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MIL-HDBK-1390
29 January 2015

DEPARTMENT OF DEFENSE HANDBOOK

LEVEL OF REPAIR ANALYSIS

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FOREWORD

1. This handbook is approved for use by all departments and agencies of the Department of Defense (DoD).

2. This handbook provides guidance for the framework and descriptions governing the performance of Level of Repair Analysis during a product's life cycle as defined by SAE AS1390, Level of Repair Analysis (LORA). When these requirements and activities are performed in a logical and iterative nature, they comprise the LORA process. The LORA process is an analytical effort undertaken to influence decisions on a system's design, maintenance planning, cost, and Integrated Product Support (IPS) Element resources. As a consequence, the LORA process forms an integral part of the Product Support Analysis (PSA) process by using results of, and feeding results to, various PSA activities and the Logistics Product Data (LPD) as defined in SAE TA-STD-0017, Product Support Analysis.

3. SAE AS1390 was adopted for use by the DoD on 08 October 2014 and SAE TA-STD-0017 was adopted for use by the DoD on 11 June 2013.

4. This handbook applies to all system acquisition programs, major modification programs, and applicable research and development projects requiring LORA through all phases of the product life cycle.

5. This handbook does not present a "cookbook" approach to LORA – such an approach could not accommodate the vast, widely varying, array of potential materiel acquisitions and scenarios. It does offer examples and points to consider to help you shape your overall thought processes.

6. The examples provided are just that – examples only. They are not meant to be a definitive solution. They are meant as a launch platform to give you insights into an innovative solution to your particular problem. It follows then, that explicitly following an example in this handbook is likely to create more problems than it solves.

7. It is understood that the term "new" not only applies to brand-new products, systems, or equipment, but may also refer to a change or a major modification to a product, system, or equipment.

8. All specific references to activities, sub-activities, SAE GEIA-STD-0007 Copyright © 2014, SAE TA-STD-0017 Copyright © 2014, and SAE AS1390 Copyright © 2014 are used with permission from SAE International (http://www.sae.org).

9. Comments, suggestions, or questions on the document should be addressed to Commander, U.S. Army Materiel Command, Logistics Support Activity (LOGSA), ATTN: Logistics Data Standards (AMXLS-AL), Building 3307, Mauler Road, Redstone Arsenal, AL 35898-7466 or emailed to usarmy.redstone.logsa.list.multiview@mail.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

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1 SCOPE

1.1 Scope. This handbook addresses the overall LORA process and its associated activities, the selection and tailoring of those activities to meet DoD program supportability objectives, and sample contract language for acquiring LORA deliverables. The handbook offers implementation guidance on SAE AS1390, Level of Repair Analysis, activities as an integral part of the overall systems engineering process. The information contained herein is applicable, in part or in whole, to all system acquisition programs, major modification programs, and applicable research and development projects requiring LORA through all phases of the product life cycle. The focus of this handbook is to provide guidance to the members of the defense acquisition workforce who are responsible for the supportability of materiel systems requiring LORA. This handbook is for guidance only and cannot be cited as a requirement.

2 APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in Sections 4, 5, or 6 of this handbook. This section does not include documents cited in other sections of this handbook or recommended for additional information or as examples.

2.2 Government documents. The following government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-245	-	Handbook for Preparation of Statement of Work (SOW)
MIL-HDBK-502	-	Product Support Analysis
MIL-HDBK-798	-	System Engineer's Design for Discard Handbook

(Copies of these documents are available online at https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publication form part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE DIRECTIVES

DoDD 4151.18	-	Maintenance of Military Materiel

(Copies of DoD Directives are available at http://www.dtic.mil/whs/directives or from the Defense Technical Information Center, 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060-6218.)

DEPARTMENT OF DEFENSE INSTRUCTIONS

DoDI 4151.20	-	Depot Maintenance Core Capabilities Determination Process
DoDI 5000.02	-	Operation of the Defense Acquisition System

(Copies of DoD Instructions are available at http://www.dtic.mil/whs/directives or from the Defense Technical Information Center, 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060-6218.)

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DEPARTMENT OF DEFENSE MANUALS

DoD 4120.24-M	-	Defense Standardization Program (DSP) Policies and Procedures
DFARS Part 204	-	Defense Federal Acquisition Regulation Supplement (DFARS) for Administrative Matters
DFARS Part 207	-	DFARS for Acquisition Planning
DFARS Part 227	-	DFARS for Patents, Data, and Copyrights
DFARS Part 246	-	DFARS for General Contracting

(Applications for copies of DoD Manuals are available online at https://www.dtic.mil. Copies of DFARS documents are available online at http://www.acq.osd.mil/dpap/dars/dfarspgi/current/index.html.)

DEPARTMENT OF DEFENSE GUIDEBOOKS

Defense Acquisition Guidebook
DoD Guide for Integrating Systems Engineering into DoD Acquisition Contracts
Product Support Manager Guidebook

(Copies of the Defense Acquisition Guide Book are available online at https://dag.dau.mil/Pages/Default.aspx. The DoD Guide for Integrating Systems Engineering into DoD Acquisition Contracts are available online at www.acq.osd.mil. The Product Support Manager Guidebook is available online at https://acc.dau.mil.)

DEFENSE ACQUISITION UNIVERSITY PUBLICATIONS

Integrated Product Support (IPS) Element Guidebook

(Copies of the Integrated Product Support (IPS) Element Guidebook are available online at https://acc.dau.mil.)

DEFENSE STANDARDIZATION PROGRAM OFFICE

SD-15	-	Performance Specification Guide
SD-19	-	Parts Management Guide
SD-22	-	Diminishing Manufacturing Sources and Material Shortages

(Copies of these documents are available online at https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

DEPARTMENT OF DEFENSE FORMS MANAGEMENT PROGRAM OFFICE

DD Form 1423	-	Contract Data Requirements List

(Copies of DoD Management forms are available online at https://www.dtic.mil.)

FEDERAL PUBLICATIONS

FAR Part 1	-	Federal Acquisition Regulations System
FAR Part 12	-	Acquisition of Commercial Items
FAR Part 15	-	Contracting by Negotiation
FAR Part 46	-	Quality Assurance
FAR Part 52	-	Solicitation Provisions and Contract Clauses

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(The electronic version of the FAR is available online at http://farsite.hill.af.mil and www.acquisition.gov.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of documents are those cited in the solicitation or contract.

SAE INTERNATIONAL

SAE AS1390	-	Level of Repair Analysis (LORA)
SAE GEIA-STD-0007	-	Logistics Product Data
SAE GEIA-HB-0007	-	Logistics Product Data Handbook
SAE TA-STD-0017	-	Product Support Analysis

(Copies of these standards and handbooks may be purchased from SAE International ©, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA); email CustomerService@sae.org; online http://www.sae.org. Government users may have access to a download service for technical manuals and other documents and should check with their agency.)

3 DEFINITIONS

3.1 Economic LORA evaluation. A process used to determine and indentify the most cost effective maintenance concept for all products in the LORA Candidates List.

3.2 Level of repair analysis (LORA). An analytical methodology used to assist in developing maintenance concepts, influencing design, and establishing the maintenance level at which components will be replaced, repaired, or discarded based on constraints obtained through economic, noneconomic, and sensitivity evaluations, as well as operational readiness requirements.

3.3 Logistics product data (LPD). That portion of Product Support Analysis (PSA) documentation consisting of detailed data pertaining to the identification of Product Support resource requirements of a product. See SAE GEIA-STD-0007 for LPD data element definitions.

3.4 LORA candidates list. A list containing all of the products for which the LORA program is being established.

3.5 LORA program plan. A description of how the LORA program will be conducted to meet the program requirements. These descriptions include a discussion of how LORA results are utilized as part of the PSA.

3.6 Noneconomic LORA evaluation. A process addressing preempting factors which override cost considerations, or existing LORA decisions on similar products, to determine the maintenance level(s) where repair or discard can be performed. This evaluation is performed without consideration of costs. However, any recommendations or conclusions based upon this evaluation should also include an economic LORA evaluation which will assign economic value to the noneconomic decisions.

3.7 Product support analysis. The analysis required to create the package of support functions required to field and maintain the readiness and operational capability of major weapon systems, subsystems, and components, including all functions related to weapon system readiness.

3.8 Risk. A measure of future uncertainties in achieving goals and objectives within defined cost, schedule, and performance constraints.

3.9 Sensitivity evaluation. A process concerned with determining the amount by which model parameter estimates can change, which result in a different support decision for the item being analyzed. A sensitivity evaluation provides the means to assess multiple “what if” type scenarios without the need to perform an completely new economic LORA evaluation.

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3.10 Additional definitions of terms. Other definitions and terms in this handbook may be found in the following locations:

3.10.1 Glossary of defense acquisition acronyms and terms at https://dap.dau.mil/glossary/Pages/Default.aspx.

3.10.2 DoD dictionary of military and associated terms at http://www.dtic.mil/doctrine/dod_dictionary.

4 GENERAL GUIDANCE

4.1 LORA process during the acquisition life cycle. The LORA process involves a group of three systematic and comprehensive evaluations (i.e., economic, noneconomic, and sensitivity evaluations), that when conducted on an iterative basis throughout all phases of the system/equipment life cycle, arrive at level of repair/discard alternatives that satisfy sustainment objectives. Through these iterative evaluation processes, a maintenance and support concept for the system/equipment which is effective, yet economical, can be established. This is often accomplished by influencing the system's design for supportability. The LORA process should integrate design, operations, performance, cost, readiness, and product support characteristics to assist in identifying and refining the maintenance and support concept for the system/equipment. The level of detail and timing of the analyses and activities to be performed should be tailored to each system/equipment. These factors will be responsive to program schedules, milestones, risks, and the ability to influence the system design.

TABLE I. SAE AS1390 activity key

SAE AS1390 Activity Key	
1	**Program Strategy**
1.1	LORA Program Strategy
1.2	Schedule
1.3	Manpower Estimate
1.4	LORA Candidates List
2	**Program Planning**
2.1	LORA Program Plan
2.2	LORA Program Plan Updates
3	**Program Reviews**
3.1	Review Procedures
3.2	Establishing the LORA Review Team
3.3	LORA Guidance Conference
3.4	LORA Reviews
3.5	Documentation of Reviews
4	**Input Data Compilation**
4.1	Input Data for Economic LORA Evaluations
4.2	Input Data for Noneconomic LORA Evaluations
4.3	LORA Input Data Report
4.4	Updates to the LORA Input Data
5	**Evaluation Performance, Assessment, and Documentation**
5.1	Economic LORA Evaluation
5.2	Noneconomic LORA Evaluation
5.3	LORA Sensitivity Evaluation
5.4	Documentation of Results
5.5	Updating the LORA Evaluations and Documented Results
6	**Using Results**
6.1	Design Influence
6.2	Support Structure Usage
6.3	Related Analyses
6.4	Updates

NOTE:

1. TABLE I should be used as a guide for identifying the SAE AS1390 activities and sub-activities referenced throughout this handbook.

