the component. The analyst must also state the resources required to undertake the repair in terms of required tools, manpower, time etc. Source of Data: Trade-off Evaluation Results for Manpower Requirements for Equipments
	303.2.11.5A1	DETERMINE REPAIR METHOD TO BE USED	PURPOSE: To determine the optimum methodology to be used in the battlefield environment so as to restore the System/Subsystem/Critical Component to a state where it can continue its mission with full/partial capability or at least be retrievable to a maintenance facility for extensive repairs.
	303.2.11.5A2	DETERMINE REPLACEMNT PROCEDURES TO BE USED	PURPOSE: To determine the procedure to be adopted to replace the critical component in the battlefield. The possible source of parts for the replacement process amy be any of the following: Spares Cannibalizing Interchange Substitution Sharing Fabrication The procedure must be detailed and provide the operator with all instructions to affect the replacement.

	Name	Label	Description
	303.2.11.5A3	DETERMINE MENDING METHOD AND PROCEDURE TO BE USED	PURPOSE: To determine the method by which the component is to be mended. A generic list of possible mending methods may include any of the following: Jury Rigging Brazing Soldering Gluing The procedure must be detailed and provide the maximunm assistance to the operator in undertaking the process.
	303.2.11.5A4	DETERMINE OTHER REP METHOD & PROCEDURE TO BE USED	PURPOSE: To describe the alternative repair procedure that may be adopted in the battlefield environment for the component. The analyst must remember that the resources required for the mending process should be available in the battlefield environment.
	303.2.11.5A5	DETERMINE PROCEDURE TO BE USED TO BYPASS COMPONENT	PURPOSE: To determine the procedure for bypassing the component in order to restore System/Subsystem operation. The process must also determine any hazards or potential damage that may be caused as a result of the bypass.
	303.2.11.5A6	IDENTIFY REQUIRED RESOURCES FOR REPAIR	PURPOSE: To determine the resources required to repair the component by the suggested method in the battlefield environment. The resource requirements listing should should specify the source of parts, the required tools, manpower requirements, time etc. Source of Data: Trade-Off Evaluation Results on Manpower Requirements Assessment
	303.2.11.6	DETERMINE OPERATIONL MODE AFTER REPAIR	PURPOSE: To determine the operational mode of the Equipment/System/Subsystem after repair. The process would identify whether the Equipment/System/Subsystem/Component is fully operational, partially operational or fit for recovery. The analyst should also identify any limitations imposed on the operation not already specified in the technical documents. Source of Data: Required Operational Characteristics Functional Requirements Data

Name	Label	Description
AFT/DES/DAT	SYS/SUBSYS/ CRIT COMP DATA AFTER DESIGN CHANG	This Data Flow contains information on the recommended design modification and the nature of the improvement as regards resilience to battlefield environment for all Systems/Subsystems/Critical Components.
AFT/REP/DAT	COMPONENT DATA AFTER REPAIR	The data contained in this pertains to the components functionality and limitations after repair.
BAT/DMG/IMP	BATTLEFIELD DAMAGE AND IMPACT DATA	This contains a description of the type of damage the system could encounter on the battlefield and the damage to its operational capability.
COMP/BYPASS	LIST OF COMP REQUIRED TO BE BYPASSED	This Data Flow contains a list of components that are to be bypassed in the event that they fail under operational conditions in the battlefield.
COMP/INDIG/METH	LIST OF COMP REQUIRING OTHER REPAIR METHODS	This is a list of critical components that will have to be repaired using indigenous methods in the event that they are damaged during battlefield operations.
COMP/MEND	LIST OF COMP REQUIRED TO BE MENDED	The data contained here is a list of critical components that require mending in the battlefield environment in the event of a malfunction.
COMP/REP	LIST OF COMP REQUIRED TO BE REPLACED	The data contained here is a list of components which are to be replaced in the event of a malfunction in the battlefield environment.
CONTRACT/REQ	CONTRACT REQUIREMENTS	ACRONYMS: RFP REQUEST FOR PROPOSAL SOW STATEMENT OF WORK PURPOSE OF DATA: PROVIDE THE ANALYST WITH THE DETAILS OF THE CONTRACT REQUIREMENTS FOR THE SYSTEM OR THE DESIGN BEING EVALUATED. SOURCE OF DATA: CONTRACT FILE PROCURING AND ENGINEERING ACTIVITIES (RFP. AND SOW)
CRIT/COMP/DATA	CRITICAL COMPONENTS DATA	The information contained here pertains to the criticality of the components to System/Subsystem operation.
CRIT/COMP/LIST	CRITICAL COMPONENTS LIST	This Data Flow contains a listing of the critical components and parts that are to be analyzed for Battle Damage Assessment and Repair.
DES/CHG/COMP/LST	COMPONENTS REQUIRING DESIGN CHANG	This Data Flow contains a listing of the System/Subsystem components that are weak in design with respect to survivability and battlefield damage assessment and repair.

Name	Label	Description
FUNC/RQMTS	FUNCTIONAL REQUIREMENTS DATA	This Data Flow contains those items identified as new System/Equipment functional requirements.
INIT/ACT	INITIATE ACTION	PURPOSE: THE REQUIRED ACTIONS OF THOSE (IF MORE THAN ONE) ACTIVITIES NECESSARY TO ACTUATE AN ILS ELEMENT ASSESSMENT FOR A SYSTEM AND/OR EQUIPMENT WHICH PROVIDES THE FORMAL AUTHORIZATION FOR THE PERFORMANCE OF AN ILS EFFORT. THESE INITITATING ACTIONS ARE NORMALLY PERFORMED BY THE ILSMT AND/OR THE PROGRAM MANAGER. WILL INCLUDE DATA IDENTIFYING THE NEED FOR ASSESSING AN ALTERNATIVE SYSTEM/EQUIPMENT OR FOR IMPLEMENTATION OF A SPECIFIC ILS/LSA TASK, AS APPLICABLE. THIS NEED MAY BE BASED ON AN EVALUATION OF THE EXISTING REQUIREMENTS ON THE BASELINE SYSTEM/EQUIPMENT OR ON THE ILS/LSA TASKS NEEDED TO FULLY DOCUMENT AND/OR EVALUATE THE IMPACT OF ILS ON THE NEW OR EXISTING SYSTEM/EQUIPMENT OVER ITS LIFE CYCLE. THESE DATA MAY: 1. IDENTIFY THE SPECIFIC ILS/LSA TASK TO BE IMPLEMENTED 2. ESTABLISH MISSION PROFILE 3. IDENTIFY THE RESOURCES THAT EXIST AND/OR MUST BE DEVELOPED 4. ESTABLISH PRIORITIES. SOURCE OF DATA: PROGRAM MANAGER OR ILSMT
LOR/RSLTS	LEVEL OF REPAIR RESULTS	The data contained here pertains to the Level of Repair results and includes: 1. Maintenance task levels identification 2. Manhours required per task 3. Materiels required for repair: a. Technical Documentation b. Support Equipment c. Training d. Labor
MANPWR/DAT	MANPOWER REQUIREMENTS DATA	This Data Flow contains information on manpower requirements, inspection procedures and results, and other associated parameters related to the potential inspections of the developmental system and/or equipment.
REC/DES/CHG	RECOMMENDED DESIGN MODIFICATION	The data flow contains information on the nature of the deficiency and the required design modification to the Critical Component to reduce vulnerability to battlefield damage and to improve battlefield repair characteristics.
REL/DATA	RELIABILITY DATA	PURPOSE OF DATA: TO PROVIDE THE ANALYST WITH APPROPRIATE RELIABILITY DATA. THE DETERMINATION OF THE POSSIBLE AND PROBABLE FAILURE MODES REQUIRES AN ANALYSIS OF RELIABILITY DATA ON THE ITEM SELECTED TO PERFORM EACH OF THE SYSTEM INTERNAL FUNCTIONS. IT IS ALWAYS DESIRABLE TO USE RELIABILITY DATA RESULTING FROM RELIABILITY TESTS ON THE SPECIFIC EQUIPMENT TO BE USED, THE TESTS PERFORMED UNDER THE IDENTICAL CONDITIONS OF USE. WHEN SUCH TESTS ARE NOT AVAILABLE, RELIABILITY DATA FROM MIL-HDBK-217 OR FROM OPERATIONAL EXPERIENCE AND TESTS PERFORMED UNDER SIMILAR USE CONDITIONS ON ITEMS SIMILAR TO THOSE IN THE SYSTEM SHOULD BE USED.

