Integrated Logistics Support (ILS)

Its disciplines, logistic support analysis, recording, planning, and organization

Summary
Integrated Logistics Support (ILS) stands for the disciplined and unified management of the technical logistic disciplines that plan and develop support for any large system during its complete life cycle. An ILS organization including the ILS program manager and the contractors are responsible for its success. Logistic Support Analysis (LSA) ensures a central and coordinated process. Key elements in LSA are the identification and the analysis of maintenance tasks, as they dictate the required support during the system life cycle. All documentation is handled in one central Logistic Support Analysis Record (LSAR) database. The set-up of ILS at the Royal Dutch Navy is sketched as illustration.

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1. Introduction

Integrated Logistics Support (ILS) is the disciplined and unified management of the technical logistic disciplines that plan and develop support for military forces [1]. Logistics is, "the science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, those aspects of military operations which deal with: (1) design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of materiel; (2) movement, evacuation, and hospitalization of personnel; (3) acquisition or construction, maintenance, operation, and disposition of facilities; and (4) acquisition or furnishing of services." [2]

Focusing on the support of (army) equipment, Integrated Logistic Support (ILS) is a disciplined, unified and iterative approach to the technical and management activities necessary to integrate support considerations into system design during all stages of the life cycle. Integrated Logistics Support is described as a methodology for setting up the necessary logistic processes to support a capital asset during its whole life cycle. It is identified as a complete logistics approach originally developed for the US defense.

While the definitions of integrated logistics support may sound a little complicated, compare them to a hypothetical situation within the automobile industry. An automobile manufacturer spends several years developing and testing a new model car. The car is then manufactured and transported to automobile dealers. During the development phase, designers create a new body style, interior, and incorporate other features such as safety, which will attract customers. The automobile manufacturer must also create service manuals, test equipment, special tools, and maintenance courses for the service employees of automobile dealerships. The automobile dealerships and manufacturer must also stock parts. What would happen if an automobile dealer sold a car without any provision for its service?

1.1. Goals

The primarily goals of ILS include [1,2]:

- Integrate support considerations into design from the outset of the life cycle
- Determine the support requirements
- Acquire the required support
- Provide the required support at minimum cost.

1.2. Application

ILS is designed as the disciplined and unified management of the technical logistics disciplines that plan and develop support for military forces. Outside large military programs, ILS is being applied to rail systems, shipping, petroleum industry, commercial aviation, and many other areas where large sums of money are invested to create a capability [1].

2. The 10 Principle Disciplines

The US Army has identified ten separate elements of the acquisition logistics. It is important to note that while these are separate elements, each element of logistics support is directly related to one another and cannot stand alone. These ten principle ILS disciplines are [1,2]:

1 Maintenance planning; much of the support is centered around maintenance of equipment. A primary function of ILS

is to develop a concept for the maintenance program to support the system. The requirements for maintenance then drive the decisions concerning the resources necessary to support maintenance actions.

2 Manpower and personnel; Systems cannot operate and maintain themselves. ILS is charged with the responsibility of identifying the number of personnel needed to support operations and maintenance, and the skills they require.

3 Supply support; Operation and maintenance actions require material in the form of spare and repair parts. Identification and acquisition of the materials necessary to support the operation and maintenance of systems is another key responsibility of the ILS organization.

4 Support and test equipment; Some systems require additional equipment to support operations or maintenance. Support equipment specialists and test engineers conduct analyses to identify and develop these requirements.

5 Training and training support; Trained and qualified operators and maintenance personnel are required to support the systems. Within the ILS organization, are training specialists who participate in the planning process. Necessary devices and equipment to support training are also developed by this group.

6 Technical documentation; The equipment users need instructions on how to operate and maintain the system. Technical documentation is prepared by the technical publications discipline.

7 Computer resources; Computers are used to operate and maintain most systems. The majority of logistics activities have historically dealt with hardware, and most logistics requirements are focused on the maintenance of hardware. This leaves software, which does not have the physical characteristics of hardware, and hence more difficult to address in the context of failures and maintenance tasks. The resources to support software and hardware are an integral part of the support package for most systems.

8 Facilities; Operation and maintenance of most military systems and training of personnel require some type of facilities. ILS is responsible for identifying the needs, planning and developing the justification for acquisition.