4.2 Coordination and interface. The success of a LORA program depends on the coordination efforts which provide integration of LORA activities with PSA and other systems engineering analyses. Coordination efforts between all organizations/agencies involved should be described in the LORA program plan (Activity 2.1). The LORA program plan should be reviewed to ensure that input and output relationships, responsibilities, software

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tools, and the program milestones are properly addressed and identified to prevent overlap, duplication, omission, or schedule delays.

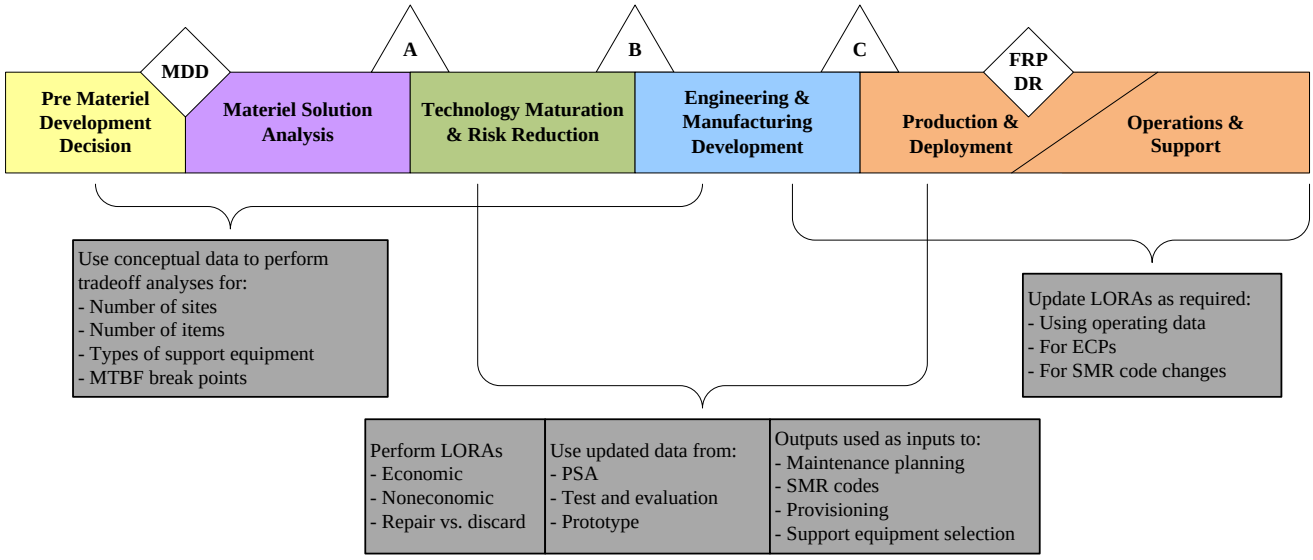

FIGURE 1. Life cycle of LORA

4.2.1 LORA environment. The LORA environment is one that integrates design, operations, and logistic support characteristics/constraints to establish the maintenance level at which an item will be removed, replaced, repaired, or discarded. The establishment of LORA into the environments of systems engineering and PSA disciplines is best seen in the regulations which require LORA, or allude to a LORA requirement, within the various military services.

4.2.2 Interface with PSA. PSA serves as the interfacing mechanism between systems engineering and the IPS activities. LORA, as an integral part of the PSA program, interfaces with such activities as maintenance planning, design engineering, reliability engineering, maintainability engineering, provisioning, support equipment development, Source Maintenance and Recoverability (SMR) coding, technical manual development, Maintenance Allocation Chart (MAC) development, and the LPD.

4.2.2.1 Maintenance planning. Maintenance planning is the process conducted to evolve and establish maintenance concepts and requirements for a materiel system. This process involves several analyses and programs in addition to LORA (i.e., PSA; Reliability Centered Maintenance (RCM); Failure Mode, Effects, and Criticality Analysis (FMECA); reliability program; maintainability program; testability). The relationship of these analyses, for purposes of maintenance planning, are generally as follows: the FMECA (SAE TA-STD-0017, Activity 9.5) identifies potential design weaknesses through systematic documented consideration of all likely ways in which a component or equipment can fail, the causes for each failure mode, and the effects of each failure; RCM (SAE TA-STD-0017, Activity 9.7) identifies preventive or scheduled maintenance tasks for an equipment end item in accordance with a specified set of procedures and establishes intervals between maintenance tasks; task analysis (SAE TA-STD-0017, Activity 12), analyzes required operations and maintenance tasks for the new system/equipment; reliability program identifies the frequency of failures; maintainability program identifies the elapsed time to correct a failure; and LORA identifies the recommended maintenance levels and support costs associated with unscheduled maintenance tasks.

4.2.2.2 Reliability engineering. Reliability engineering is the set of design, development, and manufacturing tasks by which reliability is achieved. Reliability engineering is comprised of several activities focusing on the prevention, detection, and correction of reliability design deficiencies of weak parts and workmanship defects. Several of the activities involved with reliability engineering relate to LORA (i.e., reliability modeling, reliability allocations, reliability predictions, and FMECA). Reliability modeling reorients the functional (schematic) block diagrams into a series-parallel network showing reliability relationships among the various subsystems and

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components. This reliability block diagram is the first gross breakout of candidate items requiring LORA. The system level reliability requirement is then allocated down the reliability block diagram in a top-down approach and is levied on the equipment designers. LORA, at this point, can be used as a design tool for conducting tradeoff analyses to determine whether to design an item for repair or discard. Reliability predictions are applied in a bottoms-up approach as the design progresses to determine whether the reliability allocations are feasible and attainable. Thus, LORA, which uses the failure rates determined in reliability prediction, becomes more accurate and detailed. In conducting LORA, the FMECA is used to provide a candidate list of items that are critical to reliability and will affect readiness. The LORA analyzes the reliability critical items to determine whether they are maintenance significant.

4.2.2.3 Maintainability engineering. Maintainability engineering is the process of designing the materiel system such that it can be maintained with accuracy, economy, and ease. The maintainability program involves several tasks which are used to define, develop, and improve the maintainability of a system. With respect to LORA, the maintainability engineering process, to a large extent, tracks with the reliability engineering process. Many of the activities pertaining to maintainability engineering relate to LORA (i.e., maintainability modeling, maintainability allocations, maintainability predictions, Failure Modes and Effects Analysis (FMEA), and maintainability analysis). The maintainability model is typically consistent with the reliability model described above and is used as a tool to perform allocations and predictions. The maintainability allocation and prediction tasks have the same functions as the reliability allocation and prediction tasks. However, in maintainability engineering, terms such as Mean Time To Repair (MTTR), not failure rates, are being allocated or predicted. The FMEA is consistent with the FMECA, except that the FMEA is used to ascertain information which relates to fault detection and isolation that are critical drivers of maintainability at all levels of maintenance. Unlike the FMECA, the FMEA does not assess the severity of a failure's consequence. The maintainability analysis task translates data into a detailed maintainability design approach to achieve the system MTTR requirements. LORA plays a vital role in maintainability analysis in that it evaluates the maintainability design alternatives. Also, LORA uses the MTTR data as input for evaluating repair level or discard decisions to meet the overall subsystem and component availabilities and constraints.

4.2.2.4 Provisioning. Provisioning is the process of determining and acquiring the range and quantity of spares and repair parts and support and test equipment required to operate and maintain an end item of materiel for a period of service throughout the life cycle to include initial fielding, Engineering Change Proposals (ECP), obsolescence, and other support and sustainment efforts. Provisioning involves several tasks (e.g., cataloging, SMR coding, assignment of failure factors, maintenance replacement rates, consumption expenditures, essentiality coding, identification of maintenance significant items, determination of Maintenance Task Distributions (MTD), Replacement Task Distributions (RTD)) and interfaces with various other efforts (e.g., maintenance planning, MAC development, LORA, RAM analyses, FMECA) to ensure the timely availability of minimum initial stocks of support items at the least initial investment cost the system readiness can achieve. It should be noted the development of failure factors involves the manipulation of failure rates derived in reliability engineering. LORA, relative to provisioning and optimization, provides the analytical basis from which the maintenance portion of the SMR code is obtained and identifies maintenance significant items. In addition, LORA is the analytical basis for the development of a MAC. The MAC and SMR code are then used to determine MTD and RTD.

4.2.2.5 LPD. The LPD, described in SAE GEIA-STD-0007, provides a structured method to record support requirements data from PSA tasks, such as LORA. Also, other analyses are documented in the LPD, such as FMECA, RCM, and Reliability, Availability, and Maintainability (RAM). The LORA can use data from the LPD as other analyses are completed and documented (i.e., Mean Time Between Failure (MTBF), MTTR, unit price, deployment/usage). The LPD provides a common consistency of data among the various analyses being conducted and a vital source of updated information as the weapon system under acquisition matures through the life cycle phases.

4.2.3 End user input. The end user can provide valuable insight into problem areas associated with various maintenance support concepts. The LORA process should incorporate end user input by assessing field-generated maintenance data and materiel readiness monitoring systems. Evaluating the adequacy of existing maintenance concepts and involving end user stakeholders at critical decision points in the LORA process will assist in achieving an effective and efficient LORA program.

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4.3 Development of LORA requirements. The key to a productive and cost effective LORA effort is the concentration of available resources for activities which will most benefit the overall program.

4.3.1 General requirements. The basic objectives of the LORA program are to analyze maintenance support alternatives based on economic and noneconomic factors relating to the system/equipment and use the results of the analysis to influence the design and assist in the maintenance planning process which will achieve the most effective maintenance support structure. The analyses are iterated and refined as the system/equipment progresses through the various stages of the life cycle. Development of a LORA strategy involves the identification of a LORA candidate list based on the technical data package (i.e., engineering drawings, modeling data, specifications, product definition data, performance requirements, consideration of data rights) and the identification of several alternative maintenance support concepts for those candidate items. This will provide the foundation for researching and analyzing the data in order to recommended maintenance approach. There is a considerable amount of data and variables involved when developing a LORA strategy and, therefore, tailoring of the LORA activities should be considered. Significant effects on these variables should be addressed in the tailoring process. The LORA activities should be tailored and scheduled to meet the all project decision milestones. The guidance included in Paragraph 5.7 of this handbook is designed to assist in tailoring the LORA process.

4.3.2 Type of program. The type of acquisition program can impact objectives and the degree of the LORA effort. For example, major modifications may require a new approach to some of the LORA already conducted or it may require a re-initiation of the LORA; a minor materiel change might focus on support risks associated with the changed part of the system/equipment and opportunities for improvement on the total system/equipment through improvements in supportability characteristics; and in a Product Improvement Program (PIP), a LORA could be performed to determine how the product improvement will affect the maintenance requirements for that system/equipment.

