

NATO STANDARD

ALP-10

**NATO GUIDANCE FOR INTEGRATED
LIFE CYCLE SUPPORT**

Edition D, Version 1

JUNE 2025



**NORTH ATLANTIC TREATY ORGANIZATION
ALLIED LOGISTICS PUBLICATION**

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NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

24 June 2025

1. The enclosed Allied Logistics Publication ALP-10, Edition D, Version 1, NATO GUIDANCE FOR INTEGRATED LIFE CYCLE SUPPORT, which has been approved by the nations in the LIFE CYCLE MANAGEMENT GROUP (AC/327 LCMG), is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4876.
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Thierry POULETTE
Major General, FRA (A)
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
CAN	Canada's DND will not be adopting the thirteenth ILS element, 'Environmental Conditions and Recoverability' identified in this revision of ALP-10 covered by STANAG 4876. DND has a dedicated organizational authority responsible for environmental protection and stewardship. Environmental management is already an inherent consideration of ILS and all other process requirements in materiel acquisition and support and address the intent for the 13th ILS element in ALP-10. Including this environmental ILS element in DND ILS documentation could generate confusion in both the policy requirements and authorities responsible for ensuring environmental considerations are addressed. Therefore, Canada will Ratify and Implement with the Reservation of not adopting the newly proposed 'Environmental Conditions and Recoverability' ILS element in this revision of ALP-10.
DEU	The simplifying statements on page 8, logistics were to be considered « outdated » within ILS and logistics is only a slice within a supply chain can not be agreed to without mentioning, that, on the other Hand, the specific SC of an SOI is only a slice in the greater context of implementing and managing logistical capacities on a national or mnvl and every new SOI has to integrate itself into existing Logistic/ Enabling Systems somehow.
FRA	STANAG 4876 must be a STANREC. France will implement STANAG 4876 as a guide to be used in armament operations. Parts of the covered standard ALP-10 will be used on a case-by-case basis.
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Documents Database for the complete list of existing reservations.	

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Reference Identifier	Reference Title/Description
AAP-20	NATO Programme Management Framework (NATO Life Cycle Model), Edition C, Version 1, October 2015
AAP-48	NATO System Life Cycle Processes, Edition C, Version 1, May 2022
ACodP-1	NATO Manual on Codification
AEP 67	Engineering for System Assurance in NATO Programmes
ALCCP-01	NATO Guidance on Life Cycle Costs Ed.B Ver.1, May18
ALCCP-1.1	NATO Life Cycle Cost Common Methodology, Ed.A Ver.1, Jan22
AR 700–82	Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability (SMR) Codes
ASD S4000P	International Specification for developing and continuously improving preventive maintenance
ASD STE 100	Simplified Technical English
ASD/AIA/A4A S1000D	International Specification for Technical Publications using a common source database
ASD/AIA S2000M	International Specification for Materiel Management
ASD/AIA S3000L	International Procedure Specification for Logistics Support Analysis (LSA)
ASD/AIA S5000F	International Specification for in-service data feedback
ASD/AIA S6000T	International Specification for training analysis and design
ASD/AIA SX000i	Specification for Integrated Product Support
ASME Y14.44-2008	Reference Designations for Electrical and Electronics Parts and Equipment
Bi-SC 075-007	Education and Individual Training Directive (E&ITD) 075-007.
Bi-SC Directive 075-003	Collective Training and Exercise Directive
DD Form 1949-1	Data Selection Sheet, used with MIL-STD 1388-2B
DEFCON 117	Supply of Information for NATO Codification and Defence Inventory Introduction
DEFCON 129	Packaging Requirements
Def Stan 00-025	Human Factors Engineering
Def Stan 00-040	Reliability and Maintainability: Management Responsibilities and Requirements for Programmes and Plans
Def Stan 00-042	Reliability and Maintainability: Assurance Activity
Def Stan 00-045	Using Reliability Centred Maintenance to Manage Engineering Failures

Reference Identifier	Reference Title/Description
Def Stan 00-056	Safety Management Requirements for Defence Systems
Def Stan 00-60 Pt 0	Application of Integrated Logistics Support
Def Stan 00-60 Pt 0 Annex D	UK Data Item Descriptions for a Contract Data Requirements List (CDRL)
Def Stan 00-60 Pt 1	Logistics Support Analysis (LSA) and Logistics Support Analysis Record (LSAR)
Def Stan 00-60 Pt 2	Guide to the Application of LSA and LSAR
Def Stan 00-60 Pt 3	Software Support
Def Stan 00-600	ILS requirements for MOD Projects: PT 01 ILS Requirements, Pt 02 MOD Requirements for a Supportability Case, Pt 03 Logistic Information Requirements
Def Stan 00-601	MOD Business Rules – Contracting for Technical Documentation: PT 01 AIR S1000D Business Rules PT 02 MARITIME S1000D Business Rules PT 03 LAND S1000D Business Rules PT 04 Non S1000D Business Rules
Def Stan 05-055	Measurement and Calibration System Requirements
Def Stan 66-031	Basic Requirements and Tests for Electrical and Electronic Test and Measurement
Def Stan 81-41	(Pt 2) Packaging Design, (Pt 4) Services Packaging Instruction Sheet (SPIS)
DI-ILSS-80118C	USA Data Item Description (DID) for Support Equipment Requirements Data (SERD)
DI-ILSS-81585	USA Data Item Description (DID) for Reliability Test Plan
DI-ILSS-81285	USA Data Item Description (DID) for Provisioning Technical Data
DI-ILSS-80727	USA Data Item Description (DID) for Government Furnished Material (GFM)
DI-ILSS-80868	USA Data Item Description (DID) for Special Equipment Tools and Test Equipment List
DI-MNTY-81600	USA DID for Maintainability Programme Plan
DI-MNTY-81601	USA DID for Maintainability Status Report
DI-MNTY-81602	USA DID for Maintainability Prediction Report
DI-MNTY-81603	USA DID for Maintainability/Testability Demonstration Test Report
DI-MNTY-81604	USA DID for Maintainability/Testability Demonstration Test Plan
DI-MNTY-81613	USA DID for Reliability and Maintainability Program Plan
DI-PACK-80120C	US DID for Preservation and Packing Data
DI-PACK-80121C	US DID for Special Packaging Instructions

Reference Identifier	Reference Title/Description
DI-TMSS-81952	USA DID for S1000D Project Business Rules Exchange (BREX)
DoD HDBK 743A	Handbook of Anthropometry Data
DoD 4160.21-M: 1997	US Defense Materiel Disposition Manual
DSA-2-DLSR	UK Defence Codes of Practice: Movement and Transport Safety Regulator, Defence Land Safety Regulator
EIA	Electronic Industries Alliance
EIA-649C	Configuration Management
FEDLOG	Database of Federal Stock Numbers
IEC 60300-1	Dependability Management
IEC 60300-2	Guide to Dependability Management
IEC 60300-3-02	Dependability Management – Part 3-2 – Application Guide – Collection of dependability data from the field
IEC 60300-3-03: 2017	Dependability Management – Application guide – Life Cycle Costing
IEC 60300-3-10: 2001	Dependability Management – Application Guide for Maintainability
IEC 60300-3-11	Dependability Management – Part 3-11 – Application Guide – Reliability Centered Maintenance (RCM)
IEC 60300-3-12: 2011	Dependability Management – Part 3-12 – Application Guide – Integrated Logistics Support
IEC 60706	Maintainability of Equipment: Pt 1: superseded by Pt 2. Pt 2: Maintainability requirements and studies during the design and development phase Pt 3: Verification and collection, analysis and presentation of data Pt 4: Withdrawn Pt 5: Testability and Diagnostic Testing
IEC 60812	Failure Modes and Effects Analysis (FMEA and FMECA)
IEC 61078	Analysis techniques for Dependability RBD and Boolean methods
IEC 61508	Functional Safety
IEC 61703	Mathematical expressions for reliability, availability, maintainability and maintenance support terms
IEC 62550	Spares Parts Provisioning
IEC 64202	Obsolescence Management
IPS Elements Guidebook	A guide to each Integrated Product Support element
ISO 10007	Quality Management – Guidelines for Configuration Management
ISO 10303-239	PLCS
ISO 10303-242	Engineering Data

Reference Identifier	Reference Title/Description
ISO 12207	Systems and software engineering: Software life cycle processes
ISO 14001	Environmental Management
ISO 16739	Industry Foundation Classes
ISO 21500: 2021	Project, programme and portfolio management — Context and concepts
ISO 22301	Secure Disposal of Data and Equipment
ISO 26262	Software Compliance in the Automotive Industry
ISO 27001	Information Security Management System
ISO 27002	Information Security Management System
ISO 29481	Building Information Models
ISO 50001: 2018	Energy management systems — Requirements with guidance for use
ISO 60812	Failure Modes Effects and Criticality Analysis
ISO 62402	Obsolescence Management
ISO 9001	Quality Management Systems
ISO/IEC/IEEE 15288	Systems and Software Engineering – System Life Cycle Processes
ISO/IEC/IEEE 24748-5: 2017	Systems and software engineering — Life cycle management
ISO/IEC/IEEE 24748-8: 2019	Systems and software engineering — Life cycle management: Technical Reviews and Audits on Defense Programs
ISO/IEC TR 19760: 2003	System life cycle processes
ITAR	International Traffic in Arms Regulations, US government regulations controlling distribution and use of technical data to non-USA citizens
JSP 886 Vol 7 Pt 2	ILS Management
JSP 886 Vol 7 Pt 3	Supportability Analysis
JSP 886 Vol 7 Pt 4	Software Support
JSP 886 Vol 7 Pt 8.02	Supportability Engineering – Packaging Handling Storage and Transportation
JSP 886 Vol 7 Pt 8.05	Supportability Engineering – Technical Documentation
JSP 886 Vol 7 Pt 8.06	Supportability Engineering – Test Equipment
JSP 886 Vol 7 Pt 8.07	Supportability Engineering – Support Equipment
JSP 886 Vol 7 Pt 8.08	Supportability Engineering – Facilities and Infrastructure
JSP 886 Vol 7 Pt 8.10	Supportability Engineering – Supply Support
JSP 886 Vol 7 Pt 8.13	Supportability Engineering – Obsolescence Management

Reference Identifier	Reference Title/Description
JSP 886 Vol 7 Pt 8.15	Supportability Engineering – Gatekeeper Role In Utilisation of Common Defence Materiel
JSP 886 Vol 7 Pt 8.17	Supportability Engineering – Calibration Policy
JSP 912	Human Factors (Pt1: Directive. Pt2: Guidance)
MCO 4400.120	Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability (SMR) Codes
Mil DTL 87268D	Specification for Interactive Electronic Technical Manuals
Mil DTL 87269	Database Revisable Interactive Electronic Technical Manuals
MIL-HDBK 61B	Configuration Management Guidance
MIL-HDBK 217F	Reliability Prediction of Electronic Equipment
MIL-HDBK 338B	Electronic Reliability Design
MIL-HDBK 470	Designing and developing maintainable products and systems
MIL-HDBK 502A	Product Support Analysis
MIL-HDBK 523	Guide to general style and format of S1000D Technical Manual Data Modules
MIL-HDBK 759C	Human Engineering Design Guidelines
MIL-HDBK 1012	Electronic Facility Engineering
MIL-HDBK 1013	Design Guidelines for Physical Security of Facilities
MIL-HDBK 1190	Facility Planning and Design Guide
MIL-HDBK 1280	Keyboard Arrangements
MIL-HDBK 1390	Level of Repair Analysis
MIL HDBK 1473A	Color Marking of Army Materiel
MIL-HDBK 1814	Integrated Diagnostics
MIL-HDBK 2097A	Acquisition of Support Equipment and Associated ILS
MIL-HDBK 2155	Failure Reporting Analysis and Corrective Actions Sheet (FRACAS)
MIL-HDBK-2165	Testability Design handbook for systems and equipment
MIL-STD 129	Marking for Shipment and Storage
MIL-STD 472	Maintainability Prediction
MIL-STD 740-2	Structure borne vibratory Acceleration Measurement
MIL-STD 834	Packaging Data Forms
MIL-STD 882E	System Safety
MIL-STD 1366	Transportability Criteria
MIL-STD 1388-1A	DOD Requirements for a Logistics Support Analysis
MIL-STD 1388-2B	DOD Requirements for a Logistics Support Analysis Record
MIL-STD 1472H	Human Engineering Design Criteria

Reference Identifier	Reference Title/Description
MIL-STD 1474E	Design Criteria Standard Noise Limits
MIL-STD 1629A	Failure Modes Effects and Criticality Analysis
MIL-STD 1787D	Aircraft Display Symbolology
MIL-STD 2073-1E	Military Packaging
MIL-STD 3031A	US Army Business Rules for S1000D
MIL-STD 3034A	Reliability Centred Maintenance
MIL-STD 3048B	US Air Force Business Rules for S1000D
MIL-STD 38784B	Department of Defense standard practice: General style and format requirements for technical manuals
MIL-STD 40051-1C	Preparation Of Digital Technical Information For Interactive Electronic Technical Manuals (IETMS)
MIL-STD 46855A	Human Engineering Requirements for Military Systems, Equipment and Facilities
NMCRL	NATO Master Catalogue of Reference for Logistics (NMCRL), database of NATO Stock Numbers
OPNAVINST 4410.2A	Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability (SMR) Codes
RADC-TR-77-287	A Redundancy Notebook
REACH, UN ST/SG/AC.10/1 (Vol. 1)	Transportation of Dangerous Goods
RM-4720-PR	A system approach to base stockage of recoverable items
RM-5078-PR	A multi-echelon technique for recoverable items control (METRIC)
SAE ARP 4761	Safety Assessment Process for Civil Airborne Systems
SAE AS1390	Level of Repair Analysis
SAE EIA 649A	Configuration Management
SAE EIA 649-1A	Configuration Management Requirements for Defense Contracts
SAE GEIA-HB-0007B	Companion handbook to SAE-GEIA-STD-0007C provides standard guidance (i.e., how to), data population during life cycle phases, tailoring, contracting, data selection, a data map, and detailed information on data development for key and major fields (LCN, PLISN, UOC, etc.).
SAE GEIA-STD-0007C	Logistics Product Data
SAE JA 1011	Standard for Reliability Centered Maintenance
SAE JA 1012	A Guide to the Reliability Centered Maintenance Standard
SAE TA-HB-0007-1A	Companion handbook for SAE-TA-STD-0017 that specifies Logistics Product Data Summaries
SAE TA-STD-0017A	Product Support Analysis
SEBoK	Systems Engineering Book

Reference Identifier	Reference Title/Description
STANAG 4107	Mutual Acceptance of Government Quality Assurance and Usage of the Allied Quality Assurance Publications
STANAG 4427	Configuration Management In System Life Cycle Management - The aim of this agreement is to register national acceptance of the series of Allied Configuration Management Publications (ACMP) 1 to 7.
STANAG 4457	Engineering Documentation in Multi-National Joint Projects
STANAG 4597	Obsolescence Management - The aim of this agreement is to register national acceptance of IEC 62402:2007 "Obsolescence Management - Application Guide" as providing best practice for nations and for NATO multinational programmes.
STANAG 4728	System Life Cycle Management - The aim of this NATO standardization agreement (STANAG) is to respond to the following interoperability requirements. Detailed by AAP-20 and AAP-48.
STANREC 4174	Guidance For Dependability Management
STANREC 4814	Systems and software engineering – Software life cycle processes
Systems Engineering Guidebook for intelligent Transport Systems, 2009, Version 3.0,	Federal Highways Administration, California Division
USA JSSG-2010	Joint Service Guide Crew Systems
WEEE Directive 2012/19/EU	Waste from Electrical and Electronic Equipment

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1 GENERAL

1.1 Introduction

The NATO emphasis is on the provision of military capability, to which armament systems and equipment contribute the materiel solution. From the materiel point of view, this calls for a systems life cycle approach, to ensure that the through-life requirements of the system are formulated and addressed at the outset. As described in the NATO Policy for Systems Life Cycle Management (SLCM), the aim of SLCM is to optimise capabilities over the life cycle of the system by taking into account performance, cost, schedule, quality, operational environments and Integrated Life Cycle Support. As Part of the NATO Life Cycle Management Framework, this publication provides the NATO System Life Cycle Processes to support the successful development and sustainment systems. With the system concept, life cycle model in AAP-20 and with the processes concept in AAP-48 NATO implements SLCM based of the industrial standard ISO/IEC/IEEE 15288, “Systems and Software Engineering – System Life Cycle Processes” as required in the NATO Policy.