9 Packaging, handling, storage, and transportation; Possible physical movement of the system must be accomplished in a manner that does not reduce its effectiveness. Logistics engineers plan and implement the procedures and measures.

10 Reliability and maintainability; The areas of reliability and maintainability address how long a system will operate without failure and how long it will take to fix an item when it fails, respectively. They play an important role in determining the support needed when a system is used.

Each of the 10 disciplines has a specific role in the logistics support planning process. These disciplines must then be coordinated to achieve the desired result. Three key elements which focus on the central processes, recording, and planning, respectively, are Logistics Support Analysis (LSA), Logistics Support Analysis Record (LSAR), and Integrated Logistics Support Plans (ILSP).

3. Logistic Support Analysis (LSA)

The various individual activities of the ILS disciplines must be coordinated to achieve the best logistics support. For this reason, the *process* known as Logistic Support Analysis (LSA) was developed [3].
LSA involves the integration and application of a range of quantitative and qualitative methods that aim to ensure that integrated logistic support requirements are considered comprehensively in all phases of the life cycle.

The establishment and implementation of a logistic support analysis program is often a requirement of governmental contracts for the design and development of (military) systems. MIL 1388-1A, Logistic Support Analysis, contains detailed descriptions of the requirements and the tasks that must be performed.

The LSA program consists of a series of 15 interrelated tasks, organized as follows:

3.1.1. Section 100, Program planning & control:

- Task 101 - Early LSA strategy
- Task 102 - LSA plan
- Task 103 - Program and design review

3.1.2. Section 200, Mission and support systems definition:

- Task 201 - Use study
- Task 202 - Mission hardware, software, and support system standardization
- Task 203 - Comparative analysis
- Task 204 - Technological opportunities
- Task 205 - Supportability and supportability-related design factors

3.1.3. Section 300, Preparation and evaluation of alternatives:

- Task 301 - Functional requirements identification
- Task 302 - Support system alternatives
- Task 303 - Evaluation of alternatives and trade-off

3.1.4. Section 400, Determination of logistic support resources requirements

- Task 401 - Task analysis
- Task 402 - Early fielding analysis
- Task 403 - Post production support analysis

3.1.5. Section 500, Supportability analysis

- Task 501 - Supportability test, evaluation, and verification

The scope of the LSA must be commensurate with the needs of each specific program. No tasks should be accomplished on a stand-alone basis. The SLA process is designed to enhance the interrelations between design phase and ILS and amongst the ILS disciplines.

MIL 1388-1A further divides the tasks into *subtasks*, and identifies the inputs required to perform the task, and the outputs that performing the task generates. It is outside the scope of the paper to fully explore all subtasks for each task, see e.g. [1]. Instead, only a few subtasks are highlighted, which are of main importance for the LSA process.

3.1.6. Task 301 - Functional Requirements

One important set of subtasks related to maintenance is included under *Task 301*, functional requirements identification. Subtasks 1-2 are related to system function identification. Subtask 3 includes risk identification. The *subtask 4* is devoted to the identification of operation and maintenance tasks. Subtask 4 is one of the keys to develop a detailed logistic support package for the new equipment. The place to start is Failure Modes, Effects, and Criticality Analysis (FMECA). In addition of FMECA, Reliability Centered Maintenance (RCM) is used to identify the maintenance tasks that are required to support the new equipment. Both methods are described shortly in Appendix A. Subtask 5 focuses on alternatives in the equipment design where supportability becomes a problem. Subtask 6 finally defines the updating of the program, such a continuous process is achieved.

3.1.7. Task 401 - Task analysis

Within **401**, each maintenance tasks analysis will result in the identification of all the logistic resources required to support the new system. The task analysis is the most manpower intensive. However, if done correctly, it is the single most accurate method of identifying the logistic support resources requirements. MIL-STD 1478 provides assistance in conducting the *subtask 1*, conducting detailed task analysis [10,11].

3.1.8. Task 303 - Evaluation of alternatives

As *subtask 7* in **303**, evaluation of alternatives and tradeoff analysis, a Level Of Repair Analysis (LORA) is conducted for each alternative to determine the optimum maintenance program for the system and optimum utilization of support resources. See for LORA, Appendix A.