4.4 LORA activity data and documentation data. The data and documentation resulting from the LORA activities contained in this handbook serve the following purposes:

a. Provide an audit trail of analyses performed, assumptions, and decisions made affecting the supportability of a system/equipment.
b. Provide analysis results for input to follow-on analysis tasks later in the product life cycle.
c. Provide input into materiel acquisition program documents.
d. Help prevent duplication of analyses.
e. Provide valid data for use on future acquisition programs.

4.4.1 Performing activity. The individual analysis activities conducted as part of a system/equipment's LORA program may be performed in three ways. The method is chosen at the discretion of the requiring authority. Whatever method chosen, documentation of the LORA activities should be developed to the degree which will allow another entity to use the results as input to perform other LORA activities, or as input to conduct the same activities to a more detailed level in a later acquisition phase. When certain activities are performed by the requiring authority and others are performed by the performing activity, procedures should be established to provide for the data interchange between these performing activities. Therefore, activities performed by the requiring authority should be documented equivalently to the applicable Data Item Description (DID) requirements to ensure compatibility of the documentation.

a. The first method is when the performing activity is contractually responsible for the complete LORA program. This includes input data compilation, evaluation performance, and LORA report preparation.
b. The second method involves a joint effort between the requiring authority and performing activity. In this method, the performing activity is responsible for gathering and providing the input data in the form of a LORA input data report (Activity 4.3). This is then used by the requiring authority to conduct LORA evaluations and prepare the LORA report.
c. The third method is when the requiring authority is solely responsible for performing the complete LORA program.

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4.4.2 Identification of requirements. The LORA data and documentation required for delivery to the requiring authority will be specified on the Contract Data Requirements List (CDRL). The CDRL identifies data, information, and documentation which the performing activity will be obligated to deliver under the contract. DIDs are used to define and describe the data required to be furnished by the performing activity. Applicable DIDs that describe the data resulting from performance of the LORA activities contained in SAE AS1390 are identified in TABLE II of this handbook. These DIDs are structured to identify the maximum range of data which can be documented in a report. The requiring authority can tailor the DIDs by deleting unwanted requirements from the applicable DIDs. The CDRL will specify those requirements of the DIDs that have been deleted.

TABLE II. Suggested LORA DIDs per activity

Activity	Title	DID Number	DID Title	Comments
1	Program Strategy	DI-MISC-80711A	Scientific and Technical Reports	None.
2	Program Planning	DI-MISC-80711A	Scientific and Technical Reports	None.
3	Program Reviews	DI-MISC-80711A DI-ADMN-81249A DI-ADMN-81250A	Scientific and Technical Reports Conference Agenda Conference Minutes	DI-ADMN-81249A and DI-ADMN-81250A apply to any review. DI-MISC-80711A applies to Activity 3.1 only.
4	Input Data Compilation	DI-PSSS-81873A	Level of Repair Analysis (LORA) Input Data	DI-PSSS-81873A is required when the requiring authority is to perform the LORA evaluations.
5	Evaluation Performance, Assessment, and Documentation	DI-PSSS-81872A	Level of Repair Analysis (LORA) Report	If a LORA Report is required by contract, then the LORA Input Data DID is not typically cited or required.
6	Using Results	DI-MISC-80711A	Scientific and Technical Reports	None.

4.4.3 Details to be specified. TABLES III through VIII depict the details to be specified for each LORA activity. These tables provide a list of specific details, additions, modifications, deletions, or options to the activity descriptions and input and output sections of each LORA activity that should be considered by the requiring authority when tailoring the activity description to fit program needs and preparing the Request for Proposal (RFP). These details may be specified by the requiring authority and conveyed to the performing activity in the contract/Statement of Work (SOW), as applicable.

TABLE III. Program strategy (Activity 1) – details to be specified

Activity 1 Details to be Specified
Applicability of the performing activity proposing any additional activities and modifications or deletions to activities or requirements specified in the SOW and CDRL.
Identification of LORA program review requirements.
Identification and information about data items required as deliverables (i.e., DID number; dates, frequency, quantities, distribution, medium of deliveries, and locations for distributions).
Identify the significance the LORA program is to have in systems engineering and maintenance planning efforts for the acquisition program (i.e., indicate the requirement for the LORA results to directly impact and influence the system and support equipment design, in addition to the maintenance planning for the acquisition program).
Identify the system operating environment(s) for which the LORA program is being conducted. In particular, identify whether LORA input data and LORA evaluations are to reflect a wartime, peacetime, or combination of operating environments.

TABLE IV. Program planning (Activity 2) – details to be specified

Activity 2 Details to be Specified
Identification of each activity from SAE AS1390 to be performed as part of the LORA program.
Identification of any specific LORA process indoctrination, training, or guidance conference to be provided or required.
Identify whether the LORA program plan forms a part of the contract when approved by requiring authority.
Duration of the LORA program plan to be developed (i.e., indicate the length, period, or event for which the LORA program plan is in effect or covers).
Applicability of the LORA program plan being integrated into or a separate document from the Product Support Analysis Plan (PSAP). This should be stated in the SOW to ensure that the PSAP and the LORA program plan are compatible but non-duplicative.
Identification of the LORA model(s) specified for use.
Identification of the specific LORA model data elements necessary to perform the LORA evaluations and sensitivity evaluations.

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TABLE V. Program reviews (Activity 3) – details to be specified

Activity 3 Details to be Specified
Identification and information about data items required as deliverables (i.e., DID number; dates, frequency, quantities, distribution, and medium of deliveries; and locations for distributions).
Description of the LORA Review Team (i.e., identify whether the team is composed of members from PSA Review Teams; whether the LORA program will be monitored under other teams; and identify the LORA Review Team members).
Specify whether review procedures should be included in the LORA program plan.
If a LORA Guidance Conference is required, identify when it will be held and what the topics of discussion will be.
Identification and frequency of LORA reviews required (i.e., specify dates for LORA reviews or indicate that dates should be as set forth in the approved LORA program plan, or that LORA reviews should be held as deemed appropriate by the requiring authority).
Specify whether there is a need for requiring authority approval of agenda and number of days advance notice required before each scheduled review meeting.
Indicate information (LORA results, reports, and data) is to be forwarded to the review participants by the performing activity.
Indicate whether minutes to meetings/conferences require approval by the requiring authority and whether action items in approved minutes become contractual requirements after submission through the contracting officer.
Specify the relationship (i.e., part of or separate from other reviews) of the LORA Guidance Review meetings with that of any similar group meetings (i.e., program reviews, design reviews, PSA Review meetings, etc.).

TABLE VI. Input data compilation (Activity 4) – details to be specified

Activity 4 Details to be Specified
A LORA Input Data Report applies to this activity and should be specified when required as a deliverable data item. If a LORA Report is required, then delivery of a separate LORA Input Data Report is not necessary and should not be included in the SOW. In that case, the LORA Report would document the input data used in the evaluations.
Identification of the items from the LORA Candidate List for which data is required to be assembled.
Identification of the LORA input data elements for which information is to be assembled. Identify the specific table of input data elements for the LORA models for which the data is required.
Identification of the data elements for which the requiring authority will furnish values or information. Include specific guidance in the SOW on which data elements will indeed be supplied by the requiring authority. Also, identify when the values or information for those requiring authority furnished data elements which will be furnished to the performing activity. See Appendix A for additional information.
Identification of the factors for which information is to be assembled and used in the noneconomic LORA evaluation.
Specification of the delivery media for the LORA Input Data Report, if delivery is required.
Specification of the format from Section 3 of the LORA Input Data Report.
Specification of the base year in which data elements related to costs are to be expressed.

TABLE VII. Evaluation, performance, assessment, and documentation (Activity 5) – details to be specified

Activity 5 Details to be Specified
A LORA Report applies to this activity and should be specified, when required, as a deliverable data item.
Identification of the LORA model(s) which will be used in all economic LORA and sensitivity evaluations conducted during performance of Activities 5.1 and 5.3.
Identification of specific data element(s) and the numerical range(s) over which sensitivity evaluation will be performed.
Specific constraints imposed on the system/equipment under analysis by the requiring authority.

TABLE VIII. Using results (Activity 6) – details to be specified

Activity 6 Details to be Specified
Identification of the PSA related products which are to be developed or revised with the results obtained.
Identification of the related PSA systems engineering analyses which are to be interfaced with the LORA program.
Identification of the related PSA systems engineering analyses which will incorporate the results of the LORA evaluations performed.

4.4.4 Cost considerations. The procurement of data and documentation should be carefully scoped to meet program objectives in a cost effective manner.

4.4.4.1 Factors affecting cost. The following factors may affect data and documentation costs:

a. Timing and preparation of delivery: Documentation or reordering of data should coincide with the generation of such data in design and analysis sequence in order that such data, at a later date, will not have to be recreated at added expense. Delivery of data should be postponed until the actual need date to acquire data in its most complete form without encountering repetitive updates.

b. Special formatting requirements.

c. Degree of detail required.

d. Degree of research required to obtain the data.

e. Accuracy and amount of verification required.

f. Duration of responsibility for data contents.

g. Availability and accuracy of source data from which to construct documentation.

h. Risk associated with the system design.

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4.4.4.2 Near term cost. Deferring the near term costs of LORA, due to program cost and schedule constraints, can result in significantly higher support costs over a system's life cycle. Investment decisions made about the support structure during the Materiel Solution Analysis (MSA) and Technology Maturation and Risk Reduction (TMRR) phases can preclude, or significantly reduce, later changing repair level decisions during the Operations and Support (O&S) phase. These decisions ultimately determine the support concept and the system's life cycle cost even though the funds are not spent until years later.

4.4.4.3 Cost savings with fielded systems. LORAs should be conducted on all fielded systems upgraded, or in the process of being upgraded, to determine whether the materiel change or improvement will have an impact on the existing maintenance concept. If so, it may be cost beneficial to adopt the new maintenance concept determined by the LORA. In many cases, the sensitivity evaluation of the final LORA report may be beneficial in indicating when a repair level should be changed. Cost savings and improved support capability may result from changing an item from discard to repair or from repair to discard, or by changing repair levels when the item failure rate has increased and repairing it requires existing test equipment and stocked parts.

4.4.4.4 Controlling costs. Data and data documentation costs can be controlled by the following methods:

a. Screening requirements prior to preparation of solicitation documents. Each data requirement should be reviewed for data content, end use, formatting needs, scheduled delivery, and estimated cost to eliminate duplication and ensure proper integration/scheduling of requirements.
b. Involve potential bidders in briefings and planning conferences prior to release of a solicitation document. This helps ensure that data and data documentation requirements are realistic and that the maximum use is made of data already available.

4.4.4.5 Underfunded LORA. If the LORA process is underfunded and activities are either delayed or omitted all together, the possibility for shortages of resources and spares will exist. These shortages can have adverse effects on the maintenance plan, readiness, and the support system of the equipment in one or more of the following ways.

a. Lengthen repair times (i.e., failure durations).
b. Allow failures to be generated faster than they can be fixed.
c. Lead to shortages of spares and replacements for the failed items brought in need of repair.
d. Increase downtime of equipment waiting for repair.
e. Reduce end item availability.