	Name	Label	Description
	REP/COMP	COMPONENTS REPAIRABLE IN BATTLE	This Data Flow contains a listing of components that are resilient to battle damage and are capable of being repaired on the battlefield.
	REP/METHOD	REPAIR METHODOLOGY	This Data Flow contains information on the type of repair method to be used for a failed the component under battlefield conditions. It describes the procedures to be adopted and the limitations involved.
	RSRC/REQ	RESOURCES REQUIRED FOR REPAIR	The data contained here pertains to the resources required to undertake the repair in terms of manpower, tools, time etc. This data is required in Subtask 402.2.4 to assess the combat resource requirements.
	SEL/SYS/EQPT/TO	SELECTED SYSTEM/ EQUIPMENT FOR ANALYSIS	The data consists of a description of the System/Subsystem design that the Program Management Office has requested be analyzed under task 303.2.11. Each System/Subsystem selected for analysis/evaluation as part of an overall effort to analyze several Equipment/System concepts. The analysis results lead to a tradeoff evaluation or another relational comparison to select a System/Subsystem that conforms most closely to the program requirements.
	SYS/OPER/CAPAB	SYSTEM/SUB-SYSTEM OPERATIONAL CAPABILITY	The data contained here describes the operational capability of the Equipment/System/Subsystem after the repair has been completed.
	TECH/DAT/DWG	TECHNICAL DATA AND DRAWINGS	This Data Flow pertains to the latest technical details as indicated in all of the program and contract requirements documents. A complete set of current drawings for the System/Subsystem is also included in this data flow.

Name	Label	Description
AAF	ACQUIRING ACTIVITY FILE	CONTAINS THOSE RECORDS, DOCUMENTS, DECISION PAPERS, SCHEDULES THAT WERE PREPARED AS PART OF THE ACQUISITION INITIATION, JUSTIFICATION, AND PLANNING PRIOR TO THE ASSIGNMENT OF A PROGRAM MANAGER. THE ITEMS IN THIS DATA STORE INCLUDE: A. REQUIRED OPERATIONAL CHARACTERISTICS B. O&O PLAN C. DESIRED R&M PARAMETERS D. THREAT ANALYSIS DATA E. READINESS OBJECTIVES DATA F. FUNTIONAL REQUIREMENTS DATA G. PROJECTED SCHEDULE DATA H. LOGISTICS RESOURCES DATA I. TOA J. TOD K. COST & OPERATIONAL EFFECTIVENESS ANALYSIS (COEA) DATA L. PROJECTED COST DATA M. JUSTIFICATION OF MAJOR SYSTEM NEW START (JMSNS) DATA N. DESIGN SPECIFICATIONS
CONTRACT/FILE	CONTRACT FILE	PURPOSE: THIS IS A REPOSITORY OF ANY CONTRACTUAL DOCUMENTS AFFECTING THE PROJECT. THIS FILE MAY BE CALLED UPON TO VERIFY WHAT THE CONTRACTOR HAS BEEN TASKED TO DO AND HOW WELL HE HAS DONE IT. SOURCE OF DATA: APPROVED OR UNAPPROVED RFP'S, IFB'S, ANY CHANGES, PROGRESS REPORTS, ETC.
HIST/FILE	HISTORICAL DATA FILE	CONTAINS DATA PREVIOUSLY ACQUIRED ON THE ITEM UNDER INVESTIGATION OR SOME SIMILAR SYSTEM AND MAY ADDRESS THE FOLLOWING AREAS (TO BE TREATED SEPARATELY): 1. RELIABILITY DATA 2. FAILURE RATE DATA 3. SPARES AND SPARE FUNDING DATA THE AVAILABILITY, ACCURACY, AND RELEVANCY OF EXPERIENCE OF HISTORICAL DATABASES FROM SIMILAR EXISTING SYSTEMS (OR LOGISTICALY EQUIVALENT SYSTEMS) IS CRUCIAL FOR ACCOMPLISHMENT OF THE LSA TASK IN QUESTION.
HIST/INSP/EXP	HISTORICAL INSPECTN EXPRNC	A Historical File of inspection experiences for like Systems/Equipment that can be used as a basis for development of manpower requirements, inspection procedures and results, and other associated parameters related to the potential inspections of the developmental system and/or equipment.

	Name	Label	Description
	P/F	POLICY FILES	CONTAINS THOSE MILITARY PUBLICATIONS, DECISION PAPERS, MISSIONS & FUNCTIONS, etc, WHICH ARE NEEDED TO ESTABLISH THE LOGISTICAL SUPPORT AND REVIEW REQUIREMENTS OF THE ITEM/EQUIPMENT DEVELOPMENT PROGRAM. THIS DATA STORE INCLUDES: 1. AR 12-16, "MUTUAL LOGISTICS SUPPORT BETWEEN THE U.S. AND OTHER NORTH ATLANTIC TREATY ORGANIZATION FORCES" 1a. AR 70-1, "SYSTEMS ACQUISITION POLICY AND PROCEDURES" 1b. AR 70-2, "RESEARCH, DEVELOPMENT, & ACQUISITION MATERIEL STATUS RECORDING" 1c. AR 70-10, "R&D - TEST & EVALUATION DURING DEVELOPMENT AND ACQUISITION OF MATERIEL" 1d. "AR 570-9, "MANPOWER AND EQUIPMENT CONTROL - HOST NATION SUPPORT" 2. AR 700-9, "POLICIES OF THE ARMY LOGISTIC SYSTEM" 3. AR 700-82, "JOINT REGULATION GOVERNING THE USE AND APPLICATION OF UNIFORM SOURCE MAINTENANCE AND RECOVERABILITY CODES" 4. AR 700-127, "INTEGRATED LOGISTICS SUPPPORT" 5. AR 725-50, "REQUISITIONING, RECEIPT AND ISSUE SYSTEM" 6. AR 750-1, "MAINTENANCE OF SUPPLIES & EQUIPMENT - ARMY MATERIEL MAINTENANCE CONCEPTS & POLICIES" 7. AMC-R-700-27, "LEVEL OF REPAIR ANALYSIS (LORA) PROGRAM" 8. AMC-R-750-10, "DEPOT MAINTENANCE INTERSERVICE" 9. DA PAM 700-4 10. DA PAM 700-28, "INTEGRATED LOGISTIC SUPPORT PROGRAM ASSESSMENT ISSUES AND CRITERIA" 11. DA PAM 700-50, "INTEGRATED LOGISTIC SUPPORT - DEVELOPMENTAL SUPPORTABILITY TEST AND EVALUATION GUIDE" 12. DA PAM 700-55, "INSTRUCTIONS FOR PREPARING THE INTEGRATED LOGISTIC SUPPORT PLAN" 12a. DA PAM 738-750, "THE ARMY MAINTENANCE MANAGEMENT SYSTEMS (TAMMS)" 13. DA PAM 750-21, "LOGISTIC SUPPORT MODELLING" 14. AMC PAM 700-4, "LOGISTICS SUPPORT ANALYSIS TECHNIQUES GUIDE (WITH PALMAN)" 14a. AMC PAM 700-11, "LOGISTICS SUPPORT ANALYSIS REVIEW TEAM GUIDE" 15. AMC PAM 750-2, "MAINTENANCE OF SUPPLIES AND EQUIPMENT GUIDE TO RELIABILITY CENTERED MAINTENANCE" 16. MIL-STD-152, "TECH REVIEW GUIDELINES" 17. MIL-STD-210A, "CLIMATIC EXTREMES FOR MILITARY EQUIPMENT" 18. MIL-STD-470, -471, "MAINTAINABILITY STANDARDS" 19. MIL-STD-756, "RELIABILITY MODELLING & PREDICTIONS" 20. MIL-STD-780, "MAINTENANCE ENGINEERING ANALYSIS CONTROL NUMBER (MEACNS) FOR AERONAUTICAL EQUIPMENT, UNIFORM NUMBERING SYSTEM 21. MIL-STD-781, "RELIABILITY DESIGN QUALIFICATION AND PRODUCTION ACCEPTANCE TESTS: EXPONENTIAL DISTRIBUTION 22. MIL-STD-785B, "RELIABILITY PROGRAM FOR SYSTEMS AND EQUIPMENT DEVELOPMENT & PRODUCTION" 23. MIL-STD-810, "ENVIRONMENTAL TEST METHODS & ENGINEERING GUIDELINES" 24. MIL-STD-881, "WORK BREAKDOWN STRUCTURES FOR DEFENSE MATERIEL ITEMS 25. MIL-STD-882, "SYSTEM SAFETY PROGRAM REQUIRMENTS" 26. MIL-STD-965, "PARTS CONTROL PROGRAM" 27. MIL-STD-1369A, "INTEGRATED LOGISTIC SUPPORT PROGRAM REQUIREMENTS" 28. MIL-STD-1388-1A, "LOGISTICS SUPPORT ANALYSIS" 29. MIL-STD-1388-2A, "LOGISTICS SUPPORT ANALYSIS RECORD" 30. MIL-STD-1629, "PROCEDURES FOR PERFORMING A FAILURE MODE, EFFECTS

Name	Label	Description
		& CRITICALITY ANALYSIS" 31. MIL-HDBK-472, "MAINTAINABILITY PREDICTION" 32. MIL-M-24100B, "FUNCTIONALY ORIENTED MAINTENANCE MANUALS (FOMM) FOR EQUIPMENT & SYSTEMS"
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 and Functions 12. Equipment, Manpower, and Technical risk assessments (From LSA Task 301.2.3) 13. Tradeoff Determination Analysis (TOD) 14. Tradeoff Analysis (TOA) 15. Beast Technical Approach Analysis (BTA) 16. Cost and Operational-Effectiveness Analysis (COEA) 17. Hardware Specifications 18. RAM Requirements

Name	Label	Description
PM/ILSMT	PM/ILSMT	The Program Manager or those activities, agencies or authorities that are responsible for the initiation of the requirement for an ILS element assessment during a development program for a system and/or equipment in accordance with AR 700-127. The key action (output) required of this external entity is the directive, authority, or other documentation that initiates the requirement for the application of this ILS assessment to a specific system/equipment development program at a specified point in it's life cycle in accordance with AR 700-127.
SYS/DET/DES	SYSTEM DETAIL DESIGNER	This entity refers to the designer of the system being investigated. The entity controls the Equipment/System/Subsystem technical specifications and drawings.