4. Logistic Support Analysis Record (LSAR)

The outputs of LSA feed into a central database called a Logistic Support Analysis Record (LSAR).
The purpose of this single relational database is to provide a standardized method for compiling and storing logistics and logistics-related engineering data required to support the new system when operational. The requirements are described in MIL-STD 1388-2B, DOD requirements for a Logistic Support Analysis Record [12].

Figure 1 illustrates that data for the LSAR come basically from two MIL-STD 1388-1A tasks: task 301, subtask 4, and task 401, subtask 1. Some limited data do originate in task 201, Use Study, and Task 205, Design Criteria. task 303, subtask 7, actually uses data for modeling, with the results put back into the LSAR when the LORA results are completed.

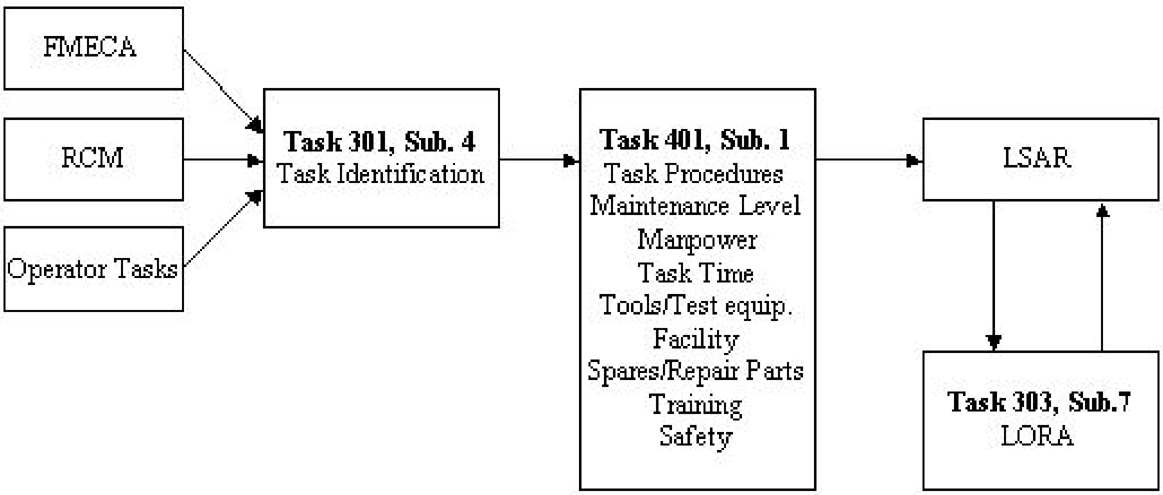

Figure 1: LSA tasks creating LSAR data [1].

The LSAR contains 104 tables, divided over ten functional areas:

- *"X tables"* (9) - Cross functional requirements
- *"A tables"* (11) - Operations and maintenance requirements
- *"B tables"* (12) - Reliability, availability, and maintainability FMECA, and maintainability analysis
- *"C tables"* (11) - Task inventory, task analysis, personnel, and support requirements
- *"E tables"* (13) - Support equipment and training material requirements
- *"F tables"* (5) - Facility consideration
- "G tables" (5) - Personnel skill considerations
- *"H tables"* (18) - Packaging and provisioning requirements
- *"J tables"* (6) - Transportability engineering analysis
- *"U tables"* (14) - Unit-under-test requirements and description

A method for managing the development of the LSAR, is to manage the analysis process that creates the data. This is accomplished using a four-step approach [1]:

1. LSA candidate identification; have all the LSA candidates been identified? Then the full range of items to be analyzed and documented can be completed.
2. Maintenance task identification (LSA task 301, subtask 4); have all maintenance tasks for each candidate been identified? Until all the maintenance tasks for each candidate have been identified, the total maintenance and support requirements for the system cannot be completed.
3. Maintenance task analysis (LSA task 401, subtask 1); the maintenance task analysis for all maintenance tasks for every LSA candidate must be complete before the total range of resources required to support operation and maintenance of the system can be identified.
4. Level Of Repair Analysis (LSA task 303, subtask 7); Only after LORA has been applied and the repair level for each

item has been agreed upon between system owner and contractor, the LSAR can be used as the source for development of the final logistics support package for the system.