4.5 LORA models. The LORA can be performed using one or more LORA models or techniques. The model/technique used is dependent on such factors as the availability of data, complexity and type of weapon system being analyzed, life cycle phase, and the purpose of the analysis (e.g., design tradeoffs, MTD and RTD development, and basis for SMR coding). LORA computer models deal primarily with the economic aspects of maintenance planning by evaluating maintenance alternatives and identifying a least-cost solution.

4.6 LORA validation. Validation should occur during the evaluation and review of the performing activity's LORA efforts (e.g., evaluating the LORA program plan and LORA report submissions) and by conducting LORA on selected fielded systems to verify that the maintenance concept determined in earlier LORAs is still valid.

4.6.1 Conducting the LORA program. Part of a potential performing activity's response to an RFP should be a description of how the LORA program will be conducted. This response may be in the form of a preliminary LORA program plan. Before awarding a contract, each proposal should be evaluated for completeness, accuracy, and validity to ensure the bidder is responsive to the LORA SOW requirements, has considered all areas required in conducting a LORA, and understands the LORA model proposed and its products. In reviewing a proposal, questions such as, "What policies will be followed in the execution of the model?" and "What variables will be sensitized?" should be addressed.

4.6.2 LORA program plan review. The LORA program plan should be reviewed as quickly as possible considering the lead time associated with developing and buying items, support and test equipment, and technical data. The LORA program plan should be reviewed for completeness, accuracy, and utility. This will ensure that the equipment acquisition, source coding, and provisioning actions are based on the best information available.

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4.6.3 LORA report iterations. The LORA process is iterative. It begins with the initial LORA and continues, with required updating, until submission and approval of the final LORA report. After the LORA report is reviewed, the requiring authority should notify the performing activity as to the acceptance of the report or of the necessity for redoing the LORA effort or report. The acceptance of the report not only means acceptance of the recommended repair decision, but it also implies agreement with the technical data, repair times, test equipment requirements, and other projections used in the analysis. In this regard, reviewing personnel should make sure that any projections within the report are also acceptable. The request to redo a LORA or LORA report should be made when the LORA recommendations are considered invalid. Corrections to technical data, test equipment, and spares projections that do not change the recommended repair level should be annotated in the LORA report. Any approved recommendations which have been suggested in a LORA review should be incorporated into the LORA report for submission.

4.6.4 LORA on a fielded system. A fielded system LORA may be conducted to identify and evaluate potential benefits derived through reexamination of the maintenance concept of the system. This type of LORA can validate whether or not the actual maintenance concept used for the fielded system is in close agreement with the maintenance concept determined in the LORA. If the maintenance concepts are not in agreement, then a new analysis needs to be conducted to determine whether it would be beneficial to change from the current in-place maintenance concept to the optimum maintenance concept identified by the new LORA.

4.6.5 Importance of sensitivity evaluations. Performing sensitivity evaluations as part of the LORA process is important to the designer and to the end user. Sensitivity evaluations can serve as a means of understanding the risks involved with a particular selection during stages of the acquisition process. Early in a program, many of the input factors may be estimates based on expert opinion, similar system data, or best guess. By performing sensitivity analysis, the designer can determine whether the repair level selected is firm or marginal. Sensitivity evaluations test the stability of the system under varying conditions and the effect of uncertain data.

4.7 LORA decision process. FIGURE 2 represents the decision process that takes place during the execution of the LORA program. The first step in the process is obtaining the preliminary design in which engineering drawings are developed along with preliminary technical, logistic, and economic data. Using the drawings, a list of candidates are determined that will be the source of the LORA evaluations and input to the LORA model. The preliminary data for both the system and candidate items (i.e., MTBF, unit cost, support equipment, and personnel requirements) are part of the LORA input data necessary to perform the LORA evaluations. Next is the identification of any preempting factors (i.e., safety, repair feasibility, mission success, readiness, environmental impacts) which would necessitate the performance of a noneconomic LORA evaluation. Regardless of any preempting factors, an economic LORA evaluation should be performed in order to generate a LORA recommendation identifying the least cost decision alternative. If this analysis recommends a repair decision, the LORA process continues to the optimum repair level (i.e., depot, intermediate, organizational) according to the service specific repair requirements. However, the analysis may recommend a discard decision as the least cost alternative. Then the sensitivity evaluation is conducted to assess the economic risks of these LORA decisions when uncertainty exists in the system design. The LORA repair versus discard decision is recorded in the LORA report and will significantly influence the maintenance concept. The LORA report documents the results of each of the maintenance alternatives for the candidate items, the results of the noneconomic and economic LORA evaluations, the results of the sensitivity analysis, and any conclusions or recommendations made by the performing activity to the requiring authority. If major changes are made to the system design or if the service specific timeframe for re-examination has expired, the LORA input data elements will be updated to reflect these changes and the entire LORA analytical process is repeated.

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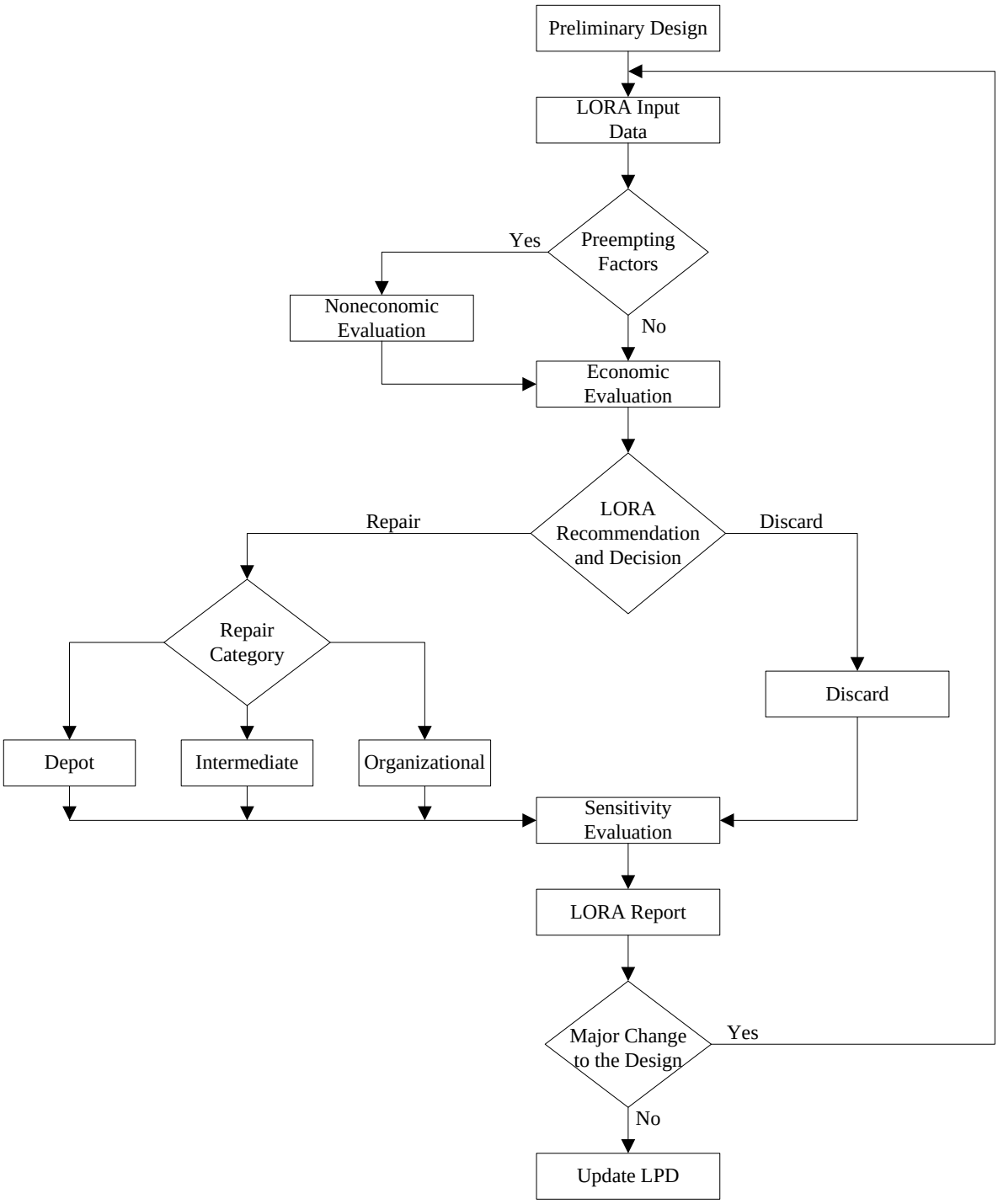

FIGURE 2. LORA decision process

5 DETAILED GUIDANCE

5.1 Introduction. In the early acquisition phases, the system/equipment's maintenance alternatives are initially being considered. Therefore, to influence design, the LORA activities should be completed on time. This includes having the most up-to-date documented results of the LORA activities available. Later, as the program progresses through the product life cycle phases and the system/equipment becomes better defined, the LORA

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activities and associated documented results should be updated to reflect the current status of the system/equipment under analysis. This iterative process is continuously performed throughout the product life cycle and applies to all activities required to be performed during execution of the LORA program. The users of this section may include the DoD contracting activity, government in-house activity, and prime contractor or subcontractor, who wishes to impose PSA activities upon a supplier.

5.2 How to use this section. This section provides structuring guidance for the LORA program as well as how to apply the individual activities and sub-activities defined in SAE AS1390. Where this document refers to a specific activity defined in AS1390, the activity number will be noted in parentheses, e.g. (Activity 1). Similarly, when this document refers to a specific activity defined in another standard, the activity number will be noted in parentheses along with the corresponding standard, e.g. (SAE TA-STD-0017, Activity 1). Appropriate service specific guidance may be necessary to supplement the guidance provided in this section. When a provisioning activity has comprehensive printed guidance that the performing activity must follow and when it is too lengthy to include in a statement of work, the governing document for the guidance should be attached as an exhibit to the contract and referenced in the SOW. Examples of governing documents are regulations, instructions, orders, and pamphlets.

5.3 Program management, surveillance, and control. The following paragraphs detail the management, surveillance, and control activities necessary to carry out the LORA program.

5.3.1 General considerations. Included in the general considerations for program management, surveillance, and control are discussions on program management, timing, and program execution.

5.3.1.1 Program management. Good management of the LORA program requires planning which identifies all the necessary actions required for program success, scheduling which identifies the timing of each required action and the responsible party for each action, and execution through timely management. Procedures should be established to ensure the right information is available when required so that timely decisions can be made and analyses may begin.