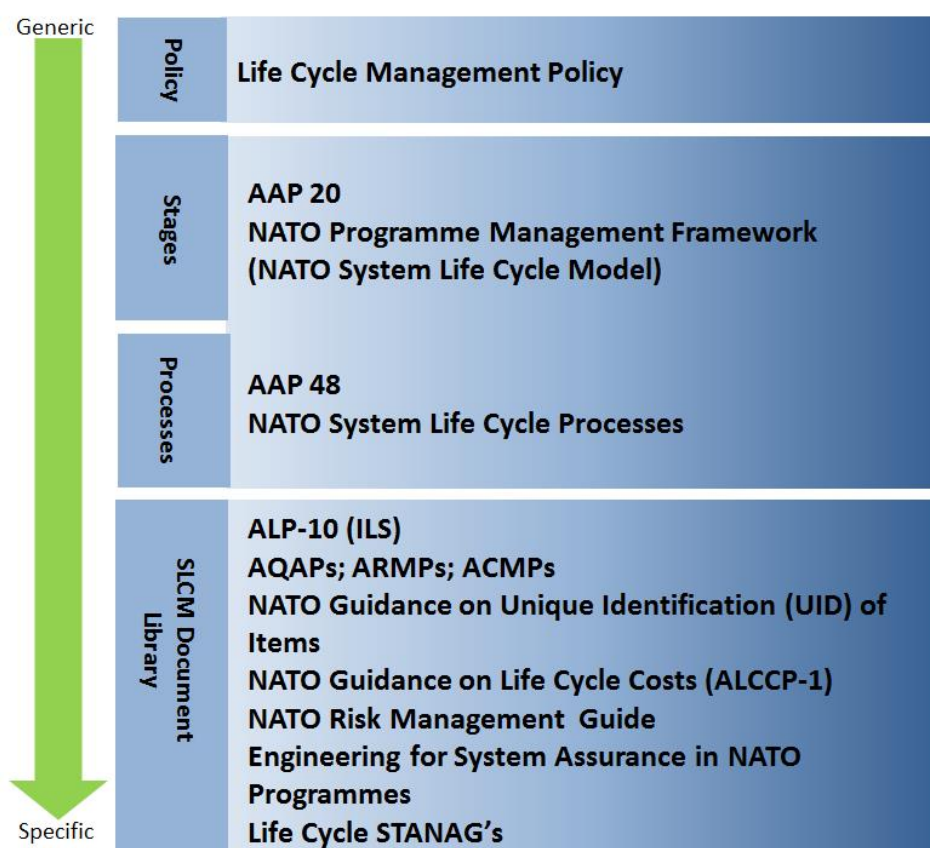


Figure 1: NATO Life Cycle Management Document Framework

The complexity of NATO systems has increased to an unprecedented level. This has led to new opportunities, but also to increased challenges for the organisations that create and utilise the systems. These challenges remain throughout the life cycle of a system and at all levels of architectural detail. They arise from several sources:

- There are inherent differences among the hardware, software and human elements from which systems are constructed.

- Almost every present-day system contains, and/or is modelled and supported by information technologies.
- There is a lack of harmonisation and integration of the involved disciplines, including: science, engineering, management, and finance.
- Keeping pace with global business environment as it moves towards technologies such as digital twin and digital thread.

1.2 Scope

This publication shall be used by NATO programmes, NATO Agencies, and Nations in the implementation of System Life Cycle Management (SLCM). It facilitates interoperability, communication, collaboration and cooperation, while minimising total cost of ownership. NATO acquisition is focusing on multinational programmes, which emphasises the need for common methods of work by Nations and Agencies.

ALP-10 provides direction on how to apply the basic principles of ILS into programmes and how to utilize international standards and specifications. Consequently, it aims to achieve NATO-wide interoperability between nations, nations and its industries and across industries, to ensure a common concept of Integrated Life Cycle Support (ILS). It is important for every programme, agency, and nation to rigorously review and tailor the ILS activities described in this document. Requiring nothing or requiring everything in ALP-10 is not a good business practice. Each programme, agency or nation must establish what their fundamental ILS requirements are and then adhere to them via internal documentation. ALP-10 provides the foundational information needed to successfully accomplish this.

Extant guidance recommends the use of civil standards wherever practically possible, consequently, NATO uses ISO/IEC/IEEE 15288 as the basis for implementing Life cycle processes. This allows for traditional acquisition and procurement cycles and also for incremental and iterative initiatives for the realisation of required capabilities.

1.3 Purpose

The purpose of this document is to provide direction on the policy, implementation and responsibilities for the application of Integrated Life Cycle Support (ILS) in NATO and multinational armament programmes.

1.4 Applicability

NATO and Nations are encouraged to use this publication as directive in nature- and therefore, ALP-10 intends to support and complement national acquisition policies and not replace them. Tailoring this document to meet NATO or national requirements becomes critical in successful implementation of ALP-10 on national or multinational programmes. ALP-10 is meant to support with concrete advice on how to approach ILS as well as to define a NATO strategy to utilize ASD/AIA specifications, next to other necessary standards. The use of ALP-10 in NATO, multinational and national programmes as an enabling part of the life cycle document framework will lead to a more effective and efficient provision of capabilities.

This includes common, co-operative, multinational, as well as jointly funded armament programmes, and may also be applied to national armaments programmes. While ILS can be applied to all armament programmes, the level of implementation will be dependent on the degree of innovation and complexity of the materiel solution, support environment.

Decisions on support requirements have the greatest impact on system performance, life cycle cost and supportability when taken early in the life cycle of a programme and a system. ILS disciplines shall plan and develop support requirements and ensure SOI quality in terms of Supportability such as Reliability, Availability, Maintainability, Safety and Testability (RAMST), etc. ILS can provide the tools to accomplish that objective in a structured and integrated way, however, to obtain that objective, the provision of front-end funding for ILS activities is required to reduce overall life cycle costs.

1.5 Overview

A very high-level summary of ALP-10 chapters is described below.

Ch.1: General Introduction of ALP-10

Ch.2: General ILS Introduction information is included, and ILS elements are defined. Activities of every ILS element (see Table 2) and their interaction with other ILS elements (inputs and outputs) have been detailed. The Activities in this chapter must be rigorously reviewed and tailored to each programme, agency or nation's requirements. See Para 2.

Ch.3: Provides a detailed description and cross-reference of the ILS processes required against the NATO System life cycle stages of AAP-20 and processes of AAP-48. See Para 3.

Ch.4: Describes the functional roles and responsibilities an ILS organization should have in order to adequately execute the ILS processes and deliver the ILS products required to support an SOI. See Para 4.

Ch.5: This chapter integrates the previous chapters. Along the respective life cycle stages, this chapter identifies all necessary processes, ILS elements and activities as well as the necessary functional roles, that have to interact. The essential interaction with the system engineering Design Reviews is shown as an overview in Figure 40, and in more detail in Figure 41 to Figure 49. Figure 40 The "user" of ALP-10 may choose the respective standards, specifications and processes. On top of the respective selection, Chapter 5 provide concrete guidance on how to set up the analysis of support requirements and the introduction of a new SOI to facilitate interoperability that facilitates interoperability on maintenance level. Chapter 5 provides guidance to analysis methods that should help to assess the maturity of a system regarding ILS as well as the maturity of a system with regards to contracting methods, like outcome and/or performance based on contrast to classical support contract methods. See Para 5.

Annex-1: ILS Concept/ ILS Plan Guidance, See Figure 51 to plan and integrate the ILS activities with the Systems Engineering Plan milestones.

Annex-2: Mapping of Processes / Stages

Annex-3: Future Technologies and Innovation

Annex-4: Glossary / Acronyms

1.6 Limitation

There is no intent for this document to define all tasks, requirements, recommendations or transactions at the organization level. The document cannot cover the requirements of all implementing organizations, as their set-up, ways of working and practices are very different. Therefore, the users (NATO, Group of Nations, Nations) programme management organisations are responsible for tailoring and mapping of the specific activities and tasks and for selecting methods, techniques and appropriate standards.

ALP-10 does not tailor the NATO system life cycle model. The users of ALP-10 are responsible for tailoring the System life cycle model of AAP-20 for the programme and aligning the processes, activities and tasks to that model. The organisations are also responsible for selecting and applying appropriate NATO publications, STANAGs or STANRECs and verify suitability for the programme.

2 INTEGRATED LIFE CYCLE SUPPORT (ILS)

2.1 Introduction

Integrated Life Cycle Support (ILS) is a combination of management and technical processes which aims to produce a supportable system design and a reasonable support capability to achieve a predetermined set of measurable performance and supportability objectives within the optimum life cycle cost. In order to achieve these targets, ILS is composed of various ILS elements. Integration and balance of the ILS elements between themselves and with the SOI design is very important to achieve an optimum support capability. By fostering collaboration between ILS elements and the SOI design, ILS improves operational availability, through better supportability in all systems and decreases life cycle costs. By setting up a digital thread for all the affected processes, used and maintained along the whole life cycle of the system, the supportability improvement is achieved more efficiently.

2.1.1 Capability

The NATO, Nations or groups of Nations need capabilities to meet their strategic objectives. The objectives are documented in strategic concepts for the Defence and Security. In order to maintain the capability to constantly satisfy these strategic objectives, it is continuously necessary to find new solutions. The main objective of a programme is to deliver the required capabilities to fill identified gaps with a solution. For more information see AAP-20.

2.1.2 System, System-of-Interest (SOI), Enabling Systems

The System-of-Interest (SOI) consists of the arrangement of subsystems, main components, components (assemblies), and parts to meet a specific and defined purpose as distinguished from other systems (Figure 2). Their essential properties arise from the relationships between the elements. The subsystems, components, and parts are able to be directly or indirectly dependent on each other and/or be linked and/or interact with each other. Examples for a SOI can be a Main Battle Tank, a Satellite, a Fighter Jet, a Destroyer, etc.

Enabling systems support a System-of-Interest during the life cycle for the system, but it does not necessarily contribute directly to its function during operation. Examples are simulators, ground equipment, tools, and spare parts. For more information see AAP-20.

The system concept for AAP-20 defines a system as a System-of-Interest (SOI) and all Enabling Systems (enablers) for the SOI. This system concept differs from the management of the life of a product within the customer organization (asset tracking, configuration management, etc.), that is an integral part of the tasks to reach and maintain the maturity during the Systems Life Cycle. ISO/IEC/IEEE 15288 provides an additional system concept and structure with a principal view on industrial needs. This system concept must also be seen as an integral part of the system concept for AAP-20.

More detailed information can be found on AAP-20 and ISO 15288 documents. Additionally, it is necessary to understand the definition of Product as a system by ISO/IEC/IEEE 15288. Due to the commitment of the NATO to implement System Life Cycle Management based on ISO/IEC/IEEE 15288, this system concept is integral part of the NATO System concept.

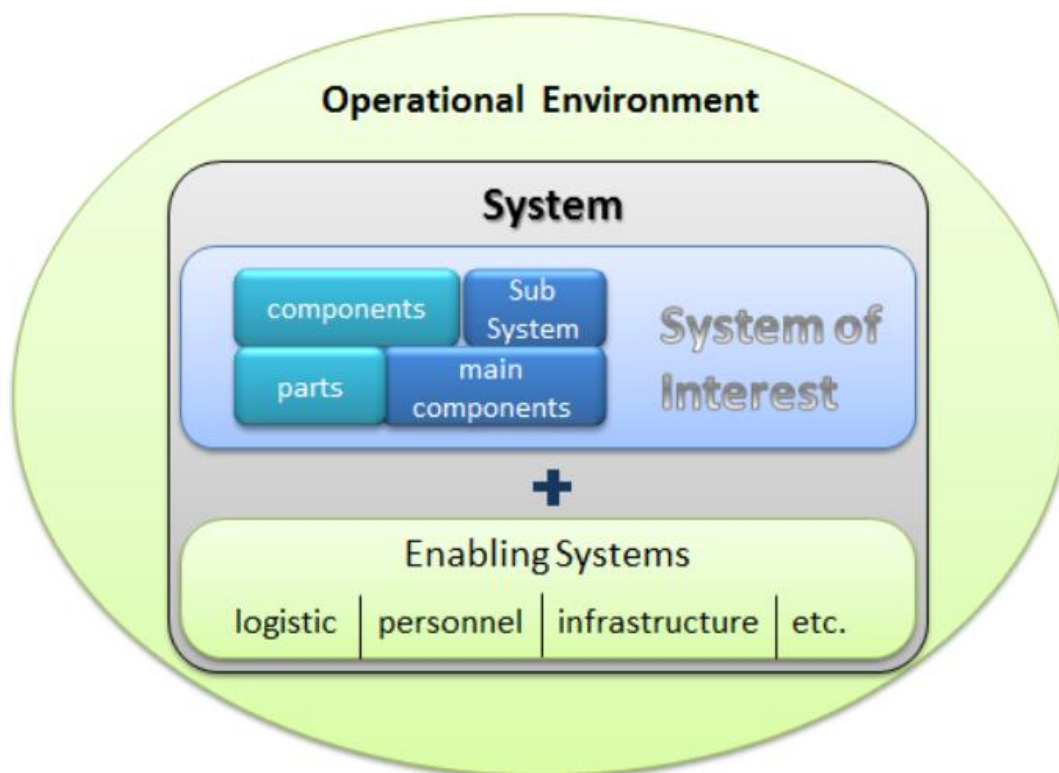


Figure 2: System, SOI and Enabling Systems

2.1.3 System Life Cycle Management (SLCM)

System Life Cycle Management describes how a SOI and enabling systems are managed throughout its life cycle using the methods of Programme Management by NATO, Agencies and Nations on the base of AAP-20.

2.1.4 NATO System Life Cycle

Every System (SOI and enabling systems) has a life cycle which describes the life of the system from cradle to grave in distinct sequential stages. Figure 3 depicts the life cycle stages for a generic System. Each stage has a distinct purpose and contribution to the whole life cycle (AAP-20). These stages provide a framework for decision making, ensure high level visibility and control over the programme and technical processes. ALP-10 is applied through the whole life cycle of the System, and it is very important to be involved in the early stages as well as the utilisation and support stages since most of the decisions affecting the life cycle cost are given during the early stages. ILS management must take place in each and every stage of the life cycle to achieve an optimum support solution. The ILS activities for each life cycle stages have been discussed in Section 2.2.



Figure 3: The NATO Life Cycle Stages

2.1.5 Definition of ILS Elements

The ILS process provides a framework to plan, develop, acquire, implement, manage, execute and withdraw support solutions/activities in order to achieve performance goals with the optimum life cycle cost. It is an interdisciplinary practice with different functional areas which are called ILS elements. ILS elements will be described in detail throughout this chapter. Table 2 provides an overview of the context of these ILS elements.

Table 2: An overview of the ILS Elements' context

#	ILS Element	Context
1.	ILS Management *	Planning and management of overall ILS process (ILS Plan). Interfacing ILS elements and life cycle domains.
2.	Design Interface	Influence the design to optimize performance and LCC by participating in the systems engineering process.
3.	Maintenance	Maintenance concepts and requirements. Executing the maintenance.
4.	Supply Support	Analysis, planning, procurement and management of all classes of supply throughout the life cycle
5.	Support and Test Equipment	Acquisition and support of the equipment required to sustain the operation and maintenance of the System.
6.	Training and Training Support	Plan, develop & resource the training. Train personnel to operate, maintain & support the System.
7.	Technical Information	Accumulate and maintain technical data for analysis. Plan, develop, produce & maintain technical publications
8.	Workforce and Personnel	Analysis and management of the amount of personnel as well as the capabilities required. The name has been updated in this version (formerly "Manpower and Personnel") to comply with the NATO Gender-Inclusive Language.

#	ILS Element	Context
9.	Packaging, Handling, Storage and Transportation (PHS&T)	Analysis of requirements and execution of packaging, handling, storage and transportation activities.
10.	Facilities and Infrastructure	Analysis and provision of facilities and infrastructure needed for operating the SOI, training, storage, maintenance etc.
11.	IT System Support *	Planning and management of mission critical hardware and/or software systems.
12.	Sustaining Engineering-*	Evaluate operational suitability in operational environment. Recommend design changes and manage disposals.
13.	Environmental Conditions and Recoverability * (EC&R)	Consider reciprocal effects of the environment & System to each other and incorporate them in systems engineering.

In the previous version of the ALP-10, nine ILS elements were described in the scope of ILS. As technological advancements lead to increased complexity and interoperability; requirements and Systems evolve continuously. These also evolve the scope and the extent of the ILS process. Therefore, the ILS elements marked with * have been introduced newly to the scope of ALP-10 to fill the gap.

Even though life cycle stages are chronological, all ILS elements are crucial and applicable in any time from the pre-concept to the end of retirement. Hence, the order of the ILS elements is not chronological. The extent of the use and coverage of the ILS elements depends on the System and/or the national/organizational practices. The actions, inputs and outputs of any individual ILS element can be tailored depending on the requirements of the programme. However, it is very important to note that each and every ILS element must be considered in every programme regardless of the Systems and the internal processes of the nations/organizations.

2.1.6 ILS Plan (ILSP)

An ILSP is the document that plans and controls the overall process for each programme. It creates the roadmap to support the System for a lifetime. ILS Strategy is implemented in this document to various ILS disciplines to coordinate, implement, procure and deploy life cycle support for a System. Support concept, maintenance planning and logistics support analysis are included in the plan along with the ILS elements. System characteristics such as reliability, maintainability, standardization, human engineering, safety etc. are also addressed in ILSP and its annexes.