5. Integrated Logistics Support Plan (ILSP)

The Integrated Logistics Support Plan (ILSP) is the business plan for ILS planning, coordination, implementation, procurement, and deployment of life support for a system. The ILSP may cover up to 50 years of activity, which is the typical life cycle of some major systems, e.g., in military context. The ILSP is a three-part document that describes in detail how the ILS program will be conducted to accomplish the program goals.

1 General; introduction, equipment description, program management.
2 Plans, Goals, and Strategy; operational plan, system readiness objectives, acquisition strategy, source selection, support acquisition, reliability-availability-maintainability indications, LSA strategy, ILS disciplines, design influence, constraints, maintenance plans, funding, standardization, support transition planning, modeling techniques, work breakdown structure, reporting, post-fielding assessment, post-production support.
3 Schedule; program milestones, coordination, reporting requirements.

The ILSP is prepared by the system owner during concept phase, and updated throughout the life of the ILS program. As such, it is a dynamic document, e.g., updated annually. The ILSP owner provides a copy of the ILSP to contractors for information and to help contractor's understanding of how contractual requirements fit into the overall ILS program.

6. Logistics Management

Successful accomplishment of goals requires proper planning and management. People are required to perform ILS requirements, and the way in which the people are organized influences how successful they will be.

6.1. ILS Organization

ILS organizations are composed of functional disciplines that have been described earlier in this paper. The way in which the disciplines are organized depends on the acquisition phase of the specific product, the company size, and the type of product supported. A conceptual organization of ILS disciplines solely based on functions is show in Figure 2 [1]. This concept is used by many large governmental contractors, that have ongoing logistics programs for many different products.

    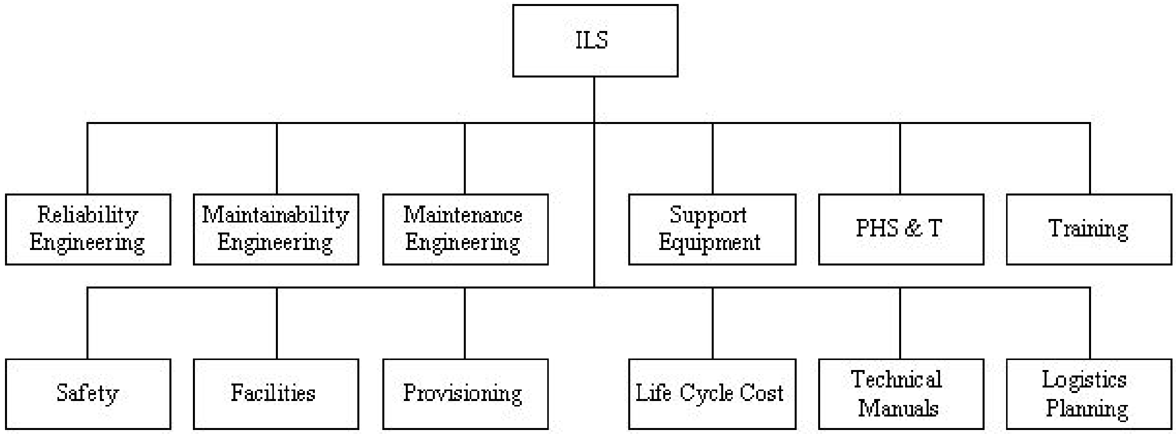

Figure 2: ILS Organizational Concept [1].

During *acquisition* phase, a smaller organization may be tailored, covering reliability and maintainability engineering, logistic resources planning, life cycle cost, and safety engineering. Also, for *smaller* companies, generally a few logisticians perform various functions to design the support package during the system life.

6.2. ILS Program Management

ILS activities are normally coordinated and controlled through a program management process. Aspects include assignment of responsibilities, changing action as the program moves through different phases, using program management tools such as schedule ad budget. The success or failure of a program depends on how well the program is managed. The person who bears the total responsibility is called the ILS (program) manager.

6.3. Role Of Contracting

Contracting plays an important role in ILS programs, especially when the government is the contract owner like in military ILS programs. Typical contracts for equipment and services have three basic sections that direct ILS activities. These three sections are (1) the product specification, (2) the statement of work, and (3) the data list.