ANNEX C

SUBTASK 303.2.11

SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

ANNEX C
SUBTASK 303.2.11
SURVIVABILITY AND BATTLE DAMAGE REPAIR CHARACTERISTICS

PROCESS 303.2.11.1 - SELECT SYSTEM/SUBSYSTEM

PURPOSE

To select the system/subsystem to be analyzed in this iteration of the LSA Subtask. The system/subsystem so selected must conform to the Work Breakdown Structure (WBS) set forth in MIL-STD-881.

PROCEDURES

1. Obtain the Work Breakdown Structure (WBS), technical drawings and specifications for the equipment to be analyzed. If no WBS is available for the equipment, the system/subsystem may be selected from the following generic, though not all inclusive, list:

   a. Power Plant Systems
   b. Fuel Systems
   c. Electrical Systems
   d. Hydraulic/Pneumatic Systems
   e. Transmission Systems
   f. Drive Systems
   g. Track/Suspension
   h. Aircraft Airframe Systems
   i. Armament Systems
   j. Fire Control Systems
   k. Communication and Control Systems
   l. Electronic Systems
   m. Human Accommodations

2. The analyst with the cooperation of the systems engineer, must develop a list of the systems/ subsystems within the design that should be analyzed. The selection should include the systems/subsystems that have high failure rates as indicated in the FMECA data. Selection can also be based on the projected extent of battle damage, considering the items vulnerability and the impact its loss would have on the operation of the system.

   Should a system/subsystem for the equipment not be available in the generic list it may be added to the database by selecting <NEW> option.

PROCESS 303.2.11.2 - EVALUATE COMPONENTS FOR THEIR CRITICALITY

To evaluate the components of the system/subsystem for their criticality in performing the functional requirements.

PROCESS 303.2.11.2A1 - Assess Battle Damage Resilience Characteristics

PURPOSE

To review the survivability and vulnerability characteristics of the system/subsystem and determine the extent to which its components are resilient to battlefield damage.

PROCEDURES

1. Obtain the following documents that refer to the implementation of BDAR:

   a. AR 70-1 Systems Acquisition Policy and Procedure
   b. AR 750-1 Materiel Maintenance Concepts and Policies
   c. AR 700-127 Integrated Logistics Support (ILS)
   d. MIL-STD-1388-1A/2A Logistics Support Analysis
   e. MIL-M-63003 Preparation of BDAR TM's
   f. AMCCOM Regulation 750-5 Battle Damage Assessment and Repair
   g. Engineering Drawings and Technical Specifications of the equipment/system/subsystem from the Program Managers Data File
   h. Design Specifications from the Acquiring Activity File

Note: AMSAA defines Survivability as:

That characteristic of personnel and materiel which enables them to withstand (or avoid) adverse military action or the effects of natural phenomena which ordinarily or otherwise would result in the loss of capability to continue effective performance of the prescribed mission.

2. The analyst must assess each system/subsystem's survivability characteristics. The system/subsystem should be

   (a) Be difficult to detect and acquire
   (b) If acquired, be difficult to hit
   (c) If hit, be difficult to damage
   (d) If damaged be easy to repair

Note: In the case of 2d above it does not necessarily imply that the system/subsystem has to be returned to full functional capability after the repair. The emphasis here should be on expedient repair with the available resources to restore some functional capability essential to the battlefield commander.

PROCESS 303.2.11.2A2 - Identify Critical Components

PURPOSE

To determine the extent to which a component is critical to the operation of the equipment/system/subsystem. In doing so the analyst must take into account the survivability characteristics of the component and the functional requirements of the system/subsystem.

PROCEDURES

1. Obtain the following data from the Program Manager's office:

   a. Reliability Data
   b. Failure Rate Data
   c. Required Operational Characteristics
      O&O Plan
   d. Functional Requirements Data

2. Assess each component and establish whether the component is critical to the performance of the Functional/Operational requirements of the System/Subsystem.

3. In assessing the criticality of the components its reliability and failure rate data must be taken into account.

4. Although, cause is not a factor for BDAR, it is pertinent to consider all possible causes that could render the component unserviceable or cause damage to it. The possible causes are:

   a. Normal Wear and Tear
   b. Careless or Improper Use
   c. Terrain
   d. Improper Maintenance Practices
   e. Enemy Action

5. The analyst must identify which of the components in the Equipment **have to be** repairable on the battlefield. Only those components that are critical to **Mission Performance** or to **Self Retrieval** are to be considered as CRITICAL (have to be repairable) components.

PROCESS 303.2.11.2A3 - Determine the Function Lost Due to the Damage

PURPOSE

This process determines the functions that would be lost due to the various types of damage that could occur to the system/subsystem/component when operating in the battlefield environment. This process further exemplifies the criticality of the component in the performance of its operational functions.

PROCEDURES

1. Obtain the following data from the Program Manager's Office:

   a. Required Operational Characteristics
   b. Functional Requirements Data
   c. O&O Plan

2. For each component, identify the possible damages that could occur.

3. For each possible damage that could occur identify and list the Operational and/or Functional requirement that the Component will be unable to perform.

PROCESS 303.2.11.3 - CONDUCT DAMAGE ASSESSMENT

PURPOSE

This process assesses all possible types of damage that could be caused to the critical components. The damage assessment must segregate systems/subsystems/critical components that are poorly designed for survivability and/or battlefield repair from those that are resilient to battle damage and capable of being repaired on the battlefield.

PROCEDURES

1. Obtain the following data:

   a. Technical Drawings and Specifications
   b. Level of Repair results

2. The analyst must assess the various critical components and identify whether the damage is repairable on the battlefield or whether a design change is required to make the critical component more battle resilient.

3. The analyst must determine whether the design of the critical component will allow a damage assessment to be made on the battlefield. To do so the analyst must study the Technical Drawings and if available take a look at the prototype of the system/subsystem and identify whether the part is accessible in the battlefield.

4. There are four ways in which to conduct a damage assessment. The system/subsystem/critical component must allow either one or more of the following:

   a. Automatic Assessment
   b. Visual Inspection
   c. Testing
   d. Process of Elimination

5. The analyst would have to make a trade-off between Assessability and Survivability of all critical components. The critical components as deficient in these aspects of design should be identified as requiring design modifications.

Note: For survivability the aim is to protect or cover, and thereby hide a critical part; whereas accessibility involves exposing a component to potential damage.

6. For the remaining critical components, the analyst must determine whether they are designed for expedient repairs in the battlefield environment.

7. Other factors to consider while assessing a critical component for Battle Damage Assessment and Repair are to identify whether the component design:

   - has built in redundancy
   - is modular
   - the system/subsystem can utilize standard parts.

8. The Analyst must then list the components in two categories:

   a. Requiring a Design Modification
   b. Capable of being repaired in the battlefield environment

PROCESS 303.2.11.4 - RECOMMEND DESIGN CHANGES

PURPOSE

To recommend design changes that must be implemented to make the system/subsystem/component resilient to battle damage and make it repairable on the battlefield.

PROCEDURES

1. The analyst in consultation with the maintenance engineers must recommend design changes which improve the survivability, battle resilience and the repairability of the critical component identified as requiring such design modifications in process 303.2.11.3.

2. In assessing the design deficiency of the system/subsystem/component the analyst must consider whether the component design incorporates one or more of the following factors:

   a. Easy accessibility of parts
   b. Automatic assessment capability
   c. Designed for testing
   d. Designed for elimination/bypassing
   e. Incorporates Built-in-redundancy
   f. Contributes to survivability
   g. Permits repair in the battlefield environment

3. The analyst must also specify how the design modification will improve the survivability, battle resilience and repairability characteristics of the critical component.

PROCESS 303.2.11.5 - RECOMMEND REPAIR METHODOLOGY

PURPOSE

This process evaluates the available repair alternatives to restore as much of the system/subsystem/critical Component's operational capabilities as possible. Having evaluated the various alternatives the analyst is to recommend the optimum method of repair. The analyst must also state the resources required to undertake the repair in terms of required tools, manpower, time etc.

PROCESS 303.2.11.5A1 - Determine Repair Method to be Used

PURPOSE

To determine the optimum methodology to be used in the battlefield environment so as to restore the system/subsystem/ critical component to a state where it can continue its mission with full/partial capability or at least be retrievable to a maintenance facility for extensive repairs.

PROCEDURES

1. The analyst must assess the severity of the damage as regards mission accomplishment (with full or partial capability). Having done so he/she is to recommend a method of repair to make the System/Subsystem/Critical Component capable of continuing the mission or returning to the maintenance area.