ILSP defines roles and responsibilities both for Nations/Organizations and contractors, and describes the interfaces between them including methods for review of progress and approval. It develops a mechanism to track and evaluate the support process.

Details related to list of materials, supply support, acquisition plans, levels of repair and actors for repair actions are specified and a mechanism on how to choose and decide on them is developed. As the post-production support of the equipment represents the largest percentage of life cycle costs, ILSP also specifies cost categories including operating and support costs and addresses the required funding and budgeting issues.

It is a living document and content can be updated to reflect the changes in the Programme requirements and/or to provide more detailed information related to support. These updates can be applied periodically or when required.

2.1.7 Supportability Analysis (SA)

Supportability Analysis is a systematic iterative process that incorporates the ILS system requirements into the System design. SA facilitates an easy, cost effective and safe maintenance with minimum requirements for workforce, test equipment, new facilities and with maximum utilization of existing personnel, tools, support equipment, facilities and support systems.

SA aims to influence design by considering life cycle support, identify support problems and cost drivers early in the system life cycle and develop supportability requirements for system life. To achieve these goals, it employs a single supportability analysis database. This database generates necessary information to achieve the specified system/component sustainability and availability requirements. It can also be used for tracking and managing the performance metrics of Systems. A Supportability Analysis Plan is generally a part of an overall ILS Plan unless it is required to be a separate plan or the project is complex. More information on SA and analysis recording can be found on the appropriate standards e.g. SAE TA-STD-0017A, DEF-STAN 00-600, ASD S3000L and SAE GEIA-STD-0007, and Mil HDBK 502A guiding on the application of SAE-TA-STD-0017A.

2.1.8 Transition to “Life Cycle” from “Logistics”

ILS is commonly known as “Integrated Logistics Support”, which was also the terminology in the previous version of the ALP-10. Aside from “Integrated Logistics Support”, “Integrated Product Support (IPS)” also refers to the same area of interest, which has been used by some nations as well as organizations, like SAE, ASD, or AIA to integrate all necessary processes and deliverables throughout the life cycle of a product.

Integrated Logistics Support (ILS) was used for decades to describe all necessary aspects to integrate Support Engineering together with Technical Engineering into a concurrent Systems Engineering approach. The scope of ILS includes: supportability analysis, enabling systems, material management and supply, Technical Information, training, infrastructure, in-service feedback, life-long support analysis and optimization. As the scope of ILS gets larger, the term “Logistics” is “outdated” to some extent.

In civil industries as well as in the scientific field, the term “logistics” is discussed in the context of the supply chain, which provides necessary processes but has a dedicated scope to a slice of the overall activities. In numerous projects along the years, ILS has been used to describe the necessary processes and generation of deliverables until the utilization phase of a programme, while In-Service-Support (ISS) has been used to describe the necessary processes and deliverables along the rest of a programme’s life cycle. This often came together with different budgets and goals for each of these topics.

In the terminology of AAP-20 and AAP-48, NATO works with the concept of systems. As a system consists of a System of Interest (SOI), which has to be supported by its enabling systems, which are valid in a certain operational environment only and have to be assessed, analysed and adjusted along its whole lifetime, the “product” is meant to be equal with the System of Interest (SOI). NATO provides a holistic view onto a complete system, along its whole life cycle to be supported in a way to maximize economic availability, reliability and maintainability to establish the interoperability.

The real success of ILS process lies in its application in early stages of the life cycle as the decisions made in these stages influences the design. This influence on the design has a significant impact on both System performance, support and life cycle costs.

In order to convey this view, AC 327 LCMG decided to use “Integrated Life Cycle Support” instead of “Integrated Logistics Support” or “Integrated Product Support” terminology. AC 327 LCMG believes that using “Life Cycle” instead of “Logistics” or “Product” will help the ILS community to foster systems thinking and life-cycle approach to consider each one of the stages of the life cycle as well as the whole life cycle of the system while keeping the established acronym “ILS”.

2.1.9 Life Cycle Cost (LCC)

LCC can be defined as cumulative direct and indirect costs of a System over its entire life cycle. LCC is used at the beginning of the life cycle in order to choose the best viable option. LCC analysis is conducted in the scope of ILS element Design Interface, and it provides necessary information to decide on the best alternative. It intends to forecast future spending, specify cost sensitivity to possible design changes, and quantify risks, advantages & disadvantages.

LCC analysis can be used for evaluating the future expenditure and assessing the affordability of the programme. Moreover, it helps evaluating alternative solutions for SOI and Enabling Systems in order to reduce life cycle costs. An effective analysis, which has a key role in planning and control of LCC, points out the cost drivers, enables a better management for existing budgets, and enhances the planning of future budgets.

A valid LCC analysis needs a life cycle cost framework which defines LCC breakdown structure, analysis methods & tools, data & related assumptions and risk analysis. LCC analysis feeds on a single Logistics support database which is produced throughout LSA. For further details and methodology, please refer to “ALCCP-01 NATO Guidance on Life Cycle Costs Ed.B Ver.1, May18” and “ALCCP-1.1 NATO Life Cycle Cost Common Methodology, Ed.A Ver.1, Jan22”.

Estimations in LCC analysis must be consistent with the Programme requirements. LCC estimation is mostly affected by the nature and complexity of SOI, the scope of cost estimation, system life cycle stage and data availability. The characteristics of high-quality cost estimates are accuracy, comprehensiveness, ability to replicate & audit, traceability, credibility and timeliness. (ALCCP-01)

LCC cost incurred in each and every life cycle stages varies. Generally, costs incurred in concept, development, production, and retirement stages add up to 15% of total life cycle cost; however, 85% of the cost is incurred in utilization and support stages. On the other hand, of all the decisions made during the life cycle, the decisions made in utilization, support and retirement stage has only a 10% effect on LCC. The remaining 90% of the decisions that affect LCC are made in concept, development and production stages. This interesting fact reveals the importance of influencing the early design using LSA studies to achieve the optimum LCC for a System.

A list of additional terms and definitions used in this document is provided in Annex 4.

2.2 ILS Elements

Integrated Life Cycle Support (ILS) is the management and technical process through which supportability is integrated into the design of a SOI and considered throughout its life cycle. It is the process by which all elements of Integrated Life Cycle Support related to the System are planned, acquired, tested, and provided in a timely and cost-effective manner.

Activities of ILS elements start with the definition of the Integrated Life Cycle Support concept, continues with supportability analysis and sustainment/support activities during the life cycle and

ends with disposal of SOI. Support of a System during the utilization and support stages requires personnel, spares, transportation, support and test equipment, facilities, technical information, IT System Support, etc.

There are 13 ILS elements which are related to the support of the System within the scope of ALP-10 (Figure 2). (Activities that are not related with the System are excluded from this document.)

The Environmental Conditions and Recoverability ILS element is defined as a separate ILS element to increase awareness during the life cycle of the System and due to the increasing importance of environmental issues/regulations and their effects on the supportability.

2.2.1 ILS Management

2.2.1.1 Overview

ILS Management aims to elaborate support solutions in accordance with the ILSP. ILSP is created and maintained to achieve supportability and to ensure that related support strategies are considered throughout the system life cycle. ILS strategies maintain integrity and balance between availability and technical performance of the System. Integrity among technical solution, support solution and operation concept lead to efficiency and life cycle cost optimization (affordability). ILS management also provides continuous ILS leadership throughout the life cycle of System.

It comprises planning and managing activities to have control over O&S cost and performance throughout the system life cycle. ILS management is achieved by integration of all ILS elements and the corporate level understanding about how a support solution is designed, applied and improved, considering both short- and long-term life cycle aspects.

As part of a support concept, ILS Management comprises the following activities:

2.2.1.2 Analyse Alternatives

In the scope of this activity different support solution alternatives are evaluated for different SOI alternatives using initial capability document and design engineering data to select a support solution.

- Capture and develop ILS requirements by benefiting from contract and design engineering data in order to build efficient support solutions and correspondingly fill the capability gaps defined by acquisition systems/authorities and meet the customer expectations (technical, schedule, quality etc.),
- Perform appropriate trade-offs covering cost benefit analyses and feasibility studies for each potential alternative and potential support solutions,
- Analyse the Impact of introducing a new System on existing support organization,
- Support decision making process regarding the impacts of decisions, risks etc. on mission capability, supportability and support organization
- Develop and implement a comprehensive support concept/solution,
- Ensure supportability is understood as a part of design process and an important cost driver for building the long-term support solutions.
- Verify alternative support solutions include disposal planning during alternative trade-off studies in order to conduct safe and cost-effective disposal activities,

Inputs: Initial Capability Document, Design Engineering Data, Alternatives, LCC Report

Outputs : Support Concept, Usage Requirements Document, ILS Requirements, Operational Requirements Document

2.2.1.3 Develop Integrated Life Cycle Support Plan

- Constraints such as cost or availability
- Understand the internal and external environments/stakeholders of the program acquisition process and maintain effective and continuous communication between them,
- Develop an ILSP describing whole life cycle support strategy in conjunction with ILS Requirements, ILS elements, programme constraints, roles and responsibilities,
- Ensure that ILS is involved at early phases of the design to deliver supportability feedback and influence the design to achieve optimum life cycle cost
- Establish connection with other programme documentation/plans,
- Consider ILS during production, post-production and at the time of deployment and fielding in ILSP,
- Define an integrated master schedule and perform milestone reviews,
- Consider early supportability test and evaluation to contribute design by means of observing human machine interface and interrelationship between ILS elements,
- Define key performance indicators/sustainment maturity levels allowing performance measurement and evaluation of the support process through life cycle,
- Define feedback mechanisms to ensure continuous process improvement,
- Evaluate Lessons Learned Database
- Plan risk management.

Inputs: Contract, Design Engineering Data, EC&R Feedback Report, Lessons Learned Database, Operational Requirements Document, ILS Requirements, Specification, Support Concept, Usage Requirements Document, CONOPS.

Outputs: ILS Plan (see Annex 1, and Figure 51: Systems Engineering Design Reviews)

2.2.1.4 Plan and Manage Guidance Conferences

The multiple standards and specifications used across the ILS elements contain many tailorable tasks. The data elements are many and varied and these have to be understood and applied in a common way across a project, by all involved: customer, contractor, subcontractors, advisors, etc. These attributes need to function in an integrated way and agreement across multiple parties needs to be reached for effective implementation. A very efficient way to achieve this is holding a Guidance Conference for each major issue (Supportability, Level of Repair Analysis, Supply Support and Technical Information, etc.). SAE TA-STD-0017, SAE AS1390, MIL-HDBK-502A, MIL-HDBK-1390, S3000L, DEF-STAN 00-600, etc. can be reviewed for further information.

Guidance conferences will be used to reach agreement on:

- processes and business rules
- data requirements and data definitions
- data transfer arrangements
- number and timing of data reviews, and how supportability will be integrated with Systems Engineering processes, and the Systems Engineering Design Review Schedule
- process for raising and resolving customer or contractor observations
- how LCC and resource modelling will be used for trade-off evaluation
- sampling rate of supportability and other data by the customer

- clarification of any Contract Data Requirement List (CDRL) items

- Plan and hold Guidance Conferences,
- Produce necessary documents and reports and share the outputs with relevant stakeholders
- Update ILS plans, if required

Inputs: Contract, CDRL, ILS Plan, Design Engineering Data, Support Concept, Operational Requirements Document, Usage Requirements Document.

Outputs: Guidance Documents

2.2.1.5 Document Lessons Learned

In the scope of this activity, lessons learned are documented to let evaluation and consolidation of experiences, developments, hints, risks, etc. for the improvement of future projects in terms of supportability. Lessons learned from previous projects are also evaluated (if there are any) to incorporate the past experiences.

- Evaluate lessons learned from previous projects,
- Develop a mechanism to accumulate lessons learned,
- Document and evaluate lessons learned
- Update support solution if required

Inputs: EC&R Feedback Report, Feedback Data, Feedback information, Management Reports (In-Service)

Outputs: Lessons Learned Database

2.2.1.6 Manage Configuration

The aim of this activity in the context of ILS is to monitor the configuration of the System to operate/maintain properly and safely throughout the System's life cycle and to manage the impacts of change in configuration.

- Ensure configuration management related issues are included in the ILS Plan,
- Support identification of baseline to be under configuration control,
- Perform configuration change management,
- Perform configuration evaluation and support configuration audits,
- Ensure nonconformances are managed in accordance to Major/Minor change type classification
- Make sure that no unauthorized equipment is installed and/or used
- Assure that proper support can be provided for each and all configurations
- Maintain the status of configuration documentation ensuring traceability between versions of each configuration item.

Inputs: Design Engineering Data, ILS Plan, Configuration Management Plan, Supplier Data, Feedback Data, Engineering Change Request

Outputs: Allowed Configuration, Operational Configuration

2.2.1.7 Develop and Manage Contract

Contractual activities are performed in the scope of this activity to efficiently sustain the System, ensuring compliance and minimizing risks.

- Structure and manage complete and balanced contracts (clear contract deliverables, incentives etc.) to be able to provide cost-effective support solutions and operational availability
- Develop and maintain support arrangements/agreements for sustainable ILS,
- Consider partnership opportunities (Public Private Partnership, International partners etc.) to look for higher availability and lower life cycle costs,
- Ensure that ILS outcomes and (service level) agreements are satisfied for proper post warranty support,
- Plan and perform governance of processes operated by other parties, where applicable,
- Perform life cycle cost analysis to support acquisition programs (decision making process) from initiation through disposal and do the necessary updates at program milestones,
- Benefit from life cycle cost estimates throughout acquisition milestones to effectively plan, execute and manage budgeting and funding,
- Prepare management reports and organize review meetings if necessary

Inputs: Contract, EC&R Feedback Report, Feedback Data, ILS Plan, LCC Report, Specification, Support Concept

Outputs: Management Reports, Support Contracts, Subcontracts

2.2.1.8 Manage Fleet

Objective of this activity is to provide necessary systems allowing the User to conduct their daily operation.

- Manage performance metrics (which were previously defined in the programme's earlier stages) in accordance with the ILS elements to be able to contribute delivering desired outcomes and providing efficient and effective support solutions,
- Manage fleet by providing support for the right number of systems, at the right time and the right configuration for operational use to the customer,
- Manage support capacity to get aligned with the operational needs,
- Provide sustainment information/reporting at programmatic reviews,

Inputs: Operational Planning, Allowed Configuration, Operational Configuration, Feedback Data, LSA dataset, Maintenance Report

Outputs: Fleet Performance Report

2.2.1.9 Manage Warranty

Warranty provides a buyer with legal assurance that the seller is providing an item or service that will perform as presented before the purchase transaction was complete. The aim of this activity is to manage warranty which is a special period during the In-Service ILS Activities. Manage warranty activities can start before In-Service ILS activities, like the case of OEM warranty.

- Ensure that warranty requirements are compiled.
- Ensure that there is a warranty procedure to enable the user to make warranty claims and manage warranty activities.
- Evaluate the warranty claims and determine if the claim is in the scope of the warranty
- Manage failures and if required, report for technical analysis
- Manage Warranty database
- Prepare Warranty Report

Inputs: Contract, Support Concept, Design Engineering Data, ILS Plan, LSA dataset, Obsolescence Report, Supplier Data

Outputs: Warranty Report

2.2.1.10 Manage In-Service ILS activities

Objective of this ILS element is to manage the performance of System during In-Service ILS activities.

- Implement the ILS package to maintain readiness and operational capability after fielding
- Ensure required mechanisms are in place to ensure effective feedback during operational life,
- Implement and operate a failure resolution process/tool (FRACAS),
- Collect and analyse information about operational data (root causes of failures and effects, RAMST (Reliability, Availability, Maintainability, Safety and Testability) data/trend, changes in operational usage profile, supply support etc.,
- Continuously monitor and record performance metrics
- Monitor and evaluate support organization and improve further, if necessary,
- Evaluate service life (extension, early withdrawal) by means of modernization and technological updates in due course,
- Provide input for repair, upgrade, disposal or retirement decisions.
- Monitor Engineering Change Requests' effects and monitor if they still meet the support requirements,
- Manage risks and apply mitigation actions.
- As a principle, adopt continuous process improvement to achieve better outcomes.
- Prepare In-Service Management Reports

Inputs: Contract, EC&R Feedback Report, Engineering Change Request, Fleet Performance Report, ILS Plan, Obsolescence Report, Operational Suitability Report.

Outputs: Management Reports (In-Service)

2.2.1.11 Perform Obsolescence Management

Obsolescence management activities are performed in the scope of this activity to increase the availability of the System.

- Define an obsolescence management strategy (understood as the appearance of unavailability of materials, components, resources, processes, services or know-how) and ensure operational readiness,
- Plan Obsolescence Management,
- Participate Obsolescence Board Meetings as required
- Implement obsolescence solution,
- Feedback obsolescence incidents,
- Prepare Obsolescence reports.