The product specification includes a complete technical description of the system. Of course this also covers reliability, maintainability, and supportability goals. For example, a typical statement would include:

"... The system shall have a mean time between failure of not less than 1,000 hours ..."

Because of the MIL-STD standards, the Statement-Of-Work (SOW) can be rather straightforward. For example:

"... The contractor shall conduct a Logistic Support Analysis program to include accomplishments of Tasks 101, 102, 103, 201, 205, 301, 303, 401, and 501 of MIL-STD 1388-1A..."

The data list represents the complete list of documentation that a contractor must submit. Items are normally reports, plans, engineering drawings, and other documents related to the contract. The data list can be very significant, because the majority of ILS activities result in some kind of documentation, such as program plans, technical manuals, spares lists, etc.

The end result is a set of requirements that guide the contractor in producing/delivering what the contract owner wants.

7. Example: Royal Dutch Navy

ILS is being recognized by the Royal Dutch Navy as a disciplined planning and organizing approach to optimize the cost-effectiveness of technical systems [13]. It considers all support elements as influencing system design, and determines the support requirements needed. Based on the main entities of ILS, they have modeled the logistics process and their relationships in a conceptual flow diagram as illustrated in Figure 3.

8. Conclusion

Integrated Logistics Support (ILS) stands for the disciplined and unified management of the technical logistic disciplines that plan and develop support for any large system during its complete life cycle. An ILS organization including the ILS program manager and the contractors are responsible for its success.

Logistic Support Analysis (LSA) ensures a central and coordinated process. Key elements in LSA are the identification and the analysis of maintenance tasks, as they dictate the required support during the system life cycle. All documentation is handled in one central Logistic Support Analysis Record (LSAR) database.

9. References

[1] Jones, J.V., *Integrated Logistics Support Handbook*. McGraw-Hill, New York, 1995.

[2] MIL-STD 1369A, *Integrated Logistics Support Program Requirements*.

[3] MIL-STD 1388-1A, *Logistic Support Analysis.*

[4] MIL-STD 1629, *Failure Modes, Effects, and Criticality Analysis*.