2. Assess the nature of repairs required to restore the lost function, either fully or partially as soon as possible.

3. Identify the methodology to be adopted in affecting the repair in the most efficient manner. The method used should fall into one of four broad categories:

   a. Replace a damaged component or subsystem
   b. Mend the damaged component or subsystem
   c. Bypass the damaged component or subsystem
   d. Use other creative or resourceful means to provide the needed function to the system, subsystem, or Critical Component

   In determining the repair method the analyst must consider the availability of the required resources in the battlefield environment.

PROCESS 303.2.11.5A2 - <u>Determine Replacement Procedure to be Used</u>

PURPOSE

To determine the procedure to be adopted to replace the critical component in the battlefield. The possible source of parts for the replacement process may be any of the following:

a. Spares
b. Cannibalizing
c. Interchange
d. Substitution
e. Sharing
f. Fabrication

The procedure must be detailed and provide the operator with all instructions to affect the replacement.

PROCEDURES

1. Determine the source of the replacement part from one of the six methods mentioned above.

2. Replacement of a component will most likely restore the full function of the system/subsystem/critical component. In the event that the replacement is carried out by cannibalizing from within the system/subsystem it is possible that the portion of the system from which the component was cannibalized might have degraded capability/performance.

3. Identify the time required to diagnose, remove, reinstall and test the components. Also assess the manpower requirements and the tools required to conduct the process.

4. When using substitute parts that do not fit exactly, specify the adaptation and modifications required in the replacement process.

5. Develop a step-by-step procedure to be adopted when replacing the component, if such a procedure does not already exist in the maintenance manuals for the system/subsystem.

PROCESS 303.2.11.5A3 - <u>Determine The Mending Method and Procedure to be Used</u>

PURPOSE

To determine the method by which the component is to be mended. A generic list of possible mending methods may include any of the following:

Jury Rigging - patching an existing part by gluing, tying or substituting almost anything that will allow the function to continue.

Brazing/Soldering - Uniting metal pieces by intensely heating the parts to be joined.

The procedure must be detailed and provide the maximum assistance to the operator in undertaking the process.

PROCEDURES

1. Assess the nature of the damage and whether the damage can be repaired by mending.

2. Identify the method that is to be employed for the mending process and assess the manpower requirements and the tools required to conduct the repair.

3. Determine the time required to diagnose, remove, mend, refit and test the component.

4. Specify the adaptation and modifications required in the mending process.

5. Develop a step-by-step procedure to be adopted when mending the component, if such a procedure does not already exist in the maintenance manuals for the system/subsystem/component.

PROCESS 303.2.11.5A4 - Determine The Other Repair Method and Procedure to be Used

PURPOSE

To describe the alternative repair procedure that may be adopted in the battlefield environment for the component. The analyst must remember that the resources required for the mending process should be available in the battlefield environment.

PROCEDURES

1. Assess the nature of the damage and identify any alternative repair procedure that may be applied to restore the functionality of the component.

2. Having identified an improvised procedure that may be adopted specify the parts or other indigenous items that may be required to carry out the repair process.

3. Assess the manpower, time and tools required to diagnose, remove, repair, test and replace the component in the battlefield environment. In this regard the analyst may consider that in the battlefield environment the repair crew may not adhere to standard safety procedures and adopt shortcuts in the repair process.

4. Develop a step-by-step procedure to be adopted when repairing the component in such an improvised manner if such a procedure does not already exist in the maintenance manuals for the system/subsystem.

5. The analyst should specify any inherent hazards to personnel or additional damage to the system/subsystem/component that might occur as a result of such an indigenous method being adopted. The analyst must ensure that the hazards so specified fall within the bounds of the philosophy of battle resilience and survivability.

PROCESS 303.2.11.5A5 - Determine the Procedure to be Used to Bypass the Component

PURPOSE

To determine the procedure for bypassing the component in order to restore the system/subsystem operation. The process must also determine any hazards or potential damage that may be caused as a result of the bypass.

PROCEDURES

1. Assess the nature of the damage and assess the pros and cons of bypassing the component in order to restore the system/subsystem's functionality.

2. Identify any expedient materiels/parts that might be required to affect the bypass.

3. Assess the manpower, time and tools required to accomplish and test the bypass. In this regard the analyst may consider that in the battlefield environment the repair crew may not adhere to standard safety procedures and adopt shortcuts in the repair process.

4. Develop a step-by-step procedure to be adopted when bypassing the component if such a procedure does not already exist in the maintenance manuals for the system/subsystem.

5. The analyst should specify any inherent hazards to personnel or additional damage to the system/ subsystem/component that might occur as a result of the bypass. The analyst must ensure that the hazards so specified fall within the bounds of the philosophy of battle resilience and survivability.

PROCESS 303.2.11.5A6 - Identify the Required Resources for the Repair

PURPOSE

To determine the resources required to repair the component by the suggested method in the battlefield environment. The resource requirements listing should specify the source of the parts, the required tools, manpower requirements, time etc.

PROCEDURES

1. Depending on the methodology to be adopted for the repair, the analyst must identify all the possible components or materiels required to carry out the repair process.

2. For each component or materiel so identified, specify where the item is to be obtained (from kits, by substitution from standard or non standard replacement, by improvising from other items available in the battlefield etc.).

3. Assess the requirements of tools for the process and discuss their availability in the battlefield.

4. Assess the manpower requirements for the process. The analyst must bear in mind that it is not always necessary to have specialized/ideally qualified personnel to do the job in the battlefield environment.

5. Assess the time requirements to complete the repair process by the suggested method.

6. Identify any other special requirements that might be required to efficiently conduct the repair process.

PROCESS 303.2.11.6 - DETERMINE THE OPERATIONAL MODE AFTER REPAIR

PURPOSE

To determine the Operational mode of the equipment/system/ subsystem after repair. This process identifies whether the equipment/system/subsystem/component is fully operational, partially operational or fit for recovery. The analyst should also identify any limitations imposed on the operation not already specified in the technical documents.

PROCEDURES

1. Assess the capability of the System/Subsystem after the repair has been completed. Classify the equipment/system/subsystem's operational mode in one of the following ways:

   a. Fully Capable
   b. Partially Capable
   c. Self-Recovery Capable

2. Describe any additional precautions or limitations imposed on the operation of the equipment/system/ subsystem after repair. This description must also include any additional hazards to personnel or materiel.

ANNEX D

LSA SUBTASK 303.2.11
VERT APPLICATION METHODOLOGY

VERT APPLICATION METHODOLOGY

BACKGROUND:

Venture Evaluation and Review Technique (VERT) was developed as a network analysis technique to facilitate management decision making. It allows a systematic planning and control of programs and enables managers to find solutions to real life managerial problems.

The terms of the APJ contract require the provision of batch files for each of the VERT networks associated with the various Data Flow Diagrams in the APJ 966 projects.

APJ has been successful in adopting a method for the creation of these networks using the existing EXCELERATOR software package and establishing a naming convention compatible with that used in the Data Flow Diagrams. To do this APJ has made use of the PC model of VERT. A Structured Analysis project was used for this purpose. The prototype VERT network structure was made for one top level and one lower level data flow diagram.

The PC model of VERT has certain limitations built into it. To overcome some of these limitations, certain conventions were used to create the input files. To maintain full generality a set of "dummy" default values were established. The model allows the user to alter the default values of time, cost, and performance to satisfy their specific requirements.

METHODOLOGY:

The basic symbols used to structure the network are:

(i) **SQUARES** - to indicate NODES. These are decision points in the project, or points beyond which the project cannot proceed unless certain criteria are met. There are two type of nodes, one which supports input operations and, the second type which supports output operations.

(ii) **LINES** - to indicate ARCS which are activities that have time, cost, and performance criteria associated with them.

In practice, however, both the arcs and nodes are similar, in that both have time, cost, and performance criteria associated with them. The arcs have a primary and a cumulative set of time, cost, and performance criteria whereas the nodes have only a single cumulative set.

(iii) **NAMING CONVENTIONS** - Efforts have been made to keep the naming convention as compatible as possible to the Data Flow Diagrams. The naming convention used is displayed below.

NODES - All nodes are prefixed with the letter **N**. The individual Nodes are identified by a number and a letter. The number refers to the number of the node within the diagram and the letter refers to the diagram number in the project. In the event that a node has been referenced in an earlier diagram they also carry the number of the node in the earlier diagram as a prefix to the individual node number.

N2.4A

N - All nodes are prefixed with the letter **N**
2 - Gives the number of the node it relates to in a higher level diagram or an earlier data flow diagram within the project. In this case it refers to node **N2** of the top level diagram.
4 - Gives the number of the node it relates to in a higher level diagram or an earlier data flow diagram within the project. In this case it refers to node **N2** of the top level diagram.
A - The nodes in each subsequent explosion are allotted an alphabetical suffix indication the number of the explosion diagram in the particular project. In this case it is the first lower level diagram within the project.