Inputs: Contract, Design Engineering Data, ILS Plan, Supplier Data, DPHM Report

Outputs: Obsolescence Report

2.2.2 Design Interface

2.2.2.1 Overview

Design Interface aims to impact the design from the early stages with the objective of facilitating supportability in order to maximize the availability, effectiveness and capability of the system at the optimum life cycle cost. Supportability requirements (RAMST, affordability, etc.) from the contract and internally derived requirements are used as inputs to achieve this objective. The other ILS elements can be properly interfaced with the design, manufacturing and corresponding operations of the system through this element.

It evaluates all aspects of the System from Concept to Retirement Stage, including the SOI's operational/maintenance concept and the adequacy of the support infrastructure.

For that purpose, the following activities are performed.

2.2.2.2 Perform Life Cycle Cost Analysis (LCCA)

Life cycle cost (LCC) refers to the total of the direct, indirect, recurring, non-recurring and other related costs incurred throughout the System life cycle. For this reason, several activities are performed.

- Support Baseline Comparison Analysis (BCA) to learn supportability lessons from known analogous equipment and bring cost driver knowledge into the new System.
- Support tender evaluation process under cost perspective.
- Conduct LCC trade-offs to find out potential life cycle cost benefits for different design and support solution alternatives early at the system life cycle as decisions can be costly and irreversible.
- Evaluate the risks, cost sensitivities and the uncertainties of the support solution alternatives
- Select the most cost-effective option among different competing design alternatives for a System, considering all of the life cycle stages and operational performance.
- Determine the efficiency and cost improvement points for the selected support solution alternative, if any.
- Establish resource modelling to quantify resources for: spare parts, S&TE, personnel, facilities, system fuel requirements, etc.
- Prepare and update the LCC Reports for each design review: System Requirements Review (SRR), Preliminary Design Review (PDR), Critical Design Review (CDR), Test Readiness Review (TRR), Production Readiness Review (PRR)
- Monitor LCC over the life cycle and update if necessary.

Inputs: IT System Support report, Contract, Design engineering data, F&I report, ILS plan, LSA dataset, Workforce and personnel report, System Disposal File, Provisioning data, Specification, Supplier Data, Support concept, Support & Test Equipment Report.

Outputs: LCC report.

2.2.2.3 Perform Supportability Analysis

Supportability is the characteristics of the System for an efficient and effective sustainability throughout the system life cycle. Decisions before the Utilization Stage of the System affects almost 90% of the life cycle cost. In order to improve support strategy for military systems, it is crucial to conduct supportability analysis (Supportability requirements, RAMST, FMECA, FTA, LORA, RCM, MTA, Affordability, Human factors analysis, Transportability, etc.) during the Development Stage and influence the design as early as possible by submitting observations, and recommendations or proposals as soon as possible and before the next Design Review (if possible) regarding the supportability aspects.

Design influence starts with defining the supportability requirements and flowing these into subsystem design specifications. The parallel activity to develop the supportability input for existing design review questionnaires for each major Systems Engineering design review is just as important. This ensures that the progress of supportability requirements is monitored through each design review and that they become embedded in the design. Weak supportability requirements analysis and ineffective design review questionnaires from these early stages leads to poor supportability performance in fielded SOI.

Supportability analysis must follow the strategy determined for the SA or ILS Plan. This task selection will vary depending on design freedom. Commercial off the shelf (COTS) items will attract tasks for resource identification, but little design influence. Full design freedom items must receive the full spectrum of tasks and be subjected to greater scrutiny.

Amongst the activities in the supportability framework, safety is worth of some prominence due to its main objectives. Together with the other aspects of supportability, it allows to minimize the risk to acceptable levels, not only for people and systems but also for environment. In a systematic way, safety minimizes the unintended effects of accidents/failures with acceptable cost. Therefore, a systematic safety effort is a prerequisite for achieving the required safety level. It ensures optimal functionality of the System and prevents costly changes and accidents. That's why the safety effort must start early in the Concept Stage and be integrated in the work all through the life cycle.

Detailed information on some Supportability Analysis can be found below:

- A reliability prediction analysis must be carried out to show the performance of the new System of Interest for comparison with the contract availability and reliability requirements. The agreed common System breakdown provided by the SA Candidate Items List is a good data source to ensure data can be shared across the ILS Team and with Systems Engineering. The analysis and report will influence parts selection, component derating, and provide data for Life Cycle Cost and resource quantity modelling and planning. It must also identify reliability risks and provide an input to the Reliability Case. Risks may be mitigated via accelerated or life testing and the Supportability Test, Evaluation and Verification (STEV) Planning process must be used to Report on the findings and conclusions for System supportability. This data must be shared with the maintenance planning team especially for items with limited or overhaul life that will become the SOI cost drivers. Once the initial reliability prediction report is issued, the analysis shall be maintained to track design change and provide up to date source data for resource planning and supportability analysis, until the analysis of measured field data supersedes the prediction methods.
- Maintenance Task Analysis is a methodology that describes how to analyse an identified maintenance task concerning its support requirements including spare parts and consumables, support equipment, personnel, facilities and task duration information. It

is used to identify and detail maintenance tasks and define the resources needed for the tasks. Task safety and environmental conditions are also evaluated during the analysis. MTA contributes to design alternatives for tasks that exceed key supportability requirements, for example where Task duration is far greater than MTTR.

- A Level of Repair Analysis (LORA) must be conducted to determine the most economical and efficient maintenance level to perform corrective maintenance. LORA is a very important analysis which influences design and support solution, total ownership cost, and operational readiness of the SOI. The result of the LORA influences the maintenance tasks and corresponding task requirements (e.g., support equipment, personnel and spare parts). Both economic and non-economic factors such as costs, reliability values, time, maintainability/testability constraints or availability goals for the System must be considered during the analysis.
- A maintainability prediction analysis must be carried out to show the performance of the new SOI for comparison with the contract maintainability requirements. The agreed common System breakdown provided by the SA Candidate Items List and initial Task Inventory are good data sources to ensure data can be shared across the ILS Team and with Systems Engineering. The initial Task Inventory will be validated by the FMEA and RCM analysis and these outputs shall be aligned with the maintainability analysis. The analysis and report will influence parts selection, maintenance planning, and provide data for Life Cycle Cost and resource quantity modelling and planning. It must also identify maintainability risks and to highlight issues for Human Factors design influence. The maintainability report will be of interest to the Training development and Technical Information teams. Once the initial maintainability prediction report is issued, the analysis shall be revised to track design change and provide up to date source data for resource planning and supportability analysis, until the analysis of measured field data supersedes the prediction methods.
- A Testability analysis must be carried out to show the performance of the new System of Interest for comparison with the testability contract requirements. The agreed common System breakdown provided by the SA Candidate Items List is a good data source to ensure data can be shared across the ILS Team and with Systems Engineering. The FMEA/FMECA Report shall identify each failure mode, failure effect and a method of detection. Working with Systems Engineering Team the analysis must strive to influence testability design to maximise automatic detection of failures to minimise the need for separate support and test equipment and keep life cycle costs to a minimum. The shorter the time taken to detect failures the lower the maintenance downtime and better the SOI availability. The testability design may also provide a system for warnings and cautions to operators of failure conditions that require their actions. The testability analysis and report shall influence testability design and design requirements of separate S&TE where test gaps prove this to be necessary. It may also provide data for Life Cycle Cost and Level of Repair Analysis modelling and planning. It must also identify testability risks and provide an input to the Reliability and Maintainability Case.
- A Safety Hazard analysis must be carried out to ensure that the new System of Interest can be certified as safe to operate and maintain. The Safety Hazard analysis should be managed by a Safety Management or Hazard Management programme plan. It must also identify Safety Hazard risks and provide an input to the Safety Case.
- A Human Factors analysis and design influence process must be carried out to ensure that the new SOI can be operated and maintained in battle conditions without personnel being rendered ineffective and exasperated. Influencing the design to correctly define the operating crew size to optimise the life cycle cost is also part of this activity. The analysis must be managed by a Human Factors Management programme plan. The

analysis must also identify the human engineering risks and provide an input to the Safety Case and the R&M Case.

Design Interface activities continue during the Utilization Stage. The field data (including data stored in the SOI) related to all support activities are used for this purpose. Hence it is important to evaluate which data will be required during Development Stage.

- Plan and deliver an LSA/Supportability Guidance Conference to agree processes, data interpretation, data recording and review for the analysis standard used.
- Record in an LSA/Supportability Guidance Document the agreements reached between Customer, Contractor, and Suppliers
- Perform Supportability Analysis, adopting the tailored approach for analysis tasks to suit the standard or specification adopted. Tasks can include:
 - Analysis Task Tailoring (to maximize supportability impact for least effort)
 - Supportability Strategy Development
 - Support and Design Review Planning
 - Candidate Items List
 - Task Inventory
 - Define the Supportability Requirements for Design and Support processes
 - Use Study and existing Facilities/Resources
 - Baseline Comparative Analysis
 - Technological Opportunities
 - Supportability and related Design Requirements
 - Functional Analysis, including FMECA, LORA and RCM
 - R&M Predictions
 - Support Solution Alternatives Analysis
 - Trade-Off Evaluation of Design and Support Solution
 - Early Fielding Analysis and Planning
 - Post-Production Support analysis, Obsolescence and Diminishing Manufacturing Sources and Material Shortages (DMSMS)
 - Supportability Test Evaluation and Verification planning and analysis
- Ensure that system safety analysis is performed in the scope of Supportability Analysis to achieve the required safety level
- Influence the design in terms of Support Solution to optimize the System performance and Support Solution
- Identify the expensive and unreliable items using the Cost over Reliability factor, where $CoR = \text{Unit Cost} \times QPA/MTBF$. The largest CoR values will help to identify the items where design influence effort should be spent.
- Ensure supportability analysis results are recorded in the SA dataset and shared across ILS elements so that new data or design changes are common knowledge across the whole team.
- Ensure that the results of the Supportability Analysis outputs are used as an input to the relevant ILS elements.

Inputs: Contract, Design engineering data, EC&R Feedback Report, ILS plan, LSA dataset, Supplier data.

Outputs: Supportability analysis reports.

2.2.2.4 Develop Supportability Analysis Dataset

The Supportability Analysis (SA) is any analysis that results in a decision on the scope and level of life cycle support (SAE TA-STD-0017, AS1390, SAE GEIA-STD-0007). It is one of the main activities for ensuring that supportability is adequately addressed in the system design process. SA is used as a tool to define the overall requirements for supportability and for the various elements of life cycle support.

All the data generated during SA will be stored in a dataset to be managed and used across all ILS elements when necessary. SA dataset (formerly known as LSA database or LSA Records (LSAR)) is the single entity in which all support and supportability data is stored. This means that the data flow between ILS elements is always routed through the SA dataset to ensure data consistency between all ILS elements and domains. It is important that a common breakdown structure and numbering system is adopted for use across the ILS team and consistent with Systems Engineering. The Candidate Items List is often the first data agreed with Systems Engineering. The candidates are selected for being Maintenance Significant, or Structurally Significant Items (MSI or SSI). The LSA Control Number or LCN is the common numbering that will ensure that when data is shared the ILS team will all talk about the same item. It is wise to avoid ILS elements having their own numbering system as results in misunderstanding, rework and time delays.

The second significant aspect of SA dataset is the task Inventory. This starts as a draft and is validated by FMECA, LORA, and RCM for corrective and preventative maintenance. The Human Factors and Training validate the tasks. This Task Inventory provides a focus for influencing design and ensuring that support resources are fully identified to benefit the sustainment of the SOL.

- Define the standards to be used that maximise reuse of data and data sharing across ILS element teams and their standards and processes. Chapter 5.3 can be reviewed for more detailed guidance.
- Develop an SA dataset
- Maintain configuration control over the data to align with engineering data
- Monitor and update SA dataset throughout the life cycle
- Validate the SA Dataset through practical demonstration of tasks, using technical publications and all resources recorded therein. The validation must focus on the most life cycle cost driver LRUs to ensure effort was spent on the most significant items.

Inputs: IT System Support report, Configuration data, Contract, Design engineering data, DPHM Report, F&I report, Feedback data, Feedback information, ILS plan, LORA report, Workforce and personnel report, MTA report, Preventive maintenance task requirements (PMTR), Provisioning data, Specification, SSA report, Supplier data, Support concept, Support & Test Equipment Report, Supportability analysis reports, Training equipment report.

Outputs: SA Dataset.

2.2.3 Maintenance

2.2.3.1 Overview

The objective of this element is to identify, plan, resource, and implement maintenance concepts and the requirements below to execute the maintenance and to ensure the best possible equipment/capacity is available at the lowest possible cost.

Maintenance comprises the identification of all the needed requirements to enable maintenance services for the System and its support through its entire life cycle. These requirements comprise the hardware, software, network, communication, security requirements, materiel, facilities, personnel, procedures, processes, documentation and data.

This element is managed by a focus on the Candidate Items List and Task Inventory and the interaction with Design Interface. The sharing of a common System breakdown structure, via the Task Inventory aids supportability discussion and improvements. The following activities are performed.

2.2.3.2 Develop Maintenance Concept

A Maintenance Concept is a statement of maintenance considerations, constraints, and strategy for the operational support that governs the maintenance levels and type of maintenance activities to be carried out for the System under analysis.

- Evaluate Maintenance policy
- Define the number of echelons across which maintenance tasks will be allocated.
- Based on the results of the SOIs LORA, the maintenance concept details the level at which a certain repair will be performed by replacement from the SOI and what will be the repair versus discard policy for corrective maintenance
- Detail the maintenance level at which preventative maintenance takes place based upon the Task Inventory validated by the RCM analysis.
- Define maintenance responsibilities.
- Evaluate maintenance environment.
- Set up relationships between maintenance and the rest of the life cycle support elements. For example: The level of detail in the maintenance manuals required at each maintenance echelon, the resources available at the facilities in which maintenance will be performed, the skills of the maintenance personnel, etc.

Inputs : Contract, ILS Plan, Support Concept.

Outputs: Maintenance Concept. See example at Annex 1, Para 3.3.

2.2.3.3 Develop Maintenance Plan

The maintenance plan brings together almost all life cycle support resources, every one of them deriving from an ILS Element. Each maintenance task will not necessarily involve all ILS elements; but some of the ILS elements will always be required in each task. The precise goal of the Integrated Life Cycle Support philosophy is to optimize the entire logistics support package to render the best possible maintenance and support solution to fielded Systems.

- Specify when, where, and which maintenance tasks will be performed on the SOI including both preventive and corrective maintenance.
- Ensure that the System can be maintained effectively and economically at the desired level of readiness after it is placed in operational use.

- Develop and continuously improve preventive maintenance (live document) to increase the performance of the support.

Inputs: Contract, Design Engineering Data, EC&R Feedback Report, ILS Plan, LORA report, Maintenance Concept, PMTR

Outputs: Maintenance Plan.

2.2.3.4 Evaluate Level of Repair Analysis (LORA)

The Level of Repair Analysis (LORA) is a prescribed procedure for determining the most economical and efficient maintenance level to perform corrective maintenance. The result of the LORA influences the maintenance tasks and corresponding task requirements (e.g. support equipment, personnel and spare parts). LORA determinations influence design and support solution, total ownership cost, and operational readiness of the SOI.

- Determine where repairable elements of the System are removed, replaced, repaired or discarded.
- Consider both economic and non-economic factors such as costs, reliability values, time, maintainability/testability constraints or availability goals for the System.
- Influence design to minimise LCC through LORA modelling. This can be achieved by placing low value and high failure rate modules/sub-assemblies in separate LRUs away from much higher value and lower failure rate items. This prevents high value LRUs being repaired at an annual rate determined by low value, high failure rate modules.

Inputs: Contract, CONOPS, Design Engineering Data, ILS Plan, FMECA, MTA report, Supportability Analysis Reports, Support Concept, and process guidance from: SAE AS1390, or MIL HDBK 1390.

Outputs: LORA report.

2.2.3.5 Perform Maintenance Task Analysis (MTA)

The Maintenance Task Analysis is a methodology that describes how to analyse an identified maintenance task concerning its support requirements including spare parts and consumables, support equipment, personnel, facilities and task duration information.

- Identify and detail maintenance tasks
- Define task duration, required spare parts and consumables, support equipment, personnel, facilities and task information
- Consider additional information such as task criticality, training needs, pre- and post-conditions, safety and environmental requirements.
- Identify new and critical resources
- Contribute to design alternatives for tasks that exceed key supportability requirements, for example where Task duration is far greater than MTTR.

Inputs: Contract, Design engineering data, ILS Plan, LORA report, PMTR, Support Concept, Supportability analysis reports.

Outputs: MTA report.

2.2.3.6 Develop Preventive Maintenance Task Requirements (PMTR)

Preventive maintenance actions are performed to increase operability of the system and to prevent failures before they occur. They can also decrease the costs of maintenance. PMTR

must be developed in order to reduce the likelihood of certain failures or diminish the severity of the consequences, improving the efficiency or reliability of a System.