5.3.1.2 Timing. Scheduling activity accomplishments is critical for the LORA program to achieve its objectives. The criteria that should be applied for proper scheduling of LORA actions is to assure that all required actions are completed and data available when it is needed, and only the required actions are performed and only the required data is provided to prevent wasting resources and time.

5.3.1.3 Program execution. Proper program execution is achieved through continuous monitoring of the effort and having an established procedure to eliminate or minimize problems as they occur. Efficient program execution requires that working arrangements between the LORA program and other systems engineering programs be established to identify mutual concerns, maximize the benefits of mutually supporting tasks, and minimize duplication of effort.

5.3.2 Program strategy (Activity 1). This activity is the earliest planning activity for a LORA program and is the first step in developing an effective LORA program. While the program strategy is pertinent for MSA activities, it is also generally applicable prior to preparation of any solicitation documents containing LORA activity requirements. The efficient scheduling of activities and assignment of personnel to perform each activity will assure proper execution of the LORA program. Therefore, the program strategy for the scheduling of activities and personnel to perform these activities should be coordinated with other related systems engineering analyses and the agencies performing these analyses, or similar studies, to avoid duplication.

5.3.3 Program planning (Activity 2). Program planning, which encompasses the LORA program plan, is the basic tool for establishing and executing an effective LORA program.

a. General: The LORA program plan (Activity 2.1) should effectively document what LORA activities are to be accomplished, when each activity will be accomplished, what organizational units will be responsible for activity accomplishment, and how the results of each activity will be used. The LORA program plan is a stand-alone document but can be included as part of the PSAP (SAE TA-STD-0017, Activity 2) when

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a PSAP is required. Plans submitted in response to solicitation documents assist the requiring authority with the following:

(1) Evaluating the prospective performing activity's approach to performing LORA activities.

(2) Evaluating the performing activities' understanding of the LORA activity requirements and the overall process for performing LORA activities.

(3) The organizational structure for performing LORA activities.

b. Tailoring: The LORA program plan should be tailored to meet the specified goals of the system/equipment under analysis. In developing a tailored LORA program plan, time and resource constraints should be considered. However, when a LORA input data report is required, the tailored LORA program plan should state explicitly:

(1) Which data is to be provided.

(2) How data is to be provided (hardcopy, disks, data file format, etc.).

(3) Which items in the LORA Candidates List the data is to be provided on.

(4) The LORA model specified in the contract to which the data will be formatted and analyses conducted.

(5) When the data is to be provided.

c. Submission and approval: The LORA program plan is generally submitted in response to a solicitation document and generally becomes a part of the SOW when approved by the requiring authority. When requiring a LORA program plan, the requiring authority should allow the performing activity to propose additional activities or modifications to activities, with supporting rationale, to show overall program benefits to those activities contained in the solicitation document. The LORA program plan should therefore reflect the current program status and planned actions. The LORA program plan should be reviewed and approved by the requiring authority and incorporated into the contract.

5.3.4 Program reviews (Activity 3). This activity provides the opportunity for the performing activity and the requiring authority to review the progress of the LORA program and the results at scheduled intervals. A program review is an important management and technical tool of the requiring authority. Program reviews should be specified in SOWs to assure adequate staffing and funding and are typically held periodically during an acquisition program to evaluate the overall program progress, consistency, and technical adequacy. If the performing activity conducts internal reviews with contractors, subcontractors, vendors, or the requiring authority, then the documented results and minutes of these meeting are to be available to the requiring authority upon request.

5.3.4.1 LORA guidance conference (Activity 3.3). LORA program reviews should be conducted periodically as specified in the contract (generally semi-annually or quarterly). The initial LORA review should be conducted as a detailed guidance conference and be held soon after award of the contract. The purpose of this conference is to establish review procedures, provide guidance concerning analysis and data requirements, describe procedures for the exchange of data between requiring authority and performing activity, and identify any potential problems (i.e., data rights, proprietary data, and technical features of the LORA model to be used). Subsequent LORA reviews should be conducted at appropriate intervals to ensure accomplishment of the LORA review objectives. Since maintenance analyses can be a source of data needed to perform a LORA evaluation, the LORA reviews should incorporate data from the maintenance analyses being conducted as part of the provisioning effort.

5.3.4.2 LORA review and topics (Activity 3.4). The topics included in a LORA review will vary with the type of development effort, the life cycle phase, and the review technique. However, there are core topics that should be covered during a LORA review to ensure the maximum effectiveness of the LORA program. During the review, the topics to be discussed include, but are not limited to:

a. Status of action items from previous meetings.

b. Contract modifications and other program issues impacting the LORA effort.

c. Status of the LORA program task and schedule.

d. Summary of LORA results and recommendations.

e. Issues, risks, and action items.

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5.3.4.3 Documentation of reviews (Activity 3.5). The documentation of these LORA reviews and conferences is vital to ensuring the requiring authority and the performing activity are continually updated with the current status of the program as well as any conflicts or issues as they arise.

5.4 Data preparation and management. The following paragraphs detail the preparation and management activities associated with the LORA data necessary to execute an effective LORA program.

5.4.1 General considerations. The effectiveness of the LORA program is largely dependent upon assembling the appropriate quantity and quality of input data to support the evaluations. LORA evaluations require a variety of data, ranging from system/equipment hardware design features, to anticipated product support requirements and existing support structure capabilities and constraints. Data rights and all proprietary data should be identified and defined in order to avoid any negative impacts on the execution of the LORA program.

5.4.2 Input data compilation (Activity 4). This activity identifies the LORA input data which will be used in the LORA evaluations. The tedious task of data collection can be reduced by examining the data obtained from existing documents, comparative products, historical databases, and expert knowledge. When values are unobtainable, engineering estimates or calculated values should be used. However, caution should be exercised to ensure that data values are consistent and reliable. The most current data should be used. Elements related to cost should be expressed in the same base year dollars. This will ensure consistency and accuracy. A major key to having an effective LORA program is the use of the data available on similar systems/equipment to predict a maintenance concept for the system/equipment being analyzed. If design parameters are predicted, then current operational products which are similar to the product being analyzed should be identified.

5.4.2.1 Input data for economic LORA evaluations (Activity 4.1). This activity identifies values corresponding to the data elements used in the economic LORA evaluations and sensitivity evaluations. The data identified is used to establish a baseline maintenance concept. The data should be collected on all items listed in the LORA candidates list.

5.4.2.2 Input data for noneconomic LORA evaluations (Activity 4.2). The data identified in this activity are constraints, stipulations, special requirements, or other factors which restrict the maintenance concept or limit the support alternatives available (e.g., safety, HAZMAT, environmental impacts, calibration, feasibility of repair, security, training requirements, facilities). This data is used to perform a noneconomic LORA evaluation. Factors which directly affect the repair decisions obtained should be used in conjunction with the economic LORA and sensitivity evaluations to establish an optimal maintenance concept.

5.4.2.3 LORA input data report (Activities 4.3 and 4.4). This activity is generally invoked when another performing activity is responsible for conducting the LORA evaluations (Activity 5). LORA input data should be collected for all items in the LORA candidates list. Consideration should be given to the data rights being applied to this report and the maturity of the input data. In order to maximize the usefulness of this LORA input data report, the use of proprietary data should be limited and the report should be updated as better defined and more reliable data becomes available.

5.5 Evaluations. The following paragraphs detail the evaluation activities utilized to perform the LORA.

5.5.1 General considerations. The heart of the LORA process is performing, analyzing, and documenting LORA evaluations. This section defines the three individual, but closely related, LORA evaluations which are typically undertaken: economic, noneconomic, and sensitivity evaluations. All LORAs should address each type of evaluation.

5.5.1.1 Iterations. The activities contained in the evaluation sections are iterative in nature and are applicable in each phase of the life cycle. This process is performed to increasingly lower levels of indenture and detail as the system progresses through the life cycle and better defined data becomes available.

5.5.1.2 Timing. The development of support alternatives using the LORA process and evaluations should be conducted to a level consistent with the design and operational concept development. In the early phases of the life

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cycle, support alternatives should only be developed to the level required to analyze differences and conduct tradeoffs. More detail can be developed after tradeoffs are made and the range of alternatives is narrowed. Analysis of support alternatives is an inherent feature of LORA models used in the evaluation and tradeoff process.

5.5.2 Evaluation performance, assessment, and documentation (Activity 5). Optimum benefits are realized when LORA is conducted considering cost, schedule, performance, and supportability before the system design is finalized. The magnitude, scope, and level of detail of the LORA will depend upon both the acquisition phase and the system/equipment complexity. As development of the system/equipment progresses and the input data become more reliable, LORAs are progressively updated.

5.5.2.1 Economic LORA evaluation (Activity 5.1). The economic evaluations of the support alternatives identified are conducted to establish the maintenance concept which is most cost effective. These evaluations are conducted by analyzing different support alternative concepts relating to design, operation, and product support resource factors. The economic LORA evaluation is based on cost and performance factors and usually involves employing a LORA model to compute the life cycle logistics cost associated with the support alternative under consideration. The life cycle logistics costs developed as part of the LORA is a projection of the input data and typically does not take into consideration the total cost of supporting the system. Thus, a LORA should not be the only method/tool used to develop the total support cost projection for a system. The algorithms used to conduct economic LORA and sensitivity evaluations are also used to establish a baseline maintenance concept and in performance of the sensitivity evaluations.

5.5.2.2 Noneconomic LORA evaluation (Activity 5.2). This activity uses the data identified for noneconomic LORA evaluations (Activity 4.2) to determine the maintenance levels affected or restricted. This activity also determines if the support alternatives are limited and explains the rationale for the restrictions or limitations. Noneconomic LORA evaluations are undertaken to evaluate constraints, preemptive, and intangible factors which affect or restrict the maintenance level at which items are repaired or discarded. The noneconomic evaluation addresses and considers factors such as: constraints of the existing logistics support structure; safety; environmental impacts; deployment mobility; technical feasibility of repair; security; special transportability factors; human factors; vulnerability; training requirements; facilities; and survivability. The key focus during the noneconomic evaluation is to eliminate support alternatives that are not practical or feasible. Once all infeasible maintenance alternatives have been identified and eliminated from consideration, the analyst can then perform an economic evaluation to determine the most cost effective support alternatives.

5.5.2.3 LORA sensitivity evaluation (Activity 5.3). Sensitivity evaluations are conducted to assess the impact on the baseline maintenance concept. The results, including the rationale for selection and rejection of alternatives, assumptions, and risks involved should be documented for subsequent iterations. This sensitivity evaluation is an extension of the economic LORA evaluation. The sensitivity evaluation identifies and analyzes critical logistic support and performance parameters. A sensitivity evaluation consists of identifying the specific LORA model data elements which are not well defined possibly due to uncertainty of design and program characteristics, establishing a numerical range which the data element is expected to fall within, analyzing the impact and effects the numerical range has on the logistic costs and maintenance concept, and confirming or changing the recommended maintenance concept based on the economic LORA evaluation. By conducting sensitivity evaluations, the requiring authority is able to quantify the economic risks in making LORA decisions when uncertainty exists in hardware design and program characteristics.