ARCS - All arcs are prefixed with either the letter **C** or **E**. The individual Arcs are identified by two numbers. The first number refers to the number of the arc within the diagram and the second number refers to the number of the diagram within the project. In the event that an arc has been referenced in an earlier diagram they also carry the number of the arc in the earlier diagram as a prefix to the individual arc number. The arcs which are identified by the letter **E** have direct reference to a process in the corresponding data flow diagram and as such are named the same as the process itself.

C3.3.8.4 **E12.1A2**

C - All arcs are prefixed with the letter C. In some cases, however, arcs carry a prefix of **E**. These particular arcs correspond to a process within the data flow diagram and are thus named the same as the process itself.
3.3- Gives the number of the arc it relates to in a higher level diagram or an earlier data flow diagram within the project. In this case it refers to arc number 3 in lower level diagram **#3** within the project.

8.4- Indicates that this particular arc is the #8 arc in the #4 lower level diagram of the project.

BATCH FILES

INPUT FILES - The input file names are given the extension *.**IN**.
OUTPUT FILES - The simulation output files are given the extension *.**OU**.
PRINT FILES - The print files have been given the extension *.**PR**.

(This would allow subsequent updates of the input files to be numbered as **IN1...**, **OU1...**, **PR1...** etc.)

DEFAULT SETTINGS:

Control Record:

(i) The output option selected is "0" which provides a detailed listing, and high level of summary information.

(ii) The input record listing option selected is "0" which prints all input records.

(iii) The composite terminal node output option selected is "16" which assumes family mode and intrafamily transfer of histogram data.

(iv) The number of interactions used are "10" in the demonstration model to facilitate operation in the debug mode if required.

(v) The composite node name and the network name are left as blanks.

(vi) In the run identification the name of the corresponding Data Flow Diagram is used as identification for the network description.

Arc Records:

(i) For each of the arcs the following records are provided:

(a) Master Arc Record
(b) Time Distribution Satellite
(c) Cost Distribution Satellite
(d) Performance Distribution Satellite

(ii) The Distribution Satellite Records are created to provide a uniform statistical distribution.

(iii) The default values used for the minimum and maximum in each criteria are:

TIME	10.0	10.0
COST	10.0	100.0
PERFORMANCE	10.0	50.0

Node Records:

(i) Input Logic - The input logic for the nodes are either "**INITIAL**" or "**AND**".

(ii) Output Logic - The output logic has been defaulted to "**AND**" or "**TERMINAL**".

(iii) The output option indicator and the storage option indicator are defaulted to read "0".

(iv) The node description has also been left blank.

(It is again noted that the user can change the default values to desired values as identified by the particular requirement and applications.)

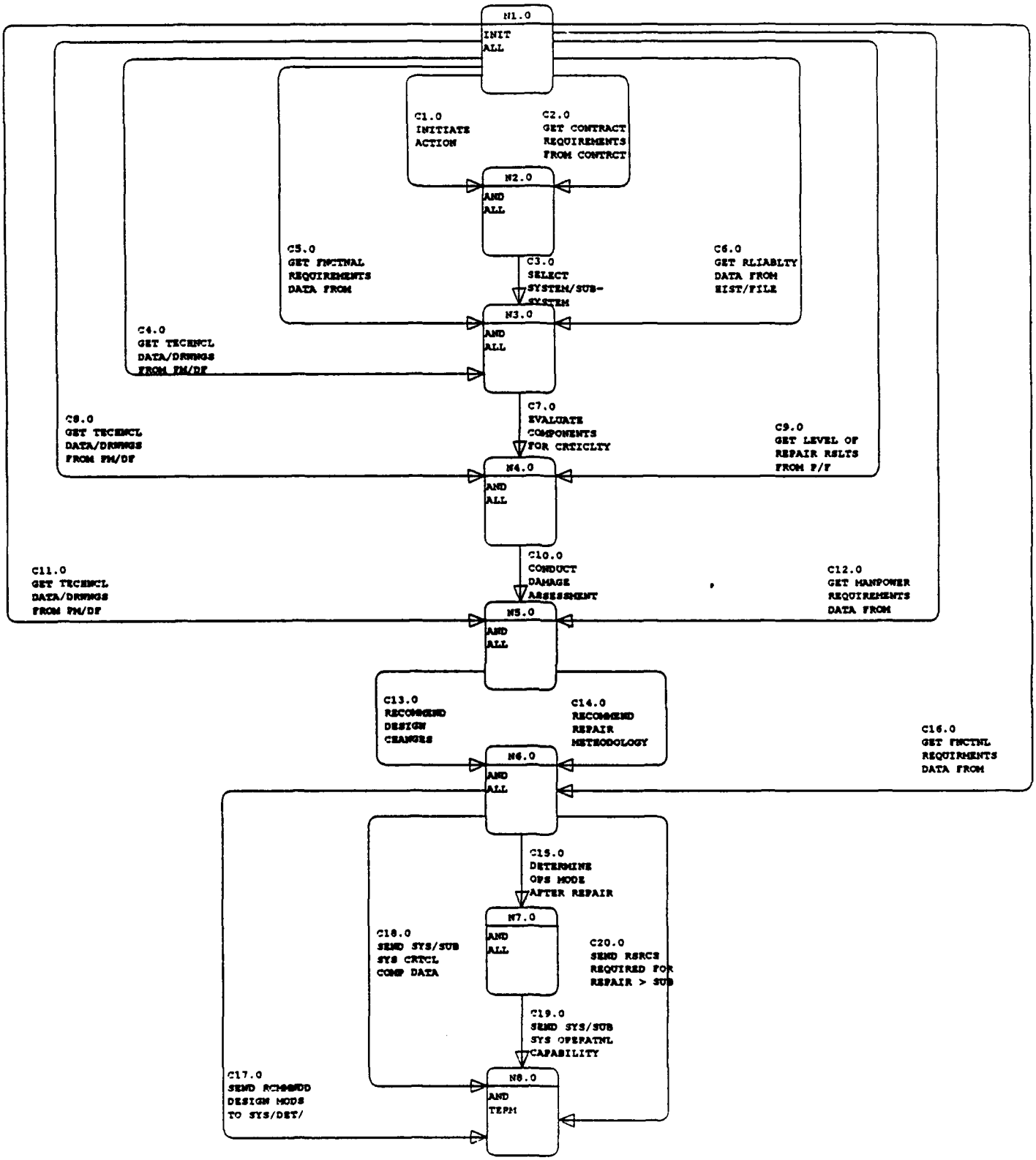
DOCUMENTATION:

With every project report APJ will be providing the following documents relating to the VERT:

(i) A VERt network diagram corresponding to a particular data flow diagram.

(ii) A print out of the VERT network inputs for the particular data flow diagrams.

(iii) A floppy disc containing the sample input, print and the simulation output files for the default VERT network.