PMTR can be Scheduled (fixed-frequency) or Condition-based. Scheduled tasks are executed at periodic intervals. Task frequency depends on the life distribution of the items. Scheduled maintenance tasks can be grouped and planned on items with the similar life expectancy. Condition-based tasks are executed depending on the level of degradation of the item under analysis. The items can be monitored with regular inspections or using sensors to assess their conditions.

- Assess the predefined failure modes and evaluate whether or not to include them in the PMTR,
- Evaluate OEM documentation and include required preventive maintenance in PMTR, if necessary
- Define the type of PMTR and the interval / limits of each activity,
- Ensure that all the PMTR and necessary resources are included in MTA.

Inputs: Contract, Design engineering data, ILS Plan, Supplier Data, Support Concept, Supportability analysis reports.

Outputs: PMTR

2.2.3.7 Perform Diagnostics, Prognostics and Health Management (DPHM) Analysis

Using the contract, design engineering data, ILS Plan and Supportability analysis reports, the DPHM analysis is performed. DPHM analysis is an engineering methodology to predict potential failures in a timely manner and correspondingly assess the remaining useful life of equipment to enable the decision makers to implement the best and most cost-effective support solutions. Current approaches include model-based approaches (e.g. mathematical models, physics of failures etc.), data-driven approaches (e.g. machine learning, statistical methods etc.) and combination of first two methods. The DPHM analysis activities must be developed as part of the preventive maintenance program.

- Perform DPHM Analysis.
- Provide necessary data and information to the PMTR.

Inputs: Contract, Design engineering data, ILS Plan, Supportability analysis reports.

Outputs: DPHM Report.

2.2.3.8 Execute Maintenance Tasks

Using the support concept, contract and the Maintenance Plan, the maintenance tasks are conducted. While conducting the maintenance tasks, recording the feedback data in detail is very important to reassess the ILS activities and update the outputs if necessary.

- Execute maintenance tasks.
- Incorporate design changes, such as updates.
- Prepare maintenance report after maintenance tasks
- Record feedback data

Inputs: Support Concept, Contract, Maintenance Plan, S&TE, Technical Publications.

Outputs: Maintenance report, Feedback data.

2.2.3.9 Perform Software Support Analysis (SSA)

The Software Support Analysis (SSA) identifies how software affects System operation or maintenance. This analysis implies meeting any necessary needs or requirements to maintain the software operational and capable of satisfying its function. It also includes the provisioning of the equipment, support infrastructure, additional software, facilities, workforce or any other resource required to keep software active and available.

- Describe how software under analysis can affect the operation and maintenance tasks
- - Define the support requirements of the software to include performance, safety, security, reliability
- Evaluate effectiveness of supporting tools

Inputs: Design engineering data, ILS Plan, LORA report, MTA report, Supportability analysis reports, Support Concept.

Outputs: SSA report.

2.2.3.10 Perform In-Service Maintenance Optimization (ISMO)

Several factors can affect a SOI and its enabling systems during the in-service phase. These impacts can change Systems maintenance concepts. For the evaluation of the effectivity of the both the corrective and preventive maintenance tasks documented in a SOI maintenance program, the review and optimization processes are essential.

The required usage data feedback must contain sufficient information to justify these changes. The requirements on usage data feedback must be evaluated as part of the In-Service Maintenance Optimization feedback to monitor the results of the changes.

- Evaluate the effectivity of the Preventive maintenance tasks and intervals/limits
- Identify missing preventive maintenance activities and develop respective PMTR amendments
- Evaluate the usage data feedback and make required adjustments
- Evaluate frequent corrective maintenance tasks resulting in high maintenance effort and assess if it is better to identify preventive maintenance tasks or change the repair policy from Discard to repair by an additional LORA assessment.
- Evaluate the effectivity of the corrective and preventative maintenance tasks, executing additional level of repair analyses utilizing usage data feedback to validate maintenance level and repair versus discard decisions, or to recommend modification to the maintenance concept based on in-service maintenance feedback.

Inputs: Design engineering data, Feedback data, Feedback information, ILS Plan, LORA report, SA dataset, Corrective and Preventive maintenance task requirements, Supplier data, Supportability analysis reports, DPHM Report

Outputs: In Service Maintenance Optimisation of corrective and preventative maintenance

2.2.4 Supply Support

2.2.4.1 Overview

The objective of Supply Support ILS element is to have the right spares, repair parts and all classes of supplies (including STTE and training aids, etc.) available to support the SOI, in

the right quantities and quality, at the right place, at the right time with the lowest possible life cycle cost.

This element comprises all management actions, procedures, and techniques necessary to determine requirements to acquire, catalogue, receive, implement, store, transfer, issue and dispose of spares, repair parts, updates and supplies. This includes initial provisioning for stock of spare parts and support, as well as acquiring, distributing, updating and replenishing inventories in support of supply chain management. Supply chain resilience must be evaluated to provide several means to ensure the supply when there are changes in external circumstances.

For that purpose, the following activities are performed.

2.2.4.2 Develop Supply Support Programme Plan

A Supply Support Programme Plan identifies all supply support related activities including the Guidance Conference, Initial Provisioning Lists (IPLs), NATO Codification, delivery of supplies for Logistics Support Date (LSD), and the preparation for Repair and Overhaul. It is developed with a sequence of IPLs from the early presentation of the Long Lead Time Items List to ensure the spares presented in the later and last IPLs have sufficient purchase lead time remaining to be ordered and delivered for the LSD.

- Define the standard, version and Chapters to be used for provisioning,
- Identify the System(s), End Items and Model Identifiers to be presented
- Define the Supply Support organisation, and relationships between partners, suppliers and customer(s)
- Identify the departmental responsibilities for: NATO Codification, IPL preparation and illustrations
- Define the integration with S&TE for preparation of IPL data for new special to type S&TE and Training Equipment and Training Aids
- Define the IPL presentation type and review cycle to include Codification
- Define the range of purchase lead times and approximate number of IPPN.
- Define the number of items and attaching parts to be presented in IPLs
- Derive the number of IPLs and Pre-Assessment Meetings (PAM)
- Define the validity of item price to be used for LORA and Spares modelling
- Identify integration for LORA results and Spares Modelling
- Identify the milestones in the plan for each Master IPL,
- For multi-customer projects define the IP presentation and review process
- Define the software to be used
- Plan the data exchange message system: IPL, Codification
- Define the IPL updating process for the Support stage of in-service life

Inputs: Contract, Design Engineering Data, ILS Plan, SA Dataset, Obsolescence Report, Supplier data, Support Concept, S&TE Plan, Training and Training Support Plan, ASD/AIA S2000M, SAE-GEIA-STD-0007

Outputs: Supply Support Programme Plan

2.2.4.3 Provide Provisioning Data

The provisioning data is obtained including necessary quantities of the supplies ensuring the customer requirements are taken into consideration. Proper codification of the equipment, components, and parts of the supply system must be done in order to achieve that they are uniformly named, described and classified in a standard and unambiguous manner.

Provisioning data aids: the quantification of resources, the introduction of items into inventory and in-service management.

- Plan and deliver an Initial Provisioning Guidance Conference to agree processes and data interpretation for the provisioning standard used.
- Record in an Initial Provisioning Guidance Document including the agreements reached between Customer, Contractor, and Suppliers.
- Prepare initial provisioning list. This data is normally calculated relying on the designers' knowledge of the SOI, its reliability and maintainability characteristics and support concept for spares, special tools, etc.
- Sustain the SOI with the required initial procurement of supplies based on the initial provisioning data.
- Quantify spares and S&TE utilisation
- Provide a provisioning report including spares and S&TE to recommend the quantity for purchase to cover the agreed support period, operating criteria and Customer parameters.
- Perform NATO codification of the equipment, components, and parts of the supply system in order to achieve that they are uniformly named, described and classified in a standard and unambiguous manner.
- Update the provisioning data throughout the life cycle of the System in order to match its actual needs in the most cost-efficient way. The subsequent re-provisioning of supplies throughout the rest of the useful life of the System relies on the provisioning data which is normally managed by customers based on their requirements and their own experience with the System and with the actual data recorded on System use and supplies consumption.

Inputs: Contract, Design engineering data, ILS Plan, SA dataset, Obsolescence report, Supplier data, Support concept, ASD/AIA S2000M, SAE-GEIA-STD-0007.

Outputs: Initial Provisioning Guidance Document, Provisioning data, Initial Provisioning List (IPL)

2.2.4.4 Perform Material Supply

This activity mainly consists of first fulfilling the provisioning requirements either by using existing stocks or by releasing of the provisioning orders and then the management of these orders ensuring they are fulfilled in the most efficient way.

- Monitor provisioning data
- Manage request for quotation, provisioning orders and acknowledgement of receipt,
- Generate quotations, orders, deliveries and invoices,
- Evaluate Supply Chain resilience and prepare mitigation plans if necessary.

Inputs: Provisioning data, Initial Provisioning List (IPL), Contract, Supplier data, ILS Plan.

Outputs: Quotation, Provisioning order, Supply Delivery, Invoice.

2.2.4.5 Manage Stocks

Stock and stores management is the practice of ordering, storing, tracking and controlling inventory. This activity includes initially ranging, scaling, and controlling a stock level, through

provisioning data, whilst preventing overstocking and under stocking problems. Efficient stock control requires understanding the mix of different kinds of stock and the demands on that stock.

Various analytical techniques and simulations can be used to optimize assortment and allocation of spare parts, so that the highest possible performance can be achieved at the lowest possible cost. While performing the optimization studies, it is inevitable to evaluate the technical data related to the System (reliability, repairability, etc.), the support organization (transport and turnaround times, etc.), the operational usage and costs of the System (spares prices, orders, etc.).

- Monitor provisioning data
- Manage ordering, storing, tracking and controlling inventory activities
- Perform ranging, scaling and controlling stock levels
- Monitor supply chain environment in order to optimize stock levels and decide when to order
- Prevent overstocking and under stocking problems in order to contribute to the availability of the System and lower the life cycle costs
- Prepare Inventory Report

Inputs: Contract, Feedback Data, ILS Plan, Operation Plan, Provisioning Data, Supplier Data.

Outputs: Inventory Report.

2.2.4.6 *Manage Repair and Overhaul Supply*

Repair and Overhaul management is important to maintain the stock levels in inventory. For most SOI, the repairable items that require overhaul will be one of the biggest LCC cost drivers of the System. The visibility of this characteristic should be most prominent across the ILS team when supportability analysis is being undertaken. This activity includes setting up framework contracts to permit flexibility in repair intake quantity per period, as operating rates of military systems varies seasonally.

Repair and Overhaul usually applies to the items of the SOI. Although Support and Test Equipment items also need repair, they usually need calibration at specialised facilities, sometimes outside the military domain.

- Monitor provisioning data for repairable items destined for the repair organisation
- Manage repair and overhaul quantities assigned to repair organisations
- Agree the repair parameters for repair Turn Around Time (TAT) within the repair organisation and monitor this performance (longer repair times result in lower SOI availability as unserviceable items are not returned to stock to meet the demand for stock).
- Prioritize repair and overhaul where stock shortfall will lead to reduced SOI availability (if this can be predicted from the reports or data).
- Include in-service feedback data for all repair organisations to ensure continuous improvement can be addressed to overcome supportability weaknesses
- Prepare a scheduled Repair and Overhaul Report for SOI items
- Prepare a scheduled Repair and Calibration Report for S&TE items

Inputs: Contract, Feedback Data, ILS Plan, Operation Plan, Provisioning Data, Supplier Data.

Outputs: Repair and Overhaul/Calibration Reports

2.2.5 Support & Test Equipment (S&TE)

2.2.5.1 Overview

The objective of this ILS element is to identify, plan, resource and implement the management actions to acquire and support the necessary equipment to sustain SOI. This support & test equipment must be available when needed at the optimum life cycle cost.

This element consists of all equipment (mobile or fixed) required to sustain the operation and maintenance of the SOI. One goal of this ILS element is to minimize or eliminate support equipment through design influence or technology refresh. Examples of support and test equipment can be “Common S&TE” (general purpose) like screwdrivers, wrenches, etc. as well as “Peculiar S&TE” (Special purpose) which are designed specifically to support the SOI like calibration equipment, diagnostics equipment/software, ground equipment, etc. Common S&TE must be the preferred choice when support equipment is required.

Some S&TE can be defined as SOI or part of the System in some projects according to the Contract. For example, a special designed support truck can be SOI for a support truck contract but still they are an equipment to sustain the SOI in the System definition.

For that purpose, the following activities are performed.

2.2.5.2 Plan S&TE

In this activity, requirements are analysed, and a plan is developed on how to provide and manage the S&TE during the life cycle.

- Analyse and document S&TE requirements considering both the contract and the design
- Identify the S&TE Candidate Items
- Assess the design of the System during design phase to increase supportability throughout the life cycle.
- Plan all the management actions and develop procedures for acquisition, support and final disposal of the S&TE.
- Consider the existing S&TE as well as modified or upgraded existing equipment.
- Identify the S&TE required from Government Furnished/customer sources
- Minimize the development of new support equipment and make maximum use of existing Government or commercial equipment before considering new design in order to decrease the proliferation of support equipment into the inventory. Review the FMECA and Testability design to maximise coverage of failure modes through build in test to aid diagnosis before deciding on new S&TE.
- Identify the S&TE Design Data
- Recommend S&TE quantities for purchase
- Create an allocation plan for S&TE resources
- Develop a repair/calibration policy

- Identify S&TE Utilisation

Inputs: Contract, Design engineering data, EC&R Feedback Report, ILS Plan, SA dataset, Supportability Analysis Reports, Specification, Support concept.

Outputs: Support & Test Equipment Plan.

2.2.5.3 Provide S&TE

According to the requirements and design, S&TE (including modified or upgraded equipment) is developed, acquired and delivered.

- Develop and produce S&TE
- Procure S&TE
- Install S&TE

Inputs: Contract, Support & Test Equipment Plan

Outputs: S&TE, Support & Test Equipment report.

2.2.5.4 Manage S&TE Repair and Calibration

During the Utilisation and Support stages of the SOI life cycle, items of S&TE need to be managed to maintain a pool at User Units to accommodate the calibration, test, inspection, certification and repair requirements.

- Manage S&TE scheduled maintenance: Calibration, Inspection, Test and Certification, etc.
- Manage S&TE unscheduled maintenance: Repair and overhaul, Software updates, etc.

Inputs: Contract, Support & Test Equipment Plan, Technical Publications

Outputs: Support & Test Equipment Report

2.2.6 Training & Training Support

2.2.6.1 Overview

The objective of this ILS element is, the former, to identify, plan and resource training and training support regarding the training strategy and then, to train personnel to operate, maintain and support the SOI, finally to evaluate the results of the training. All these actions must be carried out throughout its life cycle to assure optimum performance and readiness of the SOI. This ILS element also describes how training and training equipment requirements will be met and the responsibilities for meeting these requirements.

Training and Training Support, both for initial training and recurrent training, consists of analysis, processes, procedures, techniques and training equipment. There are mainly four categories of training: Operator, Maintainer, Supervisor and Instructor. Training is the main transfer of know-how through-out the organizations.

Training and Training Support comprises the following activities:

2.2.6.2 Perform TNA

Training needs analysis (TNA) is a very important activity whose main purpose is to identify the gap between the needed and the currently available Knowledge, Skills and Abilities (KSA).

- Analyse SA results and training requirements
- Conduct training needs analysis to ensure that a comprehensive training solution is provided for the operation/maintenance of a SOI.
- Define who, what, under what conditions, what level of training each user must receive and what type of training will meet the objectives.
- Define training objectives, enabling objectives and key learning points.
- Ensure that key elements like target audiences, training gaps, training environment, type of the training and expected level of expertise after completing the training are identified in the training solution.
- Define certification criteria and how to maintain the certification in the future.

Inputs: Contract, Design Engineering Data, EC&R Feedback Report, ILS Plan, SA dataset, Workforce & Personnel Report, Supportability Analysis Reports, Training Course Report

Outputs: TNA report

2.2.6.3 Perform Training Equipment Analysis

Training equipment are crucial assets for an effective training. They can include simulators, trainers, classrooms, computers, support equipment, etc.

- Analyse TNA reports and training equipment requirements
- Identify if there is a new training equipment need considering the existing facilities / the training equipment and modification of the existing facilities / the training equipment.

Input: Contract, Design Engineering Data, EC&R Feedback Report, ILS Plan, SA dataset, Support Concept, Specification, TNA Report.

Output: Training equipment plan

2.2.6.4 Develop Training Plan

A training plan identifies all training related activities including the skills, most effective approach and cost efficiencies to meet training requirements. It is developed in order to ensure productive and effective learning.

- Define qualitative and quantitative requirements for the training of operating and support personnel throughout the life cycle of the System.
- Create a training curriculum which identifies the scope of the training course like training methods, training materials, training support, etc. for all the needed courses.