5.5.2.4 LORA reports (Activities 5.4 and 5.5). The LORA report should be periodically updated to reflect the current status of the program. The following list is to be used for guidance on submission of formal LORA reports. Fewer reports may be required when a program's acquisition strategy is shortened. The LORA report includes summary of results of the LORA evaluations, assumptions made, conclusions, and recommendations. The content and frequency of the LORA reports being generated should be tailored to fit the goals and objectives of the specific program under analysis.

a. The LORA process should be initiated during the early stages of the TMRR phase to influence design, maintenance, and supportability of the system/equipment. The exception would be a selectively applicable LORA in the MSA phase to establish general preliminary maintenance concepts. The MSA LORA report serves to break down the conceptual system into potential maintenance significant items for

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the reliability, maintainability, and FMECA efforts which follow in the TMRR phase. LORA reports conducted on similar systems/equipment are analyzed in the MSA phase as well.

b. The first TMRR Phase LORA report is due after completion of the reliability allocation tasks defined in the Evaluation of Alternatives and Tradeoff Analysis (SAE TA-STD-0017, Activity 11), which includes the FMECA (SAE TA-STD-0017, Activity 9.5), and prior to performing the Task Analysis (SAE TA-STD-0017, Activity 12).

c. The second TMRR Phase LORA report is due after completion of the prototype's Operational Test I (OT I), but before the Preliminary Design Review (PDR) and contract award. This LORA report is used in the proposal evaluation and selection process to review and evaluate maintenance and support alternatives, including cost considerations that have been suggested in bidding on the contract.

d. The first Engineering and Manufacturing Development (EMD) Phase LORA report is prepared after an update of the failure analyses is performed and prior to the Critical Design Review.

e. The second EMD Phase LORA report is prepared after OT II, but before the preparation of the initial Provisioning Parts List (PPL) and before the formal provisioning review. This is an update to the first EMD Phase LORA report and is used to review and evaluate the updated maintenance and support alternatives, including cost considerations for the EMD phase.

f. The final Product and Deployment (P&D) Phase LORA report is prepared after the final failure analysis is updated and before the performing activity submits a final PPL. This P&D Phase LORA report is an update/expansion of the last LORA report submitted during the EMD phase.

g. During the O&S phase, it may be necessary to conduct a LORA in order to update or adjust the support structure of a system because of significant changes that occur (i.e., materiel changes, ECPs, or changes in utilization rates, costs, maintenance capabilities, or policy). The O&S Phase LORA should be documented in a LORA report and incorporated into the final LORA report submitted in the P&D phase. This LORA report is used to support the efforts of a fielded system review, post provisioning review, or sample data collection program.

5.5.2.5 Life cycle patterns. System acquisition programs do not always track the typical life cycle pattern discussed in the above paragraphs. An example of this is an accelerated acquisition program where the EMD phase may either be bypassed or extremely reduced. Thus, the complexity of LORA conducted and the number of LORA reports required depends on various factors such as the type of acquisition program and purpose of the analysis being conducted. At a minimum, the LORA should analyze the support alternatives of the weapon system to determine level of repair/discard alternatives and assist in assigning maintenance and supply support costs to the system's maintenance concept. The LORA report should then be used in support of the maintenance planning and provisioning process.

5.6 Use and implementation. The following paragraphs outline the activities needed to ensure the proper application of the LORA results and recommendations.

5.6.1 Using results (Activity 6). This activity provides a methodology for using the documented LORA results from Activity 5. From the results of the analysis, an optimal maintenance concept will be derived. The results should also be coordinated with systems engineering and other applicable analyses. In early phases of the life cycle, the LORA results can be used to influence design and assist in development of the maintenance concept. The LORA results are also used to develop PSA related products specified in the contract, validate resource requirements, and assist in generating the maintenance plan, MAC, as well as the SMR codes. The results should also be used to make recommendations for further analyses. When conducting a LORA on fielded systems/equipment, the LORA results should be used to assess the current maintenance concept and to recommend how it may be improved.

5.6.1.1 Design influence (Activity 6.1). The LORA results can uncover maintenance and supportability problems and provide input to the system/equipment designer to resolve the issues. These results not only drive the maintenance support for each repairable item being analyzed, but they also establish by whom and where each item will be repaired. Thus, it is useful to track the design change recommendations made as a result of the LORA evaluations and monitor their progress as the system design evolves throughout the life cycle. Evaluating the impact of not implementing a recommended design change is another helpful tool when providing input to the system

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design. In addition, assessing the life cycle and total ownership costs, along with conducting a Business Case Analysis, can serve as complimentary analyses used to influence the system design.

5.6.1.2 Impact on the IPS elements and support structure (Activity 6.2). The LORA process produces the final support solution for the system and directly impacts each of the IPS elements. It determines where each required maintenance action will be performed, the physical resources that must be available to support performance of maintenance, and what the support infrastructure must be capable of sustaining throughout the operational life of the system. The results of the LORA are documented and used as the basis for developing the resources and supply support required to implement the system's maintenance plan. As an example of LORA interfacing with the IPS elements, consider that LORA seeks to determine an optimum provisioning of repair and maintenance facilities to minimize overall life cycle costs. It not only examines the cost of the part to be replaced or repaired but all of the tasks, elements, and resources required to make sure the job is done correctly. This includes the skill level of personnel, tools required to perform the task, all necessary training, test equipment required to test the repaired product, and the facilities required to house the entire operation.

5.6.1.3 Related analyses and updates (Activities 6.3 and 6.4). As defined in SAE TA-STD-0017, LORA is an integral part of the PSA process. As such, the LORA results should be incorporated with other systems engineering analyses and PSA activities to the maximum extent possible. For example, the LORA results should provide input to the task analysis (SAE TA-STD-0017, Activity 12), in addition to interacting with several of the activities associated with the evaluation of alternatives and tradeoff analysis (SAE TA-STD-0017, Activity 11). As more refined data is obtained and the LORA is updated, these analyses should be revisited and adjusted accordingly. The LORA program plan should also be updated, as appropriate, to account for any changes to the maintenance plan and support system proposed by the most recent LORA. These reviews and updates to the LORA also provide an opportunity to identify a requirement for additional analyses to be performed on the system/equipment where previously a gap or lack of data may have existed.

5.6.2 Training resources. The Defense Acquisition University (DAU) offers a two-part continuous learning series which provides an introductory overview of LORA prior to delving more in depth into the theory and principles behind the LORA evaluations and recommendations. Enrollment in these two continuous learning modules (CLL057 Level of Repair Analysis – Introduction and CLL058 Level of Repair Analysis – Theory and Principle) can be accomplished free of charge via the DAU website at http://www.dau.mil.

5.6.3 Implementation. A free and easy-to-use tool for performing a LORA evaluation is the Computerized Optimization Model for Predicting and Analyzing Support Structures (COMPASS), available at https://www.logsa.army.mil/lec/compass.

5.7 Tailoring. Tailoring is the process of evaluating individual requirements to determine if they are pertinent and cost-effective for a specific acquisition and then modifying the requirements, as appropriate, to ensure that they contribute to a balance between program needs and cost. Rewriting, extracting, or eliminating requirements accomplishes tailoring of standardization documents. The indiscriminate blanket application of the LORA activities is discouraged. Tailoring is forced by requiring that specific activities be selected and that certain essential information relative to implementation of the selected activities be provided by the requiring authority. The performing activity may, and is encouraged to, suggest alternative means of satisfying requirements to make information more readily available and to utilize more efficient business practices.

5.7.1 Scope and purpose. The subsequent paragraphs provide guidance on how to tailor SAE AS1390. The scope of the LORA program should be tailored to the size, complexity, and life cycle phase of the individual system/equipment program. The detail of LORA is dependent upon many factors and tailoring may be required so that program dollars are used efficiently. For example, if a Non-Developmental Item (NDI) is being purchased, there will be little, if any, need to conduct a detailed LORA to try to influence the design. However, a simpler analysis, such as a repair versus discard analysis, may be beneficial to determine whether the NDI should be repaired or discarded. The factors listed in Paragraphs 5.7.1.1 through 5.7.1.4 of this handbook may influence the amount of LORA activity administered on a program or restrict the LORA to selective areas.

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5.7.1.1 Amount of design freedom. The amount of design freedom is a key consideration in LORA. Design freedom is related to program objectives, operational requirements, and technological opportunities. One objective of LORA is to influence selection of design characteristics to achieve improvements in supportability (e.g., design for discard). If the design and maintenance policy for the program are already fixed, the LORA effort will not be as beneficial. As the design and maintenance policy become fixed, the amount of LORA activity encountered will usually decline. However, if the design and maintenance policy for a program are generated concurrently until finalized, LORA will be beneficial in developing an optimized system support package. During the P&D and O&S phases, a LORA may be conducted to evaluate the maintenance concept and determine potential benefits to be gained by changing the maintenance concept.

5.7.1.2 Availability and relevancy of resources. The successful completion of a LORA requires resources in the form of people with relevant experience and sufficient funding. It is DoD policy to fund readiness and support considerations up-front in system acquisition programs. However, in reality, resources are constrained. If program funds are short, the LORA effort may have to be adjusted to compensate for lack of funds or be accomplished in-house.

5.7.1.3 Schedule constraints. Fast track programs, as their name implies, are acquisition programs in which time constraints require the design, development, production, testing, and support acquisition process to be compressed or overlapped. These programs tend to reduce the time to accomplish design-influencing analysis tasks such as LORA. Scheduling of the LORA should be considered to ensure a maintenance concept that results in an optimal product support footprint, but also meets statutory and regulatory requirements to avoid program risks.

5.7.1.4 Data availability and relevancy. The availability and accuracy of historical data on similar existing systems and equipment is crucial for accomplishing a LORA in the early stages of a program. Utilizing a Baseline Comparison System (SAE TA-STD-0017, Activity 6) can assist in assessing any technology advances and cost differentials between current and historical data. If historical data is unavailable, it can impact the effectiveness of the LORA effort.

5.7.2 Acquisition phase of the program. The extent and level of detail of the LORA program should be tailored to the appropriate life cycle phase of the program. TABLE IX identifies the applicability of the LORA activities by phase of development while the information outlined in Paragraphs 5.7.2.1 through 5.7.2.4 of this handbook should be used to determine the amount of LORA activity to be administered during each life cycle phase. FIGURE 3 through FIGURE 6 illustrates when LORA (SAE TA-STD-0017, Activity 11.7) is required as part of the conventional PSA process flow. The methodology behind this conventional PSA process flow is detailed in Paragraphs 5.8.13.5 through 5.8.13.9 of MIL-HDBK-502A. These figures and table should be used as guidance only and may require adjustment or tailoring to satisfy the requirements for specific acquisition programs.