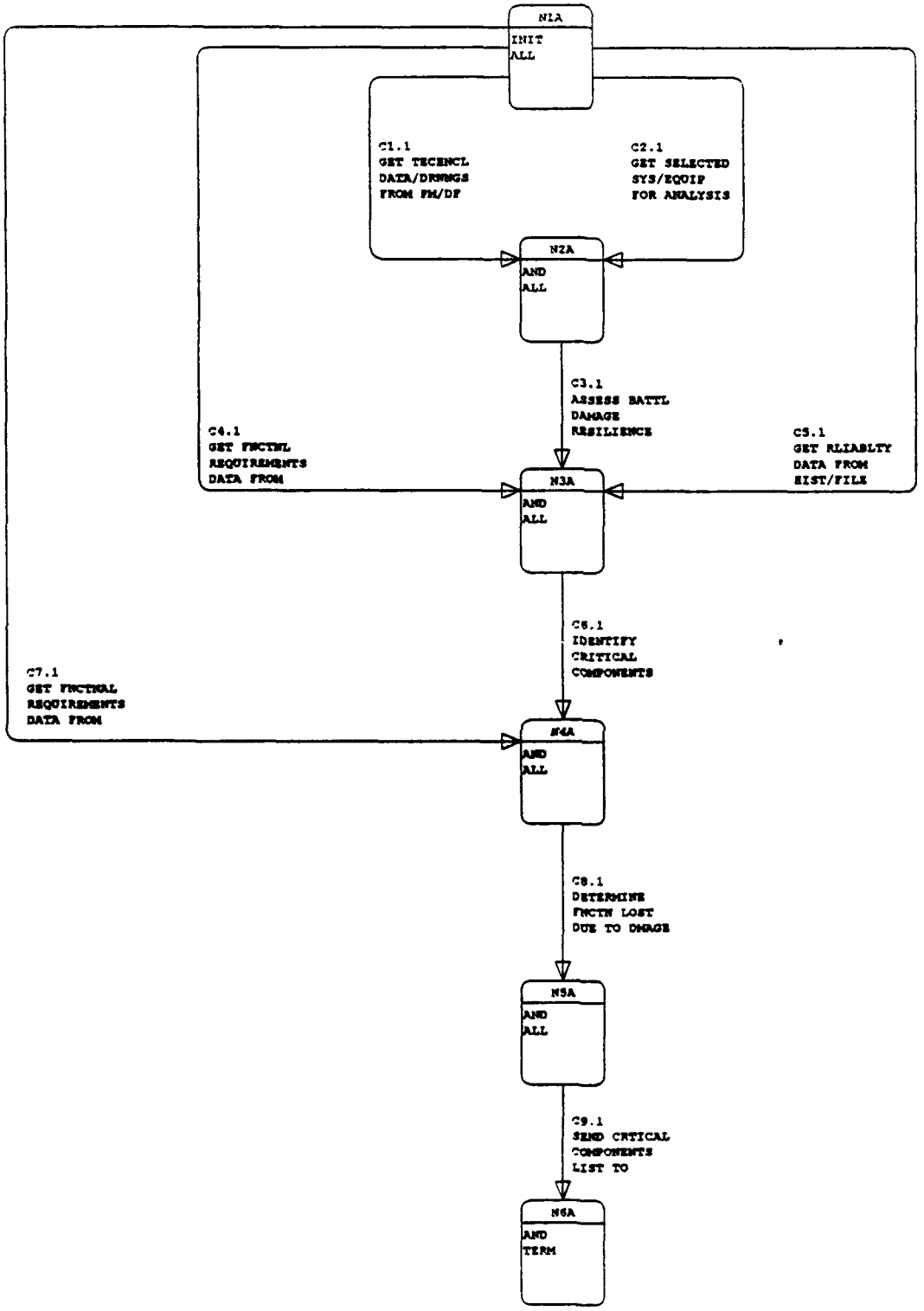


303.2.11 V - BATTLE DAMAGE
Created by: jack
Revised by: jack
Date changed: 20-FEB-91

```
1        N E W   N E T W O R K                    PAGE  1
               1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
   1. 0016  10                  BATTLE DAMAGE ASSESSMENT AND REPAIRS
                +         +         +         +         +         +         +         +
   2. C1.0     N1.0     N2.0      1.0 INITIATE ACTION
   3. C1.0     DTIME 1          2       10.0      20.0
   4. C1.0     DCOST 1          2       10.0     100.0
   5. C1.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
   6. C2.0     N1.0     N2.0      1.0 GET CONTRACT REQUIREMENTS FROM CONTRACT FILE
   7. C2.0     DTIME 1          2       10.0      20.0
   8. C2.0     DCOST 1          2       10.0     100.0
   9. C2.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  10. C3.0     N2.0     N3.0      1.0 SELECT SYSTEM/ SUBSYSTEM FOR ANALYSIS
  11. C3.0     DTIME 1          2       10.0      20.0
  12. C3.0     DCOST 1          2       10.0     100.0
  13. C3.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  14. C4.0     N1.0     N3.0      1.0 GET TECHNICAL DATA & DRAWINGS FROM THE PM/DF
  15. C4.0     DTIME 1          2       10.0      20.0
  16. C4.0     DCOST 1          2       10.0     100.0
  17. C4.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  18. C5.0     N1.0     N3.0      1.0 GET FUNCTIONAL REQUIREMENTS FROM THE AAF
  19. C5.0     DTIME 1          2       10.0      20.0
  20. C5.0     DCOST 1          2       10.0     100.0
  21. C5.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  22. C6.0     N1.0     N3.0      1.0 GET RELIABILITY DATA FROM THE HISTORY FILE
  23. C6.0     DTIME 1          2       10.0      20.0
  24. C6.0     DCOST 1          2       10.0     100.0
  25. C6.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  26. C7.0     N3.0     N4.0      1.0 EVALUATE COMPONENTS FOR CRITICALITY
  27. C7.0     DTIME 1          2       10.0      20.0
  28. C7.0     DCOST 1          2       10.0     100.0
  29. C7.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  30. C8.0     N1.0     N4.0      1.0 GET TECHNICAL DATA & DRAWINGS FROM THE PM/DF
  31. C8.0     DTIME 1          2       10.0      20.0
  32. C8.0     DCOST 1          2       10.0     100.0
  33. C8.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  34. C9.0     N1.0     N4.0      1.0 GET LEVEL OF REPAIR RESULTS FROM P/F
  35. C9.0     DTIME 1          2       10.0      20.0
  36. C9.0     DCOST 1          2       10.0     100.0
  37. C9.0     DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  38. C10.0    N4.0     N5.0      1.0 CONDUCT DAMAGE ASSESSMENT
  39. C10.0    DTIME 1          2       10.0      20.0
  40. C10.0    DCOST 1          2       10.0     100.0
  41. C10.0    DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
  42. C11.0    N1.0     N5.0      1.0 GET TECHNICAL DATA & DRAWINGS FROM THE PM/DF
  43. C11.0    DTIME 1          2       10.0      20.0
  44. C11.0    DCOST 1          2       10.0     100.0
  45. C11.0    DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
```

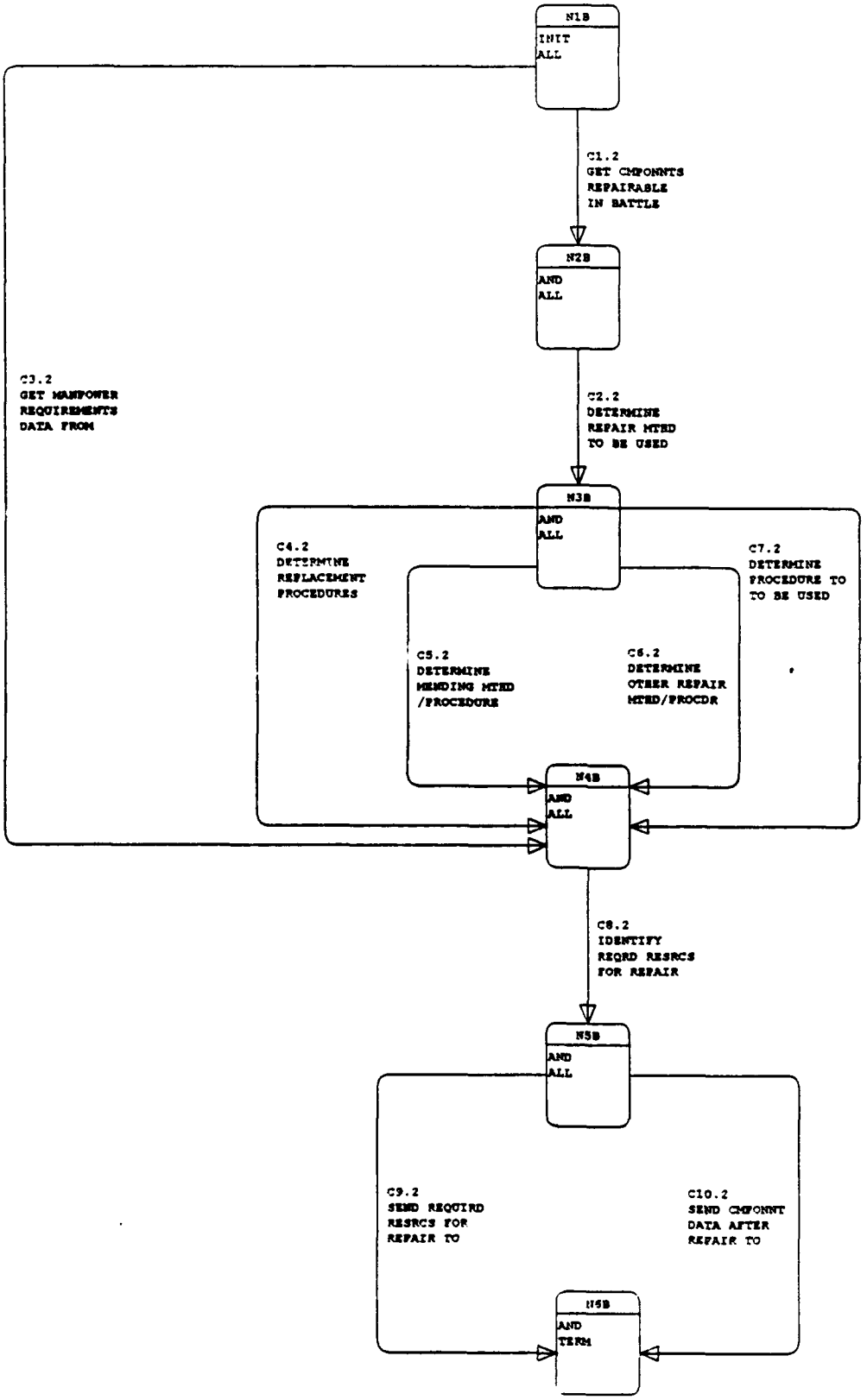
```
          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
1          N E W    N E T W O R K                PAGE  2
          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
   46. C12.0   N1.0    N5.0     1.0 GET MANPOWER REQS DATA FROM HISTORICAL INSPECT EXP
   47. C12.0   DTIME 1         2      10.0      20.0
   48. C12.0   DCOST 1         2      10.0     100.0
   49. C12.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   50. C13.0   N5.0    N6.0     1.0 RECOMMEND DESIGN CHANGES
   51. C13.0   DTIME 1         2      10.0      20.0
   52. C13.0   DCOST 1         2      10.0     100.0
   53. C13.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   54. C14.0   N5.0    N6.0     1.0 RECOMMEND REPAIR METHODOLOGY
   55. C14.0   DTIME 1         2      10.0      20.0
   56. C14.0   DCOST 1         2      10.0     100.0
   57. C14.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   58. C15.0   N6.0    N7.0     1.0 DETERMINE OPERATIONAL MODE AFTER REPAIR
   59. C15.0   DTIME 1         2      10.0      20.0
   60. C15.0   DCOST 1         2      10.0     100.0
   61. C15.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   62. C16.0   N1.0    N6.0     1.0 GET FUNCTIONAL REQUIREMENTS DATA FROM THE AAF
   63. C16.0   DTIME 1         2      10.0      20.0
   64. C16.0   DCOST 1         2      10.0     100.0
   65. C16.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   66. C17.0   N6.0    N8.0     1.0 SEND RECOMMENDED DESIGN MODIFS TO SYS DETAIL DSGNR
   67. C17.0   DTIME 1         2      10.0      20.0
   68. C17.0   DCOST 1         2      10.0     100.0
   69. C17.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   70. C18.0   N6.0    N8.0     1.0 SND SYS/SUBSYS CRIT CMPNT DATA>DSGN CHGS>PM/ILSMT
   71. C18.0   DTIME 1         2      10.0      20.0
   72. C18.0   DCOST 1         2      10.0     100.0
   73. C18.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   74. C19.0   N7.0    N8.0     1.0 SEND SYS/SUBSYS OPERAT'L CAPABILITY TO PM/ILSMT
   75. C19.0   DTIME 1         2      10.0      20.0
   76. C19.0   DCOST 1         2      10.0     100.0
   77. C19.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   78. C20.0   N6.0    N8.0     1.0 SEND RESOURCES REQUIRED FOR REPAIR TO 402.2.4
   79. C20.0   DTIME 1         2      10.0      20.0
   80. C20.0   DCOST 1         2      10.0     100.0
   81. C20.0   DPERF 1         2      10.0      50.0
               +         +         +         +         +         +         +         +
   82. ENDARC
               +         +         +         +         +         +         +         +
   83. N1.0    1  2 0 0
               +         +         +         +         +         +         +         +
   84. N2.0    2  2 0 0
               +         +         +         +         +         +         +         +
   85. N3.0    2  2 0 0
               +         +         +         +         +         +         +         +
   86. N4.0    2  2 0 0
               +         +         +         +         +         +         +         +
```

```
87. N5.0    2  2 0 0
              +        +        +        +        +        +        +        +
              1        2        3        4        5        6        7        8
         12345678901234567890123456789012345678901234567890123456789012345678901234567890
1          N E W    N E T W O R K              PAGE   3
              1        2        3        4        5        6        7        8
         12345678901234567890123456789012345678901234567890123456789012345678901234567890
88. N6.0    2  2 0 0
              +        +        +        +        +        +        +        +
89. N7.0    2  2 0 0
              +        +        +        +        +        +        +        +
90. N8.0    2  1 0 0
              +        +        +        +        +        +        +        +
91. ENDNODE
              1        2        3        4        5        6        7        8
         12345678901234567890123456789012345678901234567890123456789012345678901234567890
```