Inputs: Contract, ILS Plan, TNA report, SA dataset, Supportability analysis reports, Technical Publications

Outputs: Training Plan

2.2.6.5 Develop Training Package

The development of a Training Package is crucial for a successful training. It aims to ensure the correct formation of all the personnel who operate, maintain and support the System. This Training Package closes the Knowledge, Skills and Abilities (KSA) gap needed by learners to perform a job.

- Develop training package including student notes, training presentations, Instructor Specifications (I-Specs), Assessment material including the design of assessment processes and guidelines for assessment management
- Ensure that the KSA needed can be achieved with the training package
- Monitor changes during the life cycle of the System and update Training Packages as necessary.

Inputs: ILS Plan, TNA report, SA dataset, Supportability analysis reports, Technical Publications

Outputs: Courseware

2.2.6.6 Provide Training Equipment

Training equipment supports the training course in order to make it more understandable and useful for participants. Training equipment is any hardware and/or software used in a training process to learn a new skill. It can either be specific to the training or a generic one. Some examples can be: simulators, training models, mock-ups, computer-based training software, dummy ammunition, wall-charts, audio visual equipment, projector, etc. Complete functional SOI/subsystems and/or prototypes can also be used as training equipment.

- Develop or acquire training equipment
- Ensure the development of training equipment commensurate with different levels of the trainings needs and objectives.
- Ensure that the development and production lead times of training equipment are in-line with the training schedule

Inputs: Training equipment plan, TNA report, ILS Plan

Outputs: Training equipment, Training Equipment Report

2.2.6.7 Deploy Training/Training Implementation

In the scope of this activity all necessary actions to conduct the training is performed. Training can be implemented in two phases: Initial training and Sustainment training. Initial training consists of training the personnel who will operate and maintain the system. This training is delivered before or during the deployment period of the system. Sustainment training provides refresher training to the personnel who operate and maintain the system throughout the life cycle. Generally, during these two phases training can be performed as: Operator training, Maintenance Training, Supervisor Training and Instructor Training.

- Ensure that all necessary preparations are completed before the deployment of the training.
- Guarantee that the correct training is provided for the operation/maintenance of the SOI.
- Develop a training report that summarize/evaluate the results of a conducted training course, including lessons identified,
- Monitor changes during the life cycle of the System and deliver refreshment training as necessary.

Inputs: Courseware, Training equipment, Training Plan, S&TE.

Outputs: Training Course, Training course report.

2.2.7 Technical Information

2.2.7.1 Overview

The objective of this ILS element is to identify, plan, validate, resource, implement actions to develop, acquire and maintain technical publications and processed, organized, structured data.

This element comprises the technical information necessary to operate, maintain, repair, support, train and dispose a system throughout its life cycle. Technical Information can be provided through various media to include paper, graphics, audio, video and digital. This ILS element does not include computer software (e.g. software used to generate technical publications) or contract administration data like financial or management information.

Technical Information also includes, at minimum, the data management needs of the System engineering process, modelling and simulation activities, test and evaluation strategy, support strategy, and other periodic reporting requirements. It also includes as-maintained bills of material and SOI configuration.

For that purpose, the following activities are performed.

2.2.7.2 Develop Technical Data Package (TDP)

A Technical Data Package is complete, clear and accurate technical description to enable the construction, manufacture or development of an item or to support the performance of a certain maintenance, production or SA process throughout the system's life cycle. By this definition a TDP is always made up of configuration-controlled information. A programmes Configuration and Information management rules apply.

- Define A TDP that consists of a variety of data that defines the item or process, which may include but are not limited to:
 - Production Definition data
 - Engineering drawings
 - Modelling data
 - Associated lists
 - Specifications
 - Standards
 - Quality Assurance Provisions
 - Software Documentation
 - Packaging details
- Plan and deliver a Technical Publications Guidance Conference to agree processes and data interpretation for the provisioning standard used.
- Record in a Technical Publications Guidance Document the agreements reached between Customer, Contractor, and Suppliers
- Organize and manage the Technical Information to support a variety of functions
- Identify and control data requirements, rights and security classification
- Determine the timely and economical acquisition of all related information according to the contract,
- Define the assurance of the adequacy of data for its intended use,
- Manage the distribution or communication of the data to the point of use
- Schedule actual data analysis
- Ensure that TDP is updated according to the current configuration during life cycle

Inputs: Contract, Design engineering data, ILS plan, SA dataset, Manufacturing data, Supplier data.

Outputs: Technical Information Guidance Document, Technical Data Package.

2.2.7.3 Produce Technical Publications

Technical Publications are any type of documentation that describes the usage and support of a System. Operational and maintenance instructions, installation manuals, support equipment catalogue, part lists and illustrated parts breakdown are some examples of Technical Publications.

Technical Publications are the only documentation that are received by the ultimate user. That's why the comprehensiveness, ease of use and understandability of the Technical Publications is crucial.

- Collect operational, maintenance and safety instructions, parts breakdown and related technical information and procedures,
- Prepare all the Technical Publications needed for the installation, operation, maintenance, training, support and disposal of systems in accordance with applicable standards (MIL-STD-40051, ASD/AIA/A4A S1000D, etc.),
- Validate and update all the Technical Publications,
- Distribute the Technical Publications as either page oriented (paper, PDF, etc) or in Interactive Electronic Technical Publications (IETP) format,
- Establish feedback mechanisms to report mistakes, missing information and other failures published in Technical Publications,
- Monitor changes during the life cycle of the System and update Technical Publications as necessary.

Inputs: Design engineering data, Feedback information, EC&R Feedback Report, ILS plan, SA dataset, Provisioning data, Specification, Supplier data, Supportability analysis reports.

Outputs: Technical Publications.

2.2.8 Workforce & Personnel

2.2.8.1 Overview

The objectives of Workforce & Personnel ILS element are:

- To evaluate the workforce and personnel requirements and influence the design (if required) to minimize the workforce need.
- To have the right number of positions to perform all the operation, maintenance and support tasks for the SOI. Workforce requirements are based on the range of operations during peacetime, low intensity conflict, and wartime. Requirements must consider continuous, sustained operations and required surge capability.
- To have the personnel with those human aptitudes and capabilities, knowledge, skills, abilities, and experience levels that are needed to properly perform those tasks.

This element comprises identifying, planning and supporting the availability of qualified personnel required to operate, maintain and support the System over its life cycle.

For that purpose, the following activity is performed.

2.2.8.2 Perform workforce & personnel analysis

This analysis involves the planning, identification and allocation of personnel with the qualifications and skills required to operate, maintain and support the System over its life cycle.

- Analyse W&P requirements
- Evaluate existing workforce and their current qualifications and skills
- Develop a W&P Plan which will be mainly used in the Training and training support ILS Element

Inputs : Contract, ILS Plan, SA dataset.

Outputs: Workforce & personnel plan

2.2.8.3 Manage workforce & personnel

Managing Workforce & personnel includes resourcing, acquiring and monitoring the skills of the personnel required to operate, maintain and support the System over its life cycle.

- Decide to resource or acquire new personnel
- Deploy personnel
- Monitor the skill level of the personnel throughout the life cycle
- Develop W&P Report (if necessary)

Inputs: Contract, Workforce & personnel plan

Outputs: Workforce & personnel, Workforce & personnel report

2.2.9 Packaging, Handling, Storage and Transportation (PHS&T)

2.2.9.1 Overview

Packaging, Handling, Storage and Transportation (PHS&T) aims to identify, plan, resource and acquire PHS&T requirements to influence the design of the SOI from early stages of its life cycle to increase supportability and maximize availability. Considering human factors/ergonomics, environmental conditions, safety and security issues, appropriate support of SOI and enabling systems is ensured with well-balanced, timely and specific PHS&T solutions. PHS&T can also be referred as “Supportability Related Operations”.

This ILS element is the combination of resources, processes, procedures, design considerations and methods to ensure that the SOI and its enabling systems are packaged, handled, stored and transported in a cost-effective manner. PHS&T solutions are determined in accordance with operational concept, usability, System life cycle, necessary standards, laws, regulations and any other special requirements and shall be compatible with supply and support structure of the customer.

As part of a support concept, PHS&T comprises the following activities:

2.2.9.2 Plan PHS&T

PHS&T requirements are analysed to correctly address and plan the PHS&T activities.

- Analyse and document PHS&T requirements,
- Assess the design of the System during design phase to increase supportability throughout the life cycle,
- Analyse System transportability and evaluate design proposals

- Analyse packaging protection level requirements and design packaging solutions for each resource to be transported
- Analyse storage requirements for resources and contribute to design proposals
- Analyse the material handling requirements and recommend solutions to protect personnel and work with Human Factors and Support and Test equipment staff to design handling solutions where bulk or weight are beyond the allowed limits
- Evaluate overall cost improvement and effectiveness in accordance with PHS&T trade-offs/alternative concepts,
- Define responsibilities and maintain a living PHS&T plan throughout life cycle period,
- Plan PHS&T material/components, include disposal requirements of these materials and ensure that it is considered in Environmental Conditions and Recoverability ILS element,
- Ensure that PHS&T solutions are aligned with related laws, regulations, standards, specifications etc.,
- Assess safety and security aspects of PHS&T.

Inputs: Contract, Design Engineering Data, EC&R Feedback Report, ILS Plan, SA dataset, Material Specifications, Supplier Data, Support Concept

Outputs: PHS&T Plan

2.2.9.3 Provide PHS&T

According to the requirements and the ILS Plan PHS&T activities are performed.

- Develop PHS&T solution/equipment
- Deliver PHS&T solution/equipment

Inputs: Contract, PHS&T Plan

Outputs: PHS&T Report, PHS&T

2.2.10 Facilities and Infrastructure

2.2.10.1 Overview

Due to relatively long system life cycles and needs to optimize effectiveness of support solutions, it becomes essential to timely identify, plan, resource, develop/build and acquire facilities and infrastructure (F&I). Throughout the life cycle of a System, different types of F&I are required for the purposes of usage, maintenance, storage, disposal etc. Therefore, F&I aims to describe all F&I requirements for the related activities of SOI and enabling systems.

This ILS element includes studies to define types of facilities (e.g. permanent, semi-permanent and temporary) and improvements for existing facilities regarding capabilities, location, space needs, environmental requirements, safety and security issues. Within the scope of this area, building costs, maintenance costs and cost of operation have to be factored into the life cycle cost studies and integration to other ILS elements has to be maintained.

As part of a support concept, F&I comprises the following activities:

2.2.10.2 Plan Facilities and Infrastructure

This activity describes the criteria that must be considered for facilities and infrastructure planning.

- Ensure that F&I requirements are taken into consideration during the early stages of life cycle because of long acquisition times and funding constraints,
- Describe all the management actions, procedures and techniques and the requirements for F&I that are required to support and operate System,
- Evaluate the capabilities or deficiencies of existing facilities and other programs' requirements to identify opportunities that are mutually beneficial,
- Describe any modifications necessary for existing F&I,
- Update plan and identify new program requirements (including responsibilities and funding) and schedules required to provide necessary modified or new facilities,
- Incorporate site activation requirements into the F&I planning,
- Evaluate the safety related issues and ensure that these will be included in the supportability safety analysis report in Design Interface ILS element,
- Describe disposal strategies during early planning activities,
- Ensure early intervention of subcontractors, if any.

Inputs: IT System Support Report, Contract, Design Engineering Data, EC&R Feedback Report, ILS Plan, LORA Report, SA dataset, PHS&T Report, Provisioning Data, Support Concept, Support & Test Equipment Report, Training Equipment Report,

Outputs: F&I Plan

2.2.10.3 Provide Facilities and Infrastructure

F&I are acquired to meet requirements from planning and correspondingly support SOIs in use.

- Put the plan into practice and ensure integration to support solution,
- Develop/build, acquire and maintain F&I,
- Continually assess performance and identify improvements.

Inputs: Contract, F&I Plan

Outputs: F&I Report, F&I

2.2.10.4 Manage the Facilities & Infrastructure

Once delivered, F&I are occupied and used to meet operational, maintenance and training requirements to support SOIs in use.

- Ensure efficient operation and maintenance of the facilities to minimise Life Cycle Costs
- Continually assess facility and infrastructure performance and identify/propose improvements.

Inputs: Contract, ILS Plan, Support Concept, CONOPS, F&I Plan

Outputs: F&I Report

2.2.11 IT System Support

2.2.11.1 Overview

IT System Support aims to identify, plan and resource all computer hardware, software and enablers (interfaces, networks, servers, etc.) for successful operation and support of SOI. This ILS element also aims to provide continuous data exchange both internally and externally throughout the system life cycle.

This ILS element mainly consists of analysing IT System Support required to implement the support solution along with the existing capabilities. It includes resources and technology necessary to support data management and storage. Additionally, implementation timescales and budget allocations of IT System Support are also identified.

As part of a support concept, IT System Support comprises the following activities:

2.2.11.2 Plan IT System Support

Planning IT System Support provides an efficient program execution and IT activities throughout the life cycle. Details are as follows:

- Identify and analyse IT System Support requirement,
- Evaluate existing capabilities,
- Perform IT System Support analysis,
- Evaluate hardware/software maintenance concept including necessary modifications and upgrades,
- Plan timescales and budgets of IT System Support,
- Define a data exchange policy,
- Plan disaster recovery,
- Prepare IT System Support plan or ensure that IT System Support inputs are included in the ILSP,
- Plan obsolescence and configuration management of IT System Support,
- Ensure that data from other IT System Support are compatible between different software applications,
- Evaluate disposal of computer hardware/software.

Inputs: Contract, EC&R Feedback Report, ILS Plan, SA dataset, SSA Report

Outputs: IT System Support Plan

2.2.11.3 Provide IT System Support

This activity means providing and maintaining IT System Support through the life cycle effectively.

- Develop, produce, procure, install and maintain IT System Support,
- Ensure that planned data exchange policy is implemented,
- Ensure information security is satisfied,
- Manage software licenses,
- Ensure that necessary budget is planned for IT System Support,
- Report IT System Support related issues.

Inputs: Contract, IT System Support Plan, Obsolescence Report

Outputs: IT System Support, IT System Support Report

2.2.12 Sustaining Engineering

2.2.12.1 Overview

Sustaining Engineering supports Systems in their operational environments to assure certain level of performance parameters such as Reliability, Availability, Maintainability, Mean Downtime, Operation/Support Costs, etc. This ILS element directly contributes to continued operation and long-term sustainment. It aims to produce necessary solutions and improvement opportunities for performance, quality and efficiency problems related with SOI

and its enabling systems. While in-service or at the end of life, it ensures efficient and safe disposal of them.

Sustaining engineering covers the evaluation of all ILS activities at the time of fielding and post deployment. It begins with timely assessment of operational environment to be able to detect unforeseen deficiencies. Due to possible problems both for technical solution and supportability aspects, various investigations, measurements, change proposals, root-cause analyses, health monitoring etc. are performed. Therefore, establishing and operating such mechanisms to provide feedback and correspondingly value for ILS activities is considered as another essential activity of sustaining engineering.

As part of a support concept, Sustaining Engineering comprises the following activities:

2.2.12.2 Evaluate Operational Suitability

This activity mainly covers initial fielding activities to ensure proper usage of SOI in intended operational environment. Supportability analysis/testing are conducted to assess support parameters and to identify deviations. Change recommendations for the deviations are evaluated to improve system readiness.

- Evaluate initial fielding activities to ensure operational suitability according to Supportability Test, Evaluation and Verification (STEV) Plan,
- Evaluate safety aspects of the supportability analysis,
- Provide input to Integrated Life Cycle Support Plan,

Inputs: Operational Requirements, ILS Plan, Operational Planning, STEV Plan, Design Engineering Data, Feedback Data, Supportability Analysis Reports, Technical Publications

Outputs: Operational Suitability Report

2.2.12.3 Develop Sustainment Improvements

Developing modification or upgrade suggestions to improve sustainment performance metrics is performed in the scope of this activity.

- Evaluate feedback information and propose modifications to improve sustainment metrics,
- Plan development of required design changes,
- Provide recommendations to design and support solution to enhance supportability,

Inputs: Contract, Customer Requests, Design Engineering Data, EC&R Feedback Report, Feedback Information, ILS Plan, ISMO Report for corrective and preventative maintenance analysis, SA dataset, Obsolescence Report, Supplier Data

Outputs: Engineering Change Request

2.2.12.4 Perform Engineering Technical Analysis

This activity includes the post deployment help desk activities and initiation of service bulletins. A field service representative can also be appointed in the scope of this activity to coordinate these issues.

- Respond and solve technical queries
- Initiate service bulletins

- Deploy field service representatives if necessary

Inputs: Contract, Customer Requests, Design Engineering Data, Feedback Data, ILS Plan, SA dataset, Supplier Data, Training Equipment Report

Outputs: Feedback information

2.2.12.5 Manage Disposal

Efficient and safe disposal of System is aimed within the scope of this activity.

- Prepare disposal plan according to contract and ILS Plan, if required
- Conduct disposal activities in accordance with disposal plans,
- Evaluate disposal alternatives like recycling, cannibalization, sale, etc.
- Ensure effective and safe operation of disposal activities,
- Maintain conformity with laws and regulations,
- Keep necessary records.