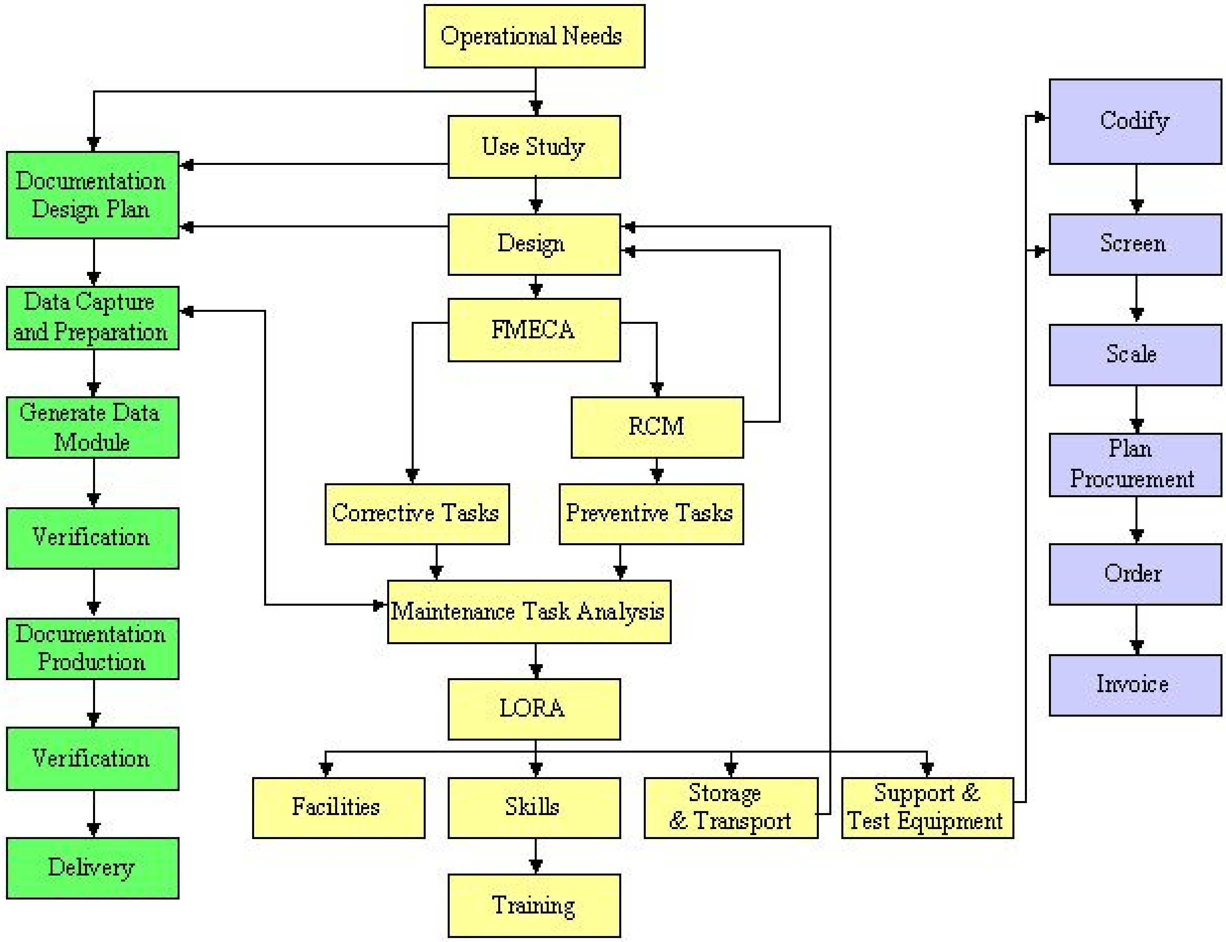

Figure 3: The Conceptual ILS Flow Diagram According The Royal Dutch Navy [13].

[5] Schram, G., *FMEA*, GS02012, http://www.aptitudexchange.com

[6] Barratt, M. Schram, G., *Criticality Analysis in Perspective*, MB03029, http://www.aptitudexchange.com

[7] Barratt, M., *Reliability Centered Maintenance*, MB02008, http://www.aptitudexchange.com

[8] MIL-STD 1390D, *Level Of Repair Analysis.*
[9] Barratt, M., *Level Of Repair Analysis*, MB0412, http://www.aptitudexchange.com

[10] MIL-STD 1478, *Task Performance Analysis.*

[11] Barratt, M. *Planning, Scheduling, and Work Orders*. MB03013. http://www.aptitudexchange.com

[12] MIL-STD 1388-2B, *Department of Defense (DOD) Requirements For A Logistic Support Analysis Record*.

[13] Stavenuiter, J. *Cost Effective Management Of Capital Assets - An Integrated Life Cycle Management Approach.* Asset Management Control Research Foundation, The Netherlands, 2002.

10. Appendix A

Three key LSA techniques are Failure Mode and Effects Criticality Analysis (FMECA), Reliability Centered Maintenance (RCM) and Level of Repair Analysis (LORA).

10.1. Failure Mo3des, Effects, and Criticality Analysis (FMECA)

This is an effective design tool and its application is an essential part of the design and development process, from functional analysis during the Acquisition Phase through to detailed design. FMECA is used to tailor a particular design and basically identifies possible system failures, the causes of those failures, and the effects of failure on a system and the criticality of failures in terms of safety and mission achievement. Identified failures may then be eliminated by improved design. For more details, see [4,5,6].

10.2. Reliability Centered Maintenance (RCM)

This technique identifies the most cost effective mix of maintenance schedules and procedures for both scheduled (servicing) maintenance and unscheduled (repair) maintenance. RCM is complementary to FMECA and should be conducted in conjunction with it. FMECA is used to identify critical maintenance actions to be included for analysis in an RCM program. For more details, see [7].

10.3. Level Of Repair Analysis (LORA)

This is essentially an analysis of maintenance actions that lead to recommendations on where scheduled (servicing) and unscheduled (repair) maintenance tasks should be conducted and when components should be discarded. LORA should be optimized to achieve maximum availability at minimum LCC. For more details, see [8,9]