203.2.11.JA V EVALU[illegible] SPIT [illegible]NF
Created by: jack
Revised by: jack
Date changed: 20-FEB-91

```
0016  10                EVALUATE CRITICAL COMPONENTS
C1.1    N1A     N2A      1.0 GET TECHNICAL DATA/DRAWINGS FROM PM/DF
C1.1    DTIME 1         2       10.0       20.0
C1.1    DCOST 1         2       10.0      100.0
C1.1    DPERF 1         2       10.0       50.0
C2.1    N1A     N2A      1.0 GET SELECTED SYSTEM/EQUIPMENT FOR ANALYSIS
C2.1    DTIME 1         2       10.0       20.0
C2.1    DCOST 1         2       10.0      100.0
C2.1    DPERF 1         2       10.0       50.0
C3.1    N2A     N3A      1.0 ASSESS BATTLE DAMAGE RESILIENCE
C3.1    DTIME 1         2       10.0       20.0
C3.1    DCOST 1         2       10.0      100.0
C3.1    DPERF 1         2       10.0       50.0
C4.1    N1A     N3A      1.0 GET FUNCTIONAL REQUIREMENTS DATA FROM THE AAF
C4.1    DTIME 1         2       10.0       20.0
C4.1    DCOST 1         2       10.0      100.0
C4.1    DPERF 1         2       10.0       50.0
C5.1    N1A     N3A      1.0 GET RELIABILITY DATA FROM THE HISTORY FILE
C5.1    DTIME 1         2       10.0       20.0
C5.1    DCOST 1         2       10.0      100.0
C5.1    DPERF 1         2       10.0       50.0
C6.1    N3A     N4A      1.0 IDENTIFY CRITICAL COMPONENTS
C6.1    DTIME 1         2       10.0       20.0
C6.1    DCOST 1         2       10.0      100.0
C6.1    DPERF 1         2       10.0       50.0
C7.1    N1A     N4A      1.0 GET FUNCTIONAL REQUIREMENTS DATA FROM THE AAF
C7.1    DTIME 1         2       10.0       20.0
C7.1    DCOST 1         2       10.0      100.0
C7.1    DPERF 1         2       10.0       50.0
C8.1    N4A     N5A      1.0 DETERMINE FUNCTION LOST DUE TO DAMAGE
C8.1    DTIME 1         2       10.0       20.0
C8.1    DCOST 1         2       10.0      100.0
C8.1    DPERF 1         2       10.0       50.0
C9.1    N5A     N6A      1.0 SEND CRITICAL COMPONENTS LIST TO PROCESS 303.2.11.3
C9.1    DTIME 1         2       10.0       20.0
C9.1    DCOST 1         2       10.0      100.0
C9.1    DPERF 1         2       10.0       50.0
ENDARC
N1A     1  2 0 0
N2A     2  2 0 0
N3A     2  2 0 0
N4A     2  2 0 0
N5A     2  2 0 0
N6A     2  1 0 0
ENDNODE
```



303.2.11.5A V REPAIR METHODOLOGY
Created by: jack
Revised by: jack
Date changed: 19-FEB-91

```
1        N E W   N E T W O R K                PAGE  1
               1         2         3         4         5         6         7         8
     12345678901234567890123456789012345678901234567890123456789012345678901234567890
  1. 0016  10                  REPAIR METHODOLOGY
               +         +         +         +         +         +         +         +
  2. C1.2    N1B     N2B      1.0 GET COMPONENTS REPAIRABLE IN BATTLE
  3. C1.2    DTIME 1          2       10.0      20.0
  4. C1.2    DCOST 1          2       10.0     100.0
  5. C1.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
  6. C2.2    N2B     N3B      1.0 DETERMINE REPAIR METHOD TO BE USED
  7. C2.2    DTIME 1          2       10.0      20.0
  8. C2.2    DCOST 1          2       10.0     100.0
  9. C2.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 10. C3.2    N1B     N4B      1.0 GET MANPOWER REQS DATA FROM HISTRCL INSP EXPERIENCE
 11. C3.2    DTIME 1          2       10.0      20.0
 12. C3.2    DCOST 1          2       10.0     100.0
 13. C3.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 14. C4.2    N3B     N4B      1.0 DETERMINE REPLACEMENT PROCEDURES
 15. C4.2    DTIME 1          2       10.0      20.0
 16. C4.2    DCOST 1          2       10.0     100.0
 17. C4.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 18. C5.2    N3B     N4B      1.0 DETERMINE MENDING METHOD & PROCEDURE
 19. C5.2    DTIME 1          2       10.0      20.0
 20. C5.2    DCOST 1          2       10.0     100.0
 21. C5.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 22. C6.2    N3B     N4B      1.0 DETERMINE OTHER REPAIR METHODS AND PROCEDURES
 23. C6.2    DTIME 1          2       10.0      20.0
 24. C6.2    DCOST 1          2       10.0     100.0
 25. C6.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 26. C7.2    N3B     N4B      1.0 DETERMINE PROCEDURE TO BE USED
 27. C7.2    DTIME 1          2       10.0      20.0
 28. C7.2    DCOST 1          2       10.0     100.0
 29. C7.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 30. C8.2    N4B     N5B      1.0 IDENTIFY REQUIRED RESOURCES FOR REPAIR
 31. C8.2    DTIME 1          2       10.0      20.0
 32. C8.2    DCOST 1          2       10.0     100.0
 33. C8.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 34. C9.2    N5B     N6B      1.0 SEND REQUIRED RESOURCES FOR REPAIR TO 402.2.4
 35. C9.2    DTIME 1          2       10.0      20.0
 36. C9.2    DCOST 1          2       10.0     100.0
 37. C9.2    DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 38. C10.2   N5B     N6B      1.0 SEND COMPONENT DATA AFTER REPAIR TO PROC 303.2.11.6
 39. C10.2   DTIME 1          2       10.0      20.0
 40. C10.2   DCOST 1          2       10.0     100.0
 41. C10.2   DPERF 1          2       10.0      50.0
               +         +         +         +         +         +         +         +
 42. ENDARC
               +         +         +         +         +         +         +         +
 43. N1B     1  2 0 0
               +         +         +         +         +         +         +         +
               1         2         3         4         5         6         7         8
```

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      12345678901234567890123456789012345678901234567890123456789012345678901234567890
1       N E W   N E T W O R K                PAGE  2
              1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
   44. N2B    2  2 0 0
               +         +         +         +         +         +         +         +
   45. N3B    2  2 0 0
               +         +         +         +         +         +         +         +
   46. N4B    2  2 0 0
               +         +         +         +         +         +         +         +
   47. N5B    2  2 0 0
               +         +         +         +         +         +         +         +
   48. N6B    2  1 0 0
               +         +         +         +         +         +         +         +
   49. ENDNODE
              1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

ANNEX E

STRUCTURED SYSTEMS ANALYSIS FUNDAMENTALS

NOTE: This presentation of Structured Analysis Fundamentals is reproduced verbatim in each report

ANNEX E
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 (see figure 1) 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 possible 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 Data Flow Diagram, told what step by step is 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.