Inputs: Contract, CONOPS, EC&R Feedback Report, Feedback Information, ILS Plan, SA dataset, Obsolescence Report, Supplier Data

Outputs: Disposal Plan, System Disposal File, Disposal Data

2.2.13 Environmental Conditions and Recoverability

2.2.13.1 Overview

Environmental conditions and recoverability aim to incorporate considerations related with:

- Environmental Health and Safety (sustainability of nature, solid waste reduction, reduction of oil use and greenhouse gas emissions (Carbon dioxide, methane, etc.), water and energy efficiency, sustainable facilities etc.),
- Productive fit between nature and human (ability to recover any type of components, parts, materials, assemblies etc. and enabling systems in necessary cases) into the systems engineering process to be able to make them understandable and manageable during whole life cycle of Systems.

Mainly, it focuses identifying environmental health and safety risks/hazards, influencing the design if possible and then managing them during the whole life cycle. Early analysis of those potential impacts ensures that measures are taken in the design and suitable actions are in place to cope with supportability problems to protect the environmental health and safety. ILS effort implemented to achieve this, provide recoverable Systems / Parts / Components, healthier, safer and adequate natural resources in the future and also in the present.

Almost all ILS elements can be affected by EC&R. For example, Design Interface is affected to produce acceptable levels of waste during a maintenance task, Maintenance ILS element is affected to correctly recover the materials/parts during a repair task and PHS&T is affected to comply with EC&R related regulations and laws.

Like many other factors, environment has an important effect on sustainability of the systems just as the systems affect the environment which can be observed at any stage throughout the life cycle of the systems. These effects may reach to an extent that prevents proper operation and supportability. For example, if a component is not allowed to be used because of EC&R related laws and regulations, the SOI will not be able to operate and perform the mission.

Considering recoverability options during design allows reusable materials which provides benefit in the scope of circular economy, decreases the damage to environment and disposal costs. Recovery options may be in the form of reuse in present form, recycled reuse, reuse after repair and reuse after manufacturing.

As part of a support concept, Environmental Conditions & Recoverability comprises the following activities:

2.2.13.2 Identification of Environmental Conditions and Recoverability Issues

This activity aims to analyse EC&R related requirements, laws/regulations and to contribute development of appropriate solutions to protect environment, to be protected from adverse effects of environmental problems and to be able to seek/provide economic benefits by recoverability options.

- Identify and define stakeholder requirements and responsibilities (including environmentally friendly and cost-effective method of recovering and reusing parts, materials etc. after a System's life cycle has ended) of environmental conditions and recoverability issues,
- Identify and define environmental risks and hazards that might occur at any stage of system life cycle,
- Identify hazardous materials, wastes and pollutants and ensure that necessary planning has been made to manage these during the life cycle
- Maintain coordination with SOI supportability analysis and evaluate EC&R related inputs
- Ensure that environmental conditions and recoverability requirements, and necessary actions are included in the relevant plans that have to be created to address use of recovered materials, reuse of Systems / Parts / Components, recyclability, use of environmentally friendly Systems, facilities, methods and procedures, waste prevention (including toxicity reduction or elimination) and ultimate disposal to be able to ensure safe and efficient sustainability,
- Evaluate environmental safety and conduct health risk assessment in accordance with laws, regulations and standards (for example REACH, UN ST/SG/AC.10/1 (Vol. 1) Transportation of Dangerous Goods, etc.)
- Consider costs associated with environmental compliance,
- Make all relevant stakeholders aware of the activities and results.

Inputs: Contract, IT System Support Report, Design Engineering Data, F&I Report, Feedback Information, ILSP, Laws/Legislations, SA dataset, Maintenance Report, Management Reports (In-Service), MTA Report, Obsolescence Reports, Operational Requirements, PHS&T Report, S&TE report, Supportability Analysis Reports, Training Course Report

Outputs: EC&R Plan

2.2.13.3 Manage Environmental Conditions and Recoverability

This activity includes the execution/management of EC&R related issues and applying an effective process.

- Monitor and keep records of risks and hazards management activities,
- Keep risk assessment up to date,
- Evaluate design and support solution if necessary for the EC&R related issues
- Deliver feedback to eliminate or reduce environmental risks and hazards,

- Ensure that necessary EC&R related information (warnings/cautions, directives etc.) is included in the supportability documentation and training,
- Develop safe procedures and ensure that safety related issues like risk reduction (for example explosive components, radioactive material and other hazardous chemicals or compounds) are included in operation and maintenance procedures,
- Ensure environmental considerations and recovery options are evaluated during disposal and recycling in conjunction with disposal plans and recovery options.

Inputs: Contract, Disposal Data, Disposal File, EC&R Plan, ILSP, Laws/Legislations

Outputs: EC&R Feedback Report

3 SYSTEM LIFE CYCLE STAGES / PROCESSES

3.1 System Definition

The AAP-20 defines a system as a System-of-Interest (SOI) and all Enabling Systems (enablers) related to the SOI. The NATO System concept addresses system management by defining the tasks to reach and maintain System maturity during the System's Life Cycle. This differs from the management of the life of products, which is an integral part of system management.

The System-of-Interest (SOI) consists of the sum of subsystems, main components, components (assemblies), and parts to meet a specific and defined purpose as distinguished from other systems. Their essential properties arise from the relationships between the elements. The subsystems, components, and parts are able to be directly or indirectly dependent on each other and/or be linked and/or interact with each other.

Enabling systems support a System-of-Interest during the life cycle for the system, but it does not necessarily contribute directly to its function during operation. Examples are simulators, ground equipment, tools, and spare parts. During the execution of a programme, the AAP-20 System Concept considers a system upon the realisation of a solution by hardware, software, or services with all necessary elements of the system maturity and until its retirement. The target of task execution during the different stages is it to achieve and to maintain the maturity of the system.

The delivered and fielded Military Capability is available when the mature system has reached its defined Operational Maturity. The Operational Maturity concept consists of the following interrelated maturity domains:

- Infrastructural (e.g. buildings, roads, airport facilities)
- Organisational (e.g. personnel, structure, processes, Information Technology)
- Training (e.g. operating manual, guidance, simulator)
- Support (e.g. materiel support, maintenance routines, technical publications)
- Further maturities as necessary, defined by the system-owner

Note: The only possibility to break this approach is Accelerated Fielding, which follows special, especially urgent needs of an organisation to deliver a certain performance. In this case it is necessary to accept a lower level of maturity of the SOI at delivery or during fielding. The required measures to reach the desired level of maturity must be defined and planned at the decision to accept lower acceptance criteria to accelerate delivery and fielding.

3.2 NATO – SLC – Model

NATO or appropriate bodies develop strategic objectives to reach their operational/political goals. The strategic objectives are realized by capabilities. Necessary capabilities are subject to constant changes due to changes of strategic objectives, assessment of the situation, technological progress etc. Capability gaps arise and needs to be filled. To be able to react quickly and to fulfil capability gaps effective and cost efficient every organisation needs a common and structure approach for its programme to fill the gaps. The AAP-20 provide a common approach with a life cycle model of seven stages. These are

- Pre – Concept – Stage
- Concept – Stage
- Development – Stage
- Production – Stage
- Support – Stage
- Utilisation – Stage
- Retirement – Stage

These seven stages build the generic stairway to run a programme. The generic of this approach allows defining for each programme the right way to reach the wanted capability. Nevertheless, the implementation of the specific stages of a programme should follow the general rules.

3.3 Process – Oriented Approach

The NATO SLCM – Framework follows the AAP-48 process-oriented approach to describe activities over the life cycle of a system as defined in AAP-20. The demands on process models consider inputs, outputs, sequences, interactions, resources and methods for monitoring, measuring and evaluation as well as the organizational integration. The AAP-48 cannot satisfy these demands on process modelling, because of the overall approach to describe the life cycle generically and in a way applicable to NATO -, Agency – and Nation programmes.

Consequently, AAP-48 focuses on inputs, outputs and activities of each stakeholder process. This approach also includes the processes of ISO/IEC/IEEE 15288. An understanding of AAP-48 the integrated relationship between AAP-48 and ISO/IEC/IEEE 15288 is necessary to fulfil the objective of the programme to reach and to maintain a capability. NATO uses the process-oriented approach to implement the ISO/IEC/IEEE 15288 principals of SLCM for traditional acquisition or accelerated fielding as well as iterative development and procurement cycles where necessary for the realisation of required capabilities.

The partitioning of the programme and system life cycle into stages is based on the practicality of doing the work in small, understandable and timely steps. In addition, stages help to identify uncertainties and risk associated with cost, schedule, general objectives and decision-making. Each stage has a distinct purpose and contribution to the whole life cycle. The transition between stages uses decision gates and entry/exit criteria in addition to milestones within stages to ensure the programme is progressing successfully.

3.4 Tailoring

The SLCM provides a generic concept for stages and processes, and it is necessary to tailor the model and the processes to the specific needs of the relevant programme. Appropriate process

tailoring across the stages is essential for effective system life cycle management. Additional Nations, Agencies, and other Users of this process concept must adjust these interfaces to their appropriate processes and domains.

Life cycle processes must be implemented, managed and supported using clearly defined goals, objectives and metrics that lead to applicable improvements. It is important to understand what to measure, why it is being measured and define the successful outcome.

With well-defined objectives for a programme and the skeleton of generic stages, processes and activities it is possible to tailor all necessary activities by taking into account:

- National law
- Knowledge from science or R&T activities
- Organisational rules
- Possibilities of industry
- Resources
- etc.

To tailor a programme the following factors could be helpful.

- The processes of the AAP-48 that apply to the domain, type of the organization (for example supplier, user, agencies, or other stakeholders) must be included in the programme plan.
- Other processes that are not in AAP-48 can be required by an agreement, or they can be required by the nature of the programme, the applicable system or the type of organization. These processes may be added, complete with their purpose, outputs and activities.
- Activities for each process and the expected outputs of each activity must be selected.
- Reporting and technical review requirements applicable to the life cycle stage or stipulated in the governing agreement or in organizational policies and procedures must be considered.
- Programme measurement requirement provisions must be included for the collection and reporting of key measures by which programme progress will be evaluated.

3.5 Stages

This section described the stages of the NATO SLC according to the AAP-20 and with the expectation on ILS processes and activities. Beside the short explanation of the different stages, the question how ILS contribute to each stage is the main focus. The Subsections follows in generally the structure to mention the purpose of the stage, to identify the stage outputs with contribution of ILS – Processes, to high light stage activities influenced by ILS – Activities and to the mention the relevant milestones. It is highly recommended to consider carefully tailoring these activities to meet your programme requirements.

In Annex 2 you can view the mapping between the main ILS – activities and the stage of the NATO SLC.

3.5.1 Pre-Concept stage

The purpose of the Pre-Concept stage is to identify and document stakeholder requirements (e.g. Targets) as well to identify risk areas (at a high level).

The ILS Processes must contribute to the identification of most promising options and to the definition of stakeholder requirements. From the viewpoint of the Pre – Concept – stage the ILS – Processes must:

- consider all option with the focus on sustainment
- analyse the impact of ILS on each option
- provide recommendations on the most promising options and there ILS – Strategy
- provide high level sustainment requirements for all options

The ILS – Processes must provide their input to Milestone M2. Development of options which are in line with the requirements. The Milestones M1 to M8 are defined in AAP-20.

3.5.2 Concept stage

The purpose of the Concept Stage is to refine and broaden the studies, experiments, and engineering models pursued during the Pre-Concept Stage and to develop preliminary system requirements and a feasible design solution. One of the key objectives of the Concept Stage is to provide confidence that the business case is sound, and the proposed solutions are achievable.

The ILS Processes must contribute to the recommended preferred solution, to the assessment of feasibility, to risk management and the initial ILS – Plan.

The most important activity is to develop the Supportability Strategy to implement this in the initial ILS Plan, with this work the ILS – Processes must also contribute to:

- refining the stakeholder requirements
- perform an assessment of feasibility
- develop the preliminary system requirements
- Develop an initial Configuration Management (CM) Plan
- Develop an initial Obsolescence Management Strategy/Plan
- Outline the design solutions in the form of drawings, models, prototypes, etc...
- Develop a preliminary programme schedule
- Perform an initial risk management activity
- Estimate the SOI Life Cycle Cost (LCC)

The ILS – Processes must provide their inputs to the Milestones M1 Study Phase Review, M2 Programme Establishment Phase

3.5.3 Development stage

The purpose of the Development stage is a full validation of the technical solution through design engineering work to the point where production actions can be taken. The Development Stage is executed to develop a SOI that meets or exceeds the stated requirements and can be produced, tested, evaluated, operated, supported, and retired.

The most important activity is to update the initial ILS – Plan. Additionally, the ILS Processes must contribute to system definition including maintenance strategy/plan as well as support and maintenance procedures, to the definition of enabling systems and to the updated ILS Plan.

The ILS – processes must contribute to:

- the evaluation and refining of system requirements, project budget, and schedule baselines and life cycle cost estimates in terms of sustainment
- the development of the SOI architecture comprised of hardware elements, software elements, humans, and their interfaces (internal and external) from viewpoint of ILS
- the confirmation, that the SOI is supportable and is cost effective for stakeholders
- the refining of requirements for the enabling systems
- the identification of resources necessary for the Production Stage over all ILS processes
- the handling of relevant data
- the development of a maintenance strategy
- the development of a retirement concept
- the update of Obsolescence Management Strategy/Plan
- the update of ILS Plan
- the update Configuration Management Plan
- the identification of enabling products for production
- the estimation of Life Cycle Cost (LCC)

The ILS – Processes must provide their inputs to the Milestones M1. Requirements Review, M2. Functional Review, M3. Design Review and M8. Production Readiness Review

3.5.4 Production stage

The purpose of the Production Stage is to manufacture and test the SOI, and produce related support and enabling systems as needed.

The most important activity is to update the ILS – Plan. Additionally, the ILS Processes must contribute to the implementation of all necessary DOTMLPFI (Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, Facilities and Interoperability) elements, to the delivery of all plans and provisions for the Support Stage and to the provision of sustainable utilisation and support.

From the viewpoint of the Production – stage the ILS –Processes must contribute

- to the production of the needed materiel elements of the solution
- to arrange the implementation or modification of the non-materiel DOTMLPFI elements
- to conduct acceptance tests for maintenance documentation or other enabling systems
- to appropriate standardisation
- to make provisions for the sustainable utilisation and support

- to provide inputs to update the retirement concept
- to estimate Life Cycle Cost (LCC)

The ILS – Processes must provide their input to Milestone M1. Approved Production Plan and M4 Acceptance of SOI.

3.5.5 Utilisation stage

The purpose of the Utilisation Stage is to operate the product at the intended operational sites and to deliver the required services with continued operational and cost effectiveness.

The ILS Processes must contribute to the delivery of the capability and to the documentation of failure and lifetime data. Once the SOI is activated and is being used, its performance must be monitored and anomalies, deficiencies, and failures must be properly recorded, identified, and resolved by using ILS Processes. Resolutions come in the forms of maintenance, minor modification (low cost/temporary), major modification (permanent), and SOI life extensions. Activities of the Utilisation Stage are closely related, and many times overlap with those of the Support Stage. In addition the ILS –Processes must:

- obtain enabling products and services
- assign trained and qualified maintenance and service personnel
- monitor the system operation by collecting data to confirm that service performance is within acceptable parameters, to include reliability, maintainability, and availability
- perform failure identification actions when non-compliance has occurred in the delivered services
- determine corrective course of action, if applicable
- update ILS procedures as necessary
- Solicit users' feedback
- support life-extension considerations

The ILS – Processes should provide their input to Milestone M2. Development of options which are in line with the requirements

3.5.6 Support stage

The purpose of the Support Stage is to provide logistics, maintenance, and support services that enable continued SOI operation and sustainable service.

The ILS Processes must contribute to maintain the delivered capability and to documented failure and lifetime date (Maintenance/Support Data), to lessons learned and to updated life cycle cost estimations.

ILS –Processes must help to:

- implement the maintenance strategy/plan and the ILS Plan
- obtain the enabling systems, system elements, and services to be used during maintenance of the system
- explore the possible areas of mutual supportability interest, strengths and weaknesses
- monitor the system's capability to deliver service and record problems for analysis

- take corrective, adaptive, perfective, and preventive actions and confirm restored capability
- maintain a history of problem reports, corrective actions, and trends to inform operations and maintenance personnel, and other projects that are creating or utilizing similar system elements
- address obsolescence management
- Conduct an After-Action Review to capture lessons learned in term of reliability, availability, maintainability, supportability and testability

The ILS – Processes must provide their input to Milestone M1. First unit fielded
M2. In-Service Review, M3. Planned major maintenance event(s)

3.5.7 Retirement stage

The purpose of the Retirement Stage is to demilitarize and dispose of the SOI at the end of its useful life and to remove related operational and support services.