TABLE IX. Tailoring of LORA activities

Activity Number	SAE AS1390 LORA Activities	PSA Life Cycle Phases				
		MSA	TMRR	EMD	P&D	O&S
1	Program Strategy	S	G	G	C	C
2	Program Planning	S	G	G	C	C
3	Program Reviews	G(1)	G	G	G(1)	G(1)
4	Input Data Compilation	S	G	G	C	C
5	Evaluation Performance, Assessment, and Documentation	S	G	G	S	S
6	Using Results	G	G	G	G	G
S-Selectively applicable, G-Generally applicable, C-Generally applicable to design changes only, (1)-Selectively applicable for equipment level acquisitions						

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5.7.2.1 MSA phase. A LORA in the MSA phase is selectively applicable and requires tailoring. The design is only conceptual, but this phase allows the best opportunity for identifying alternatives, conducting tradeoffs, and influencing the design from a supportability standpoint. Since the design is conceptual, the extent of the LORA conducted in this phase depends primarily on the availability of data. An MSA phase LORA is usually conducted to establish a preliminary maintenance concept based upon engineering studies, evaluations, historical data, and expert opinion. While an MSA phase LORA only analyzes general concepts, it establishes the foundation for future LORA efforts by providing the basis for documenting economic and noneconomic evaluations on similar systems which must be reviewed against the conceptual system and helps develop the constraints on the LORA in the TMRR phase.

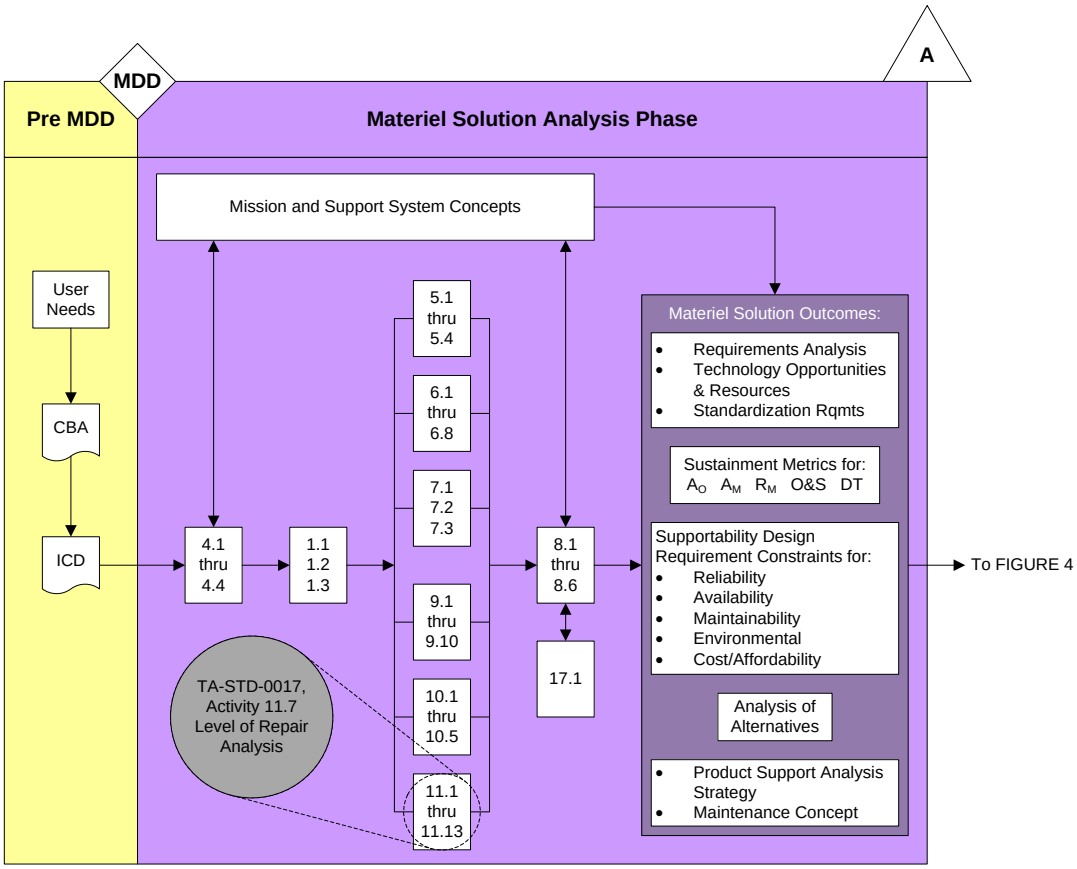

FIGURE 3. LORA requirement identified in the conventional PSA process flow for Pre MDD and MSA phases

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5.7.2.2 TMRR phase. A LORA is generally applicable in this phase. In the TMRR phase, performance characteristics of the system/equipment are more or less established. However, the actual design is still flexible. Support, design, and operational alternatives are being investigated through tradeoff analysis. In this phase, a LORA is an excellent method for performing these tradeoffs and influencing the design of the system/equipment. When effectively timed and tailored, LORA assists in establishing the maintenance concept; assists in establishing cost effective reliability requirements and allocating these system level requirements to lower indenture levels; acquires essential information to enable a detailed source of repair analysis; and assists in establishing cost effective testability requirements. A TMRR phase LORA is also conducted to identify items which should clearly be designed for discard, instead of being designed for repair.

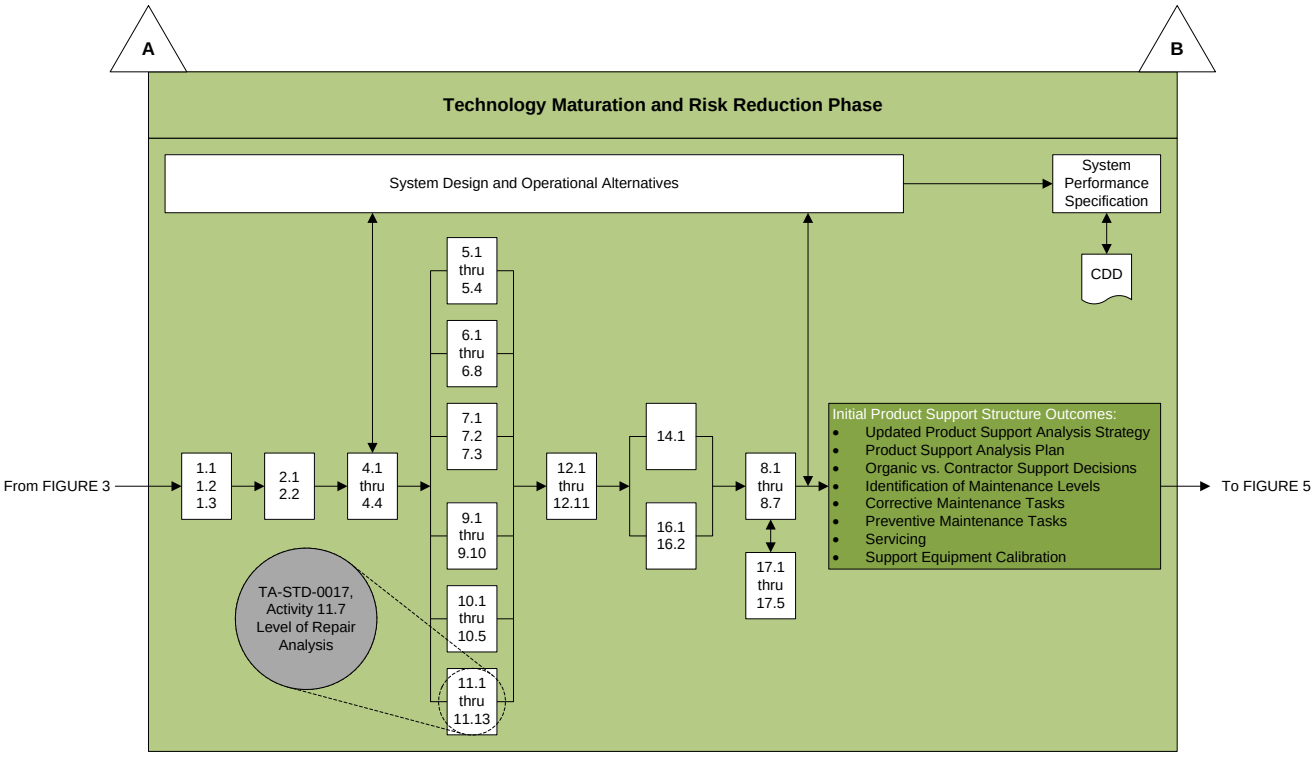

FIGURE 4. LORA requirement identified in the conventional PSA process flow for TMRR phase

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5.7.2.3 EMD phase. As in the TMRR phase, a LORA is also generally applicable in the EMD phase. The EMD phase results in a prototype product for test and evaluation, including the associated support concept. Detailed design engineering, parts selection, and fine tuning of performance are primary activities of this phase. Design influence is limited to items at the subsystem/item level, as well as to details such as, packaging, partitioning, testability, and accessibility. The support system is fairly well defined. The LORA is used to optimize the support system and determine an optimal maintenance concept for the system/equipment. This requires data in sufficient detail to complete a Core Logistics Analysis which is used as input to the Depot Source of Repair Analysis per DoDI 5000.02. LORA, in conjunction with detailed engineering design analyses, can verify the economics and engineering viability of repair level or discard alternatives at the module level. In addition, BIT versus Automated Test Equipment (ATE) tradeoffs can result in further design optimization. LORAs conducted in this phase are usually detailed and consider both the economic and noneconomic factors of the repair level or discard alternatives.