The structured Analysis phase is followed by Structured Design, then by programming and finally software test and validation. The organization of Structured Analysis and its relationship to Structured System Design is shown on Figure 2.

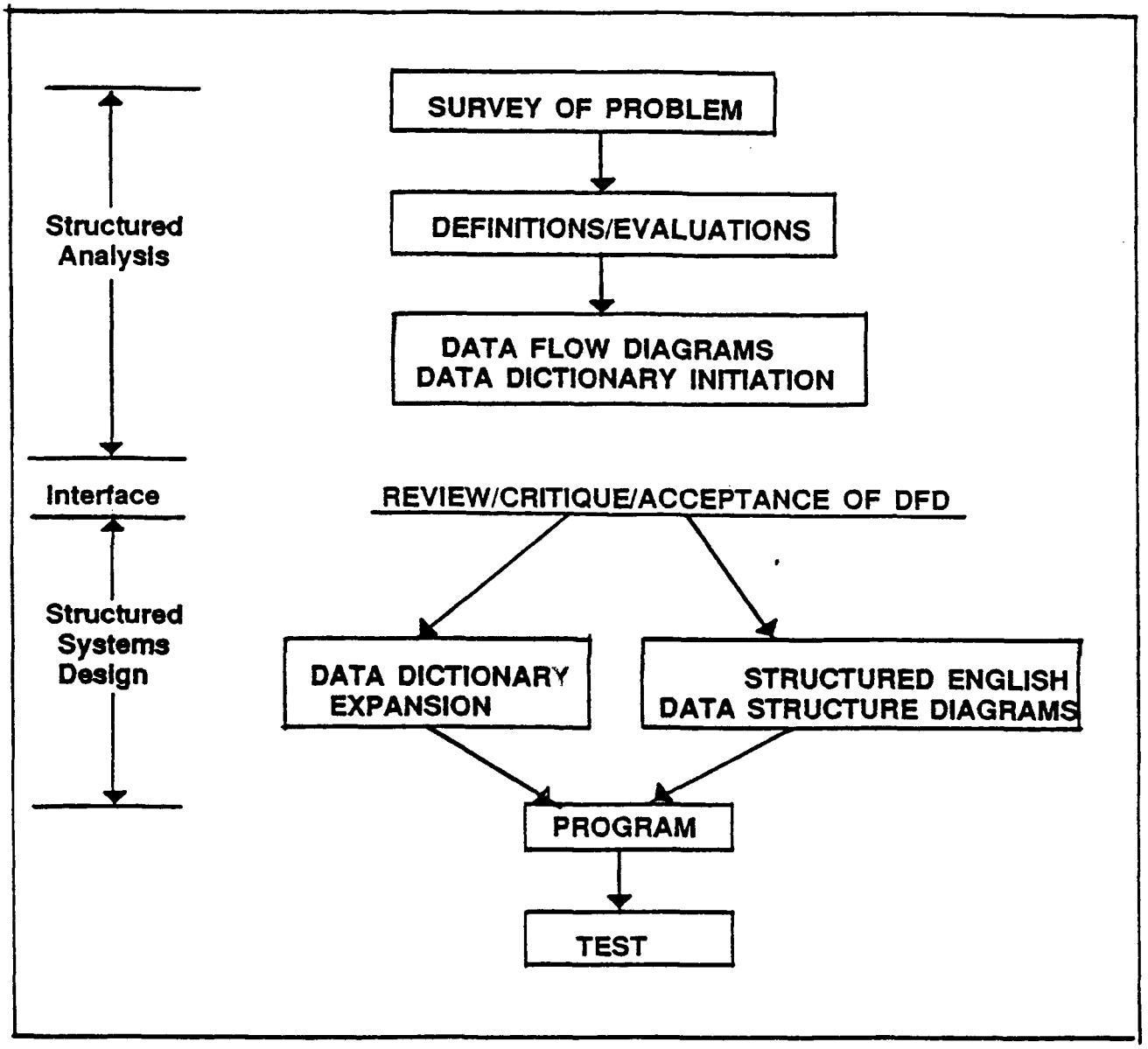

Figure 1. Structured Analysis & Structured Systems Design Organization

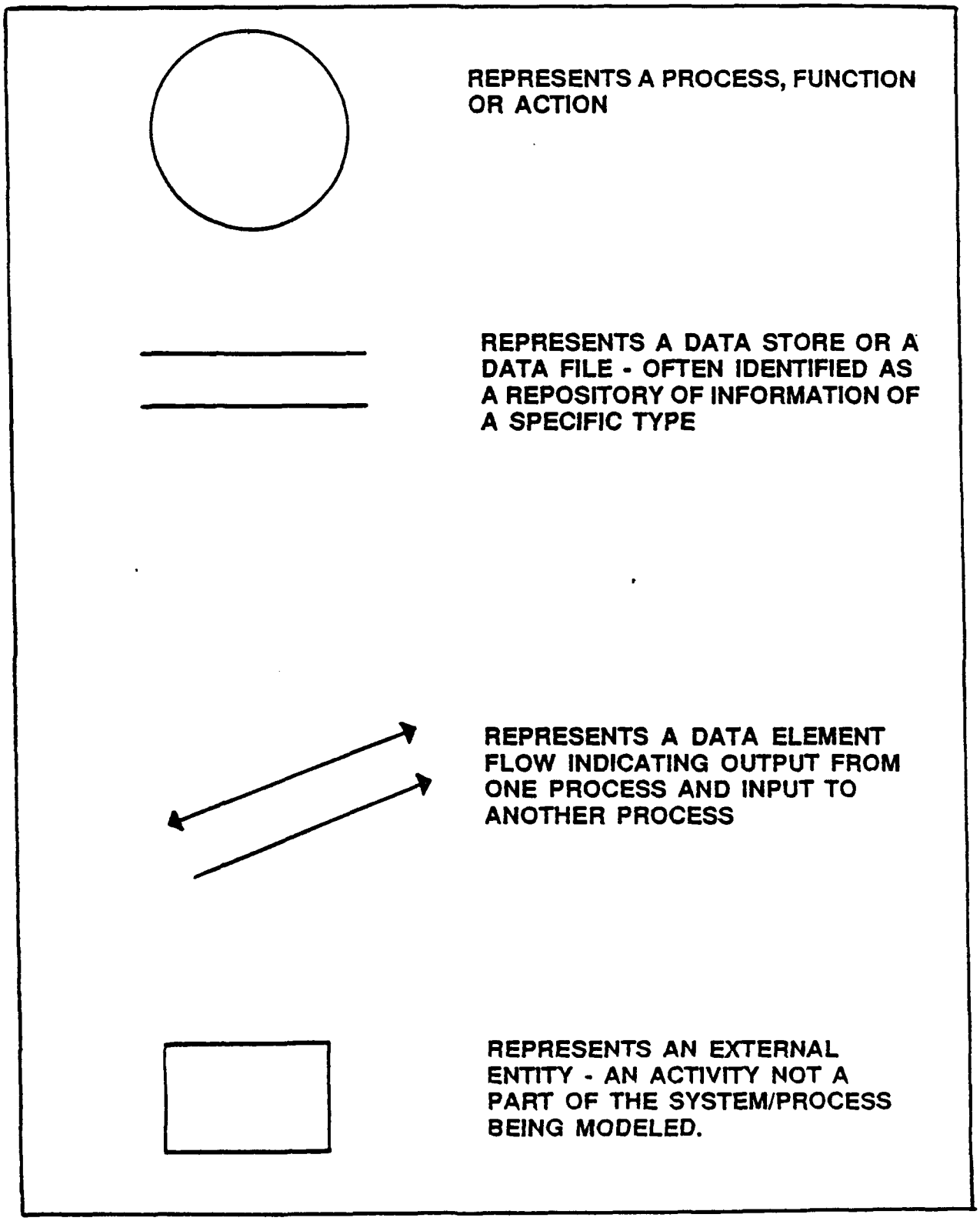

Figure 2. Standard DFD Symbol Definitions