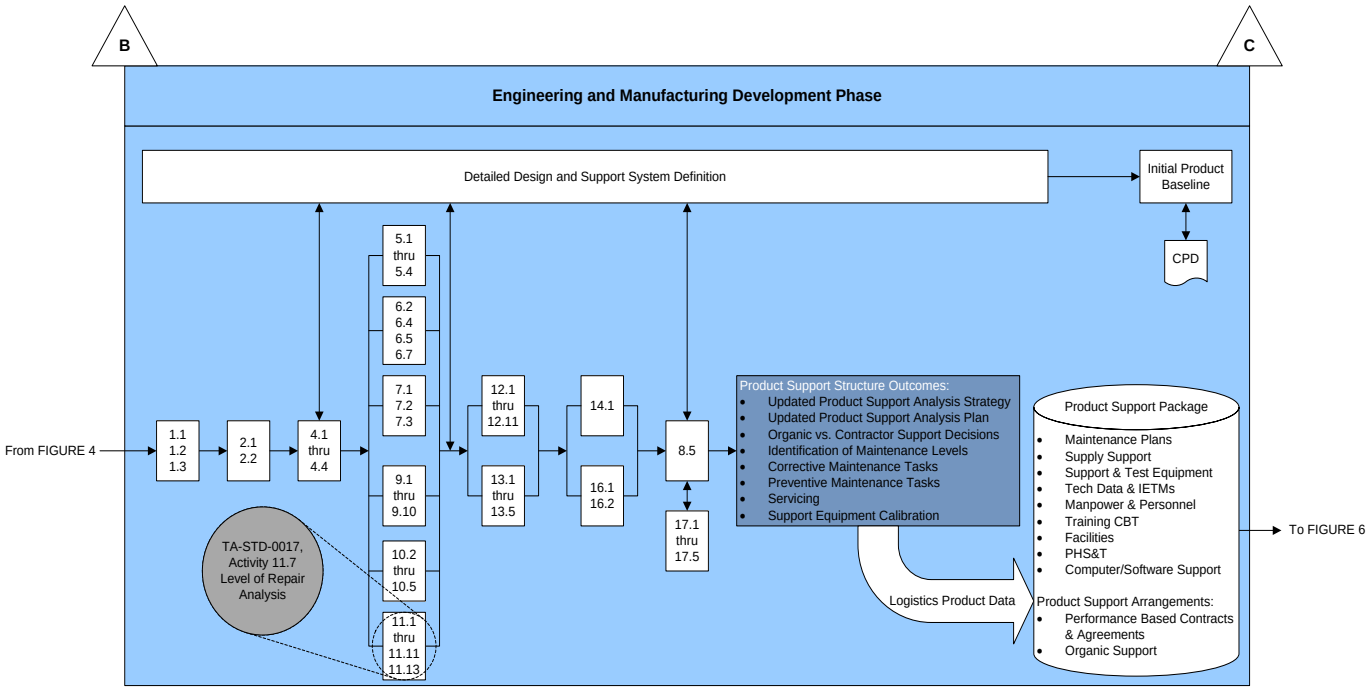

FIGURE 5. LORA requirement identified in the conventional PSA process flow for EMD phase

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5.7.2.4 P&D/O&S phases. In the P&D and O&S phases, the design is fixed and there are limited opportunities for tradeoffs or further optimization of the design. A LORA may be applicable if unanticipated circumstances arise that require design changes be made to the system/equipment. A LORA may also be conducted for update purposes to adjust LORA decisions based on field experience or evaluations on ECPs and PIPs.

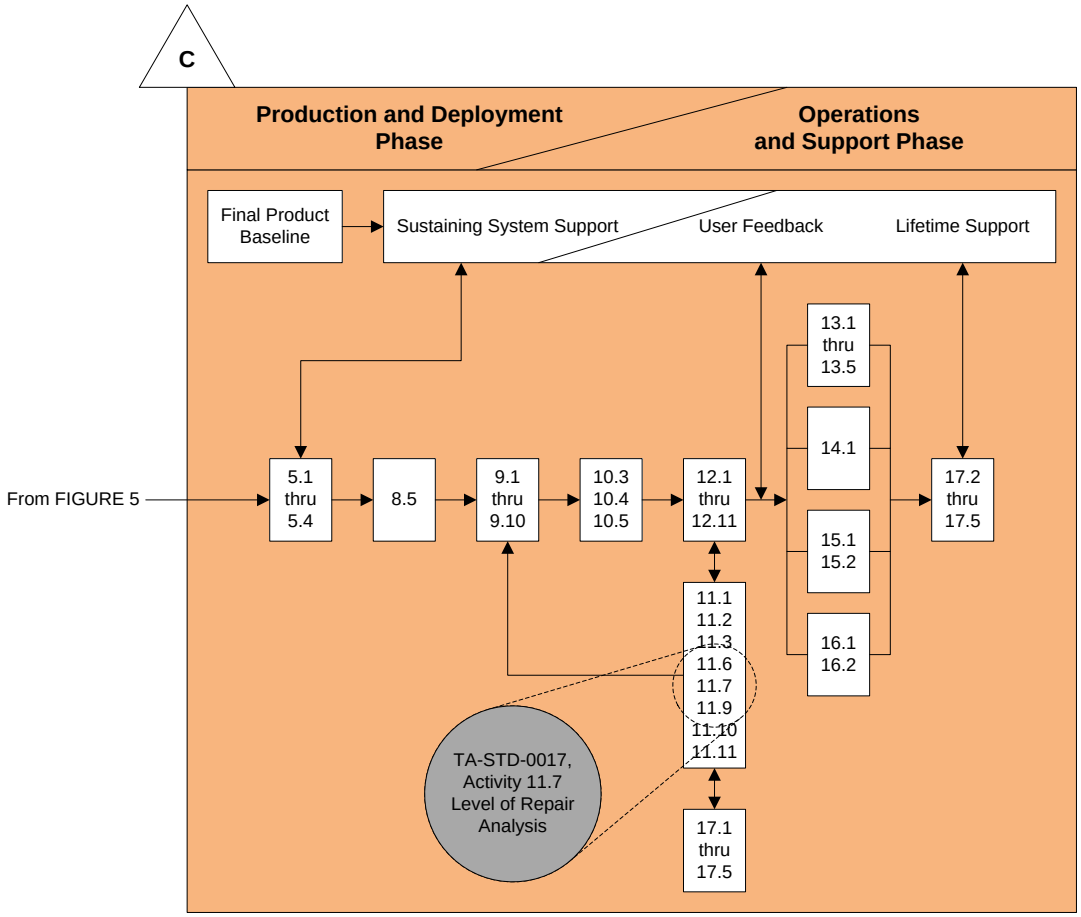

FIGURE 6. LORA requirement identified in the conventional PSA process flow for P&D phase and O&S phase

5.7.3 Previously performed analyses. Previously conducted analyses can impact LORA activity selection. These analyses may include other LORAs, PSAs, and other related systems engineering analyses, or work already accomplished. The previous work should be assessed for accuracy, reliability, and operational similarities and differences. If the documented results of the previous work are adequate, the analysis may only require updating as opposed to conducting a new analysis. Program documents may also prescribe objectives or constraints which tend to bind the scope of the LORA effort.

5.8 Decision making. Since LORAs are performed iteratively, the final analysis should verify the results of the earlier analyses or recommend a change based upon finalized input data. The LORA and associated results will be used to influence the repair or discard decisions made on materiel, and these decisions will, in turn, provide repair or discard recommendations to the equipment designer. Also, the LORA provides input to the procuring activity so that proper IPS decisions may be reached. Implementation of the LORA decisions should allow for the proper funding, scheduling, and deployment of the necessary/required support resources to meet operational readiness objectives. The goal is that those resources may be in place for the system or equipment when fielded.

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6 CONTRACTING GUIDANCE

6.1 Contracting for LORA. The following paragraphs provide information and guidance on the contracting process associated with developing and executing a LORA program. A LORA program may be a small, but important element in the total acquisition of a system, or it may be the focal element of the acquisition. Regardless of the type of acquisition or the life cycle phase, the LORA contracting process has the following three phases.

6.1.1 Planning and pre-solicitation. This is the phase in which the functional area expert identifies the need for the LORA effort and confirms that contracting is the appropriate method of satisfying the need. The functional area expert develops and coordinates the contracting package and forwards the contracting package from the functional office of responsibility to the contracting office to initiate the contracting process.

6.1.2 Solicitation and award. This is the contracting process for the acquisition of the materiel or services specified in the contracting package. Normally a RFP is publicized using the documentation in the contracting package to communicate the requirements to industry. Contracting candidates then submit written package proposals stating how the requirements in the RFP will be satisfied. It should be noted that depending on how the contracting package is written, the proposals submitted could actually include a LORA plan, a LORA report, or LORA input data in order to consider and analyze maintenance and support costs of the proposed system in the evaluation of the candidate's proposal. Then, a technical evaluation is conducted on the proposals to determine which one best meets needs of the requiring authority. Based on this evaluation, a contract is awarded. If formal advertising for competitive acquisition is not appropriate, then the supplies or services may be procured through the use of negotiation (i.e., sole source acquisition) in accordance with the Federal Acquisition Regulation (FAR).

6.1.3 Post award administration. This phase exercises and completes the management and performance of the contract. This includes the test/review and acceptance of all contract deliverables. The contracting process and contract requirements undertaken in the different life cycle phases of the materiel acquisition process will vary and are dependent on the type of acquisition effort.

6.2 Contracting package.

6.2.1 SOW, DID, and CDRL. The three primary parts of the contracting package that an IPS manager should be concerned with are the SOW, DID, and CDRL. It should be noted there is no standard prescribed format for a SOW. However, MIL-HDBK-502A does provide guidance and example formats for SOWs. There are four major areas of information which must be addressed in a SOW: the tasks and technical requirements to be performed; method by which performance of those tasks will be measured and tested; technical data to be delivered; and management of the data to be delivered. Reference to a DID or exhibit is made in the SOW to tie a task description to a deliverable product and its contents. Also, a reference is made in the SOW to the CDRL to tie the deliverable product to a time schedule for delivery. The ideal method of preparing a SOW is to refer to a standard for each functional element required, in this case, SAE AS1390. Tailoring the effort then becomes a matter of identifying only certain sections or paragraphs of the standard to be performed. Tailoring also includes addressing sections of DIDs that apply to the contract deliverable desired.

6.2.2 Execution of the LORA program with a LORA model. As discussed in Paragraph 4.4.1, a LORA program can be performed in one of three ways. When a LORA model is to be utilized as part of the LORA program, the SOW should be written to obtain the input data (i.e., LORA source data) for that particular model. This LORA model data will assist with future LORA evaluations and sensitivity evaluations. It should be noted that LORA source data should only be cited in a SOW if it cannot be provided by other contract deliverables (e.g., LPD, SAE GEIA-STD-0007, or other analysis reports) in a timely manner for use in the LORA. Obtaining LORA source data by citing the data elements required to do a LORA in a SOW is a special case that should generally be used only when the requiring authority performs the LORA organically.

6.3 Detailed contracting guidance. Additional information and guidance for contracting can be found in Section 6 of MIL-HDBK-502A. This section discusses suggested SOW and RFP language, acquisition and business strategies, CDRL examples, special contract language, and instructions for bidders.

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7 NOTES

7.1 Intended use. The purpose of this handbook is to offer guidance on LORA as an integral part of the systems engineering process. The information contained herein is applicable, in part or in whole, to all system acquisition programs, major modification programs, and applicable research and development projects requiring LORA through all phases of the product life cycle. The contractual wording contained herein is not binding, nor can this handbook be placed on contract.

7.2 Subject term (key word) listing.

Economic evaluation
Integrated logistics support
Integrated product support
Integrated product support elements
Logistics support analysis
Maintenance planning
Maintenance and support alternatives
Noneconomic evaluation
Product support analysis
Sensitivity evaluation
Source maintenance and recoverability codes
Support equipment
Test measurement and diagnostic equipment
Tradeoff analysis

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CONCLUDING MATERIAL

Custodians:
Army – TM
Navy – AS
Air Force – 10

Review activities:
Army – AT, AV, CR, MI
Navy – MC, SA, SH
Air Force – 01, 11

Preparing activity:
Army – TM

(Project PSSS-2014-001)

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