The ILS Processes must contribute to the plans and procedures for transferring the provision of services to new programmes (if applicable) and to the Programme Liquidation strategy. From the viewpoint of the Pre – Concept – stage the ILS –Processes must help:

- to identify redundant programme(s)
- to define a retirement strategy
- to acquire the enabling systems or services to be used during retirement of SOI
- to disassemble the SOI into manageable elements
- to destroy the SOI, as necessary, to reduce the amount of waste treatment or to make the waste easier to handle
- to archive information gathered through the lifetime of the programme
- to calculate the Life Cycle Cost (LCC)
- to conduct an After-Action Review to capture lessons learned

The ILS – Processes must provide their input to Milestone **M1**: First unit retired
M2: Disengagement Phase Review.

3.6 Processes

This section described the processes of the NATO SLC according to the AAP-48 and with the expectation on ILS processes and activities. Beside the short explanation of the different processes, the question how ILS contributes to each process is the main focus. The Subsections follows in generally the structure to mention the purpose of the process and to high light activities influenced by ILS – Activities

In Annex 2, Table 8 shows the mapping between the main ILS – activities and the stage of the NATO SLC.

3.6.1 Agreement Processes

3.6.1.1 Acquisition Process

The purpose of the acquisition process is to ensure that all products and/or services delivered by organisations outside the programme responsibility (which can also include

governmental organisations or industry) are in line with the appropriate requirements and based on a suitable agreement.

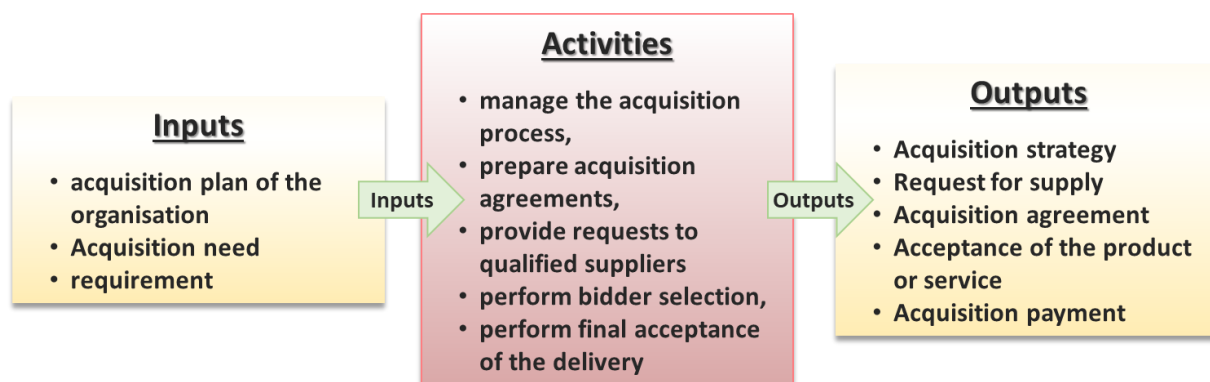


Figure 4: Acquisition Process

The ILS Processes must contribute to the activities to.

- manage the acquisition process by developing and maintaining acquisition strategies, plans and procedures and building / maintaining relationships with responsible employees in the programme organisation to develop plans and schedules.
- develop acquisition decision making procedures.
- prepare acquisition agreements by collecting information to specify the product or service needed, in order to meet the objectives of the programme, by defining acquisition criteria, milestones and standards, by identifying possible suppliers and by qualifying suppliers against established acquisition strategy,
- Provide requests to qualified suppliers and perform bidder selection,
- Establish acquisition agreements,
- Monitor the agreements by participating in acceptance and change – management procedures, by maintaining communication with stakeholders, suppliers and acceptance authorities and by participating in verification and validation process to be able to confirm final acceptance.
- Final acceptance of the delivery by confirming final acceptance.

3.6.1.2 Supply Process

The purpose of the supply process is to ensure that the programme is provided with products and/or services delivered from organisations outside of the programme responsibility or from industry that are in line with the appropriate requirements based on a suitable agreement. The supply process also responds to and corresponds with the acquisition process.

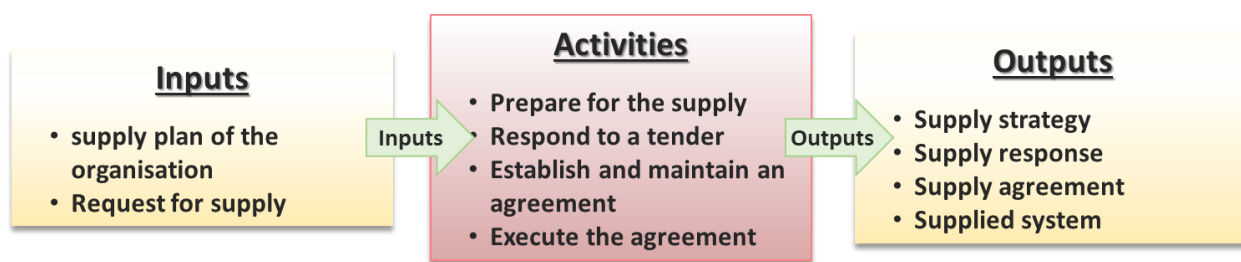


Figure 5: Supply Process

The ILS Processes must contribute to the **activities** to

- identify all the management actions, procedures, and techniques necessary to determine requirements to acquire, catalogue, receive, implement, store, transfer, issue and dispose of spares, repair parts, updates and supplies,
- plan all the management actions, procedures, and techniques for ILS activities,
- prepare supply agreement to identify acquirers, respond to a tender, and establish supply agreement for logistics support,
- execute the agreement to involve the acquirer in the acceptance and change control procedures, maintain communication with acquirer and acceptance authorities, and involve the acquirer in the verification and validation process to make sure the acquirer confirms the final acceptance.

3.6.2 Organisational Project-Enabling Processes

3.6.2.1 Life Cycle Model Management Process

The Life Cycle Model Management process is necessary to define, maintain and make available the lifecycle processes, models and procedures to be adopted by the organisation as well as developing the necessary policy to ensure adherence. The lifecycle processes, models, procedures and policies must be coherent with the organisation's objectives and strategic plan and must be able to be effectively applied.



Figure 6: Life Cycle Model Management Process

Life Cycle Model Management activities define the way in which organisations manage their programmes including the key decision gates and apply across all stages of the lifecycle.

The ILS Processes must contribute to the activities to

- develop and maintain lifecycle model including ILS relevant stages, applicable milestones and decision gates, by defining ILS relevant entry and exit criteria for decision gates and milestone,
- develop and maintain relevant ILS plans for life cycle management by including the roles, responsibilities, authorities, requirements, measures and performance criteria,
- assess the ILS relevant stages, applicable milestones and decision gates but also defining ILS relevant entry and exit criteria for decision gates and milestone,
- improve the ILS plans relevant for life cycle management by the help of identified opportunities for improvement based on assessments, individual feedback and changes in the organisational strategic plan by communicating changes in ILS plans with all relevant stakeholders.

3.6.2.2 Infrastructure Management Process

The Infrastructure Management Process is necessary to ensure that infrastructure and services are available for the NATO Programme or project. The NATO Programme or project will inform the organisational infrastructure requirements and liaise with the infrastructure organisation to design, enhance, change, implement, maintain and dispose of the infrastructure element of the Programme or project.

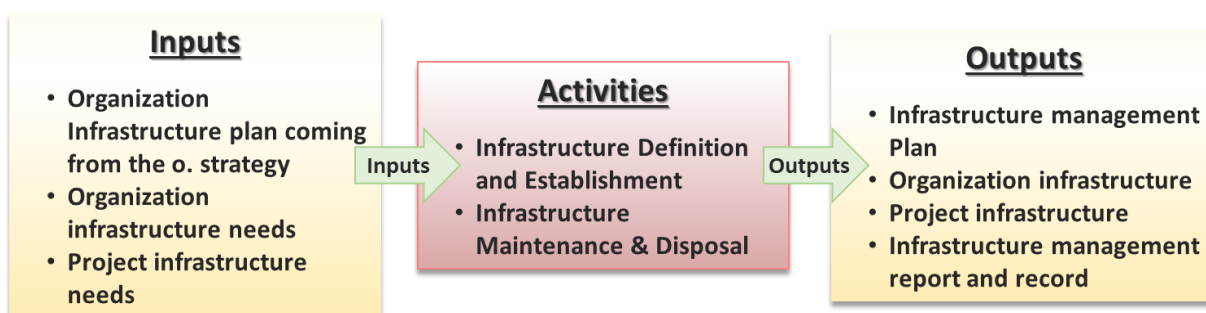


Figure 7: Infrastructure Process

The ILS Processes must contribute to the activities to:

- determine the infrastructure requirements to enable training, maintenance and storage to maximize effectiveness of system operation and the Logistics support system at the lowest total ownership cost,
- assess the interdependencies between the areas of development for the programme or project by considering the infrastructure requirements for assessment,
- consider the infrastructure requirements for other programmes, projects to de-conflict and/or identify opportunities that are mutually beneficial,
- develop the strategy and plan for the development, integration, support and disposal / termination of the infrastructure,
- determine the infrastructure funding line and liaise with the NATO infrastructure organisation,

- identify necessary infrastructure and services that will satisfy the requirements, de-conflicting with other Programmes, projects and areas of development,
- procure necessary infrastructure and services in line with the Programme or project schedule,
- accept infrastructure or service and validate against original requirements,
- continually evaluate performance of infrastructure against programme needs,
- continually assess performance and identify improvements, amendments or corrective action where appropriate and necessary.

3.6.2.3 Portfolio Management Process

The Portfolio Management Process is necessary to establish, initiate, sustain and terminate the Programmes and projects necessary to satisfy the strategic aims and objectives of NATO. The key elements in NATO's portfolio are capabilities, national commitments, and programs. This process is fundamentally about making available the necessary resources to set up, manage and maintain a coherent set of activities that align these key elements with the strategic intent of NATO.

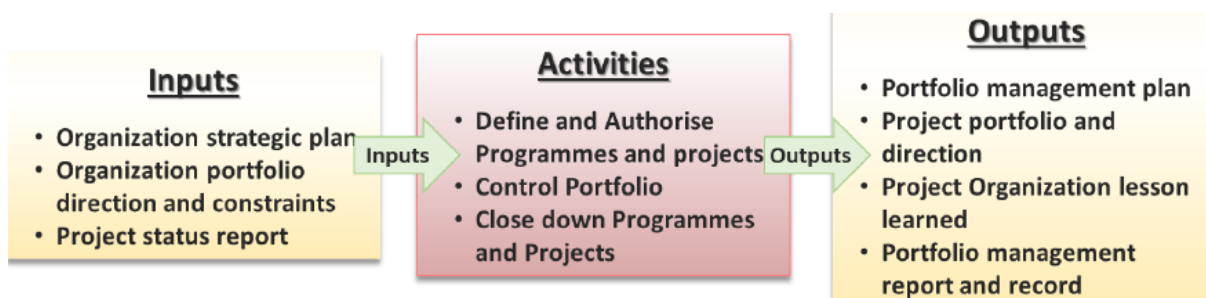


Figure 8: Portfolio Management Process

The ILS Processes must contribute to the activities to:

- define the ILS part of the identified capability gap and / or opportunities and identify the relevant ILS elements interfaces for multi-projects,
- plan the ILS part of the projects in its portfolio, by identifying ILS relevant stages including applicable milestones and decision gates and defining ILS relevant entry and exit criteria for decision gates and milestone,
- Identify, secure and make available appropriate through life funding for the ILS part of the projects to initiate the NATO Programmes and/or projects.
- continually assess the progress of resources of the programme or project against the ILS part of the programme planning documentation, the NDPP and strategic guidance.
- evaluate the resources of the programme or project comparing to planned resources,
- undertake corrective or maintenance action to retain strategic alignment, appetite for change and senior / top level buy in to the ILS part of the programme or project.
- action to close down (If the programme or project was completed),
- document lessons learned.

3.6.2.4 Human Resource Management Process

The human resource management process is necessary to ensure that Suitably Qualified and Experienced Personnel (SQEP) is available to satisfy the resource needs of all NATO programmes and projects.



Figure 9: Human Resource Management Process

The ILS Processes must contribute to the activities to:

- identify level of skills, competence, qualifications and experience necessary to deliver the NATO programme or project,
- benchmark this assessment against existing available personnel identifying the human resource gaps that need to be addressed by the organisation to satisfy the programme or project,
- assess the future SQEP needs of the programme or project across the lifecycle and feed back to the organisation,
- develop an organisation strategy for securing the required human resources necessary to complete activities,
- identify appropriate career paths for skills progression and succession planning,
- identify and implement appropriate training to up skill personnel in line with identified training needs and skill gaps,
- maintain human resource records on level of skills, competence, experience and qualifications,
- deliver skilled individuals to the programme when required and balance priorities across different programmes,
- maintain programme resource baseline and scheduling,
- maintain and manage the pool of human resource for allocation to programmes and projects,
- manage interfaces across the programme and project boundaries de-conflicting resource issues.

3.6.2.5 Knowledge Management Process

The purpose of the Knowledge Management process is to enable the organisation to exploit opportunities and reuse existing knowledge through a set of defined capabilities and assets as well as creating an audit trail for the decision management. Knowledge Management has to take into account the knowledge and experience of individuals within the organisation. The rotation of personnel is a particular issue.

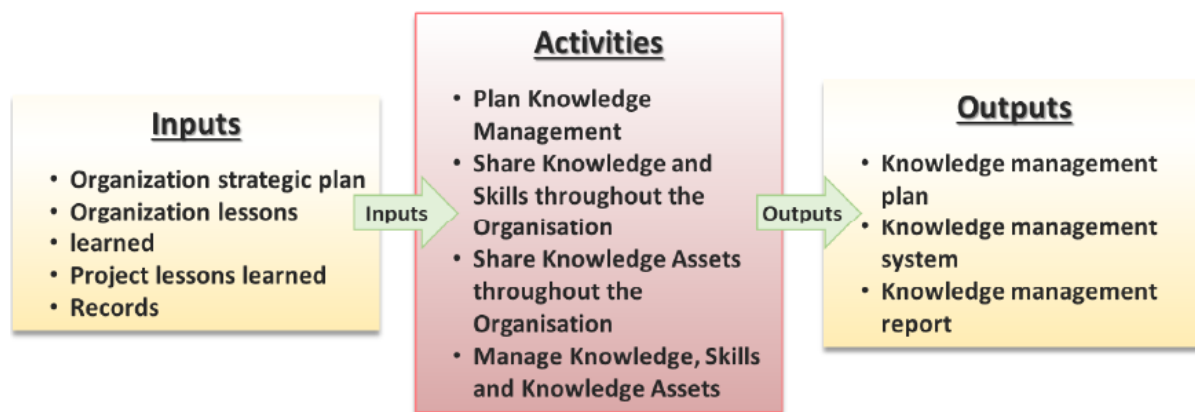


Figure 10: Knowledge Management Process

The ILS Processes must contribute to the activities to:

- establish the knowledge management strategy for the ILS part of the programme.
- establish responsibilities for identifying, capturing, and managing critical information to support the ILS part of the project or programme.
- identify the type of knowledge and information that is required to be captured such as lessons learned, successful practices, document templates etc. for ILS
- identify the ILS parts of the organisation and project that need access to or could benefit from the stored knowledge.
- capture, maintain and share knowledge and skills for ILS,
- establish the infrastructure necessary to captured knowledge by considering ILS activities in programme or project,
- knowledge about domain specific system and software elements applicable to share across the organisation.
- revise and replace knowledge assets related to ILS,
- assess where knowledge related to ILS is being used and by whom,
- determine the relevance and actuality of knowledge assets related to ILS.

3.6.2.6 Quality Management Process

The quality management process is necessary to identify quality policies and objectives that are relevant to the venture and reflect the needs and expectations of customers and other relevant interested parties. The Quality Management System (QMS) determines the processes and resources required to achieve the intended results and promotes a culture that pursues continuous improvement.



Figure 11: Quality management Process

The ILS Processes must contribute to the **activities** to:

- identify the ILS processes needed for the quality management
- determine the sequence and interaction of these ILS processes
- determine criteria and methods required to ensure the effective operation and control of ILS processes
- prepare a preliminary quality management plan including the ILS processes
- establish the programme specific quality management system as part of the organisational management systems which is identified
- conduct appropriate levels of Quality Assurance activities in order to provide confidence that the system is implemented and delivering planned results for ILS processes
- measure, monitor and analyse ILS processes, and implement action necessary to achieve planned results and continual improvement
- ensure that the quality policies and objectives of the ILS processes remain appropriate and relevant for utilisation, support and retirement stages.

3.6.3 Project Processes

3.6.3.1 Programme Planning Process

The purpose of the Programme Planning Process is to deliver and maintain an authorized and exercisable programme plan with a clear determined scope. The programme planning will focus on tailoring the programme specific stages and processes to include the necessary activities, establishing schedules with enablers, assigning resources, defining inputs, tasks, Outputs and achievement criteria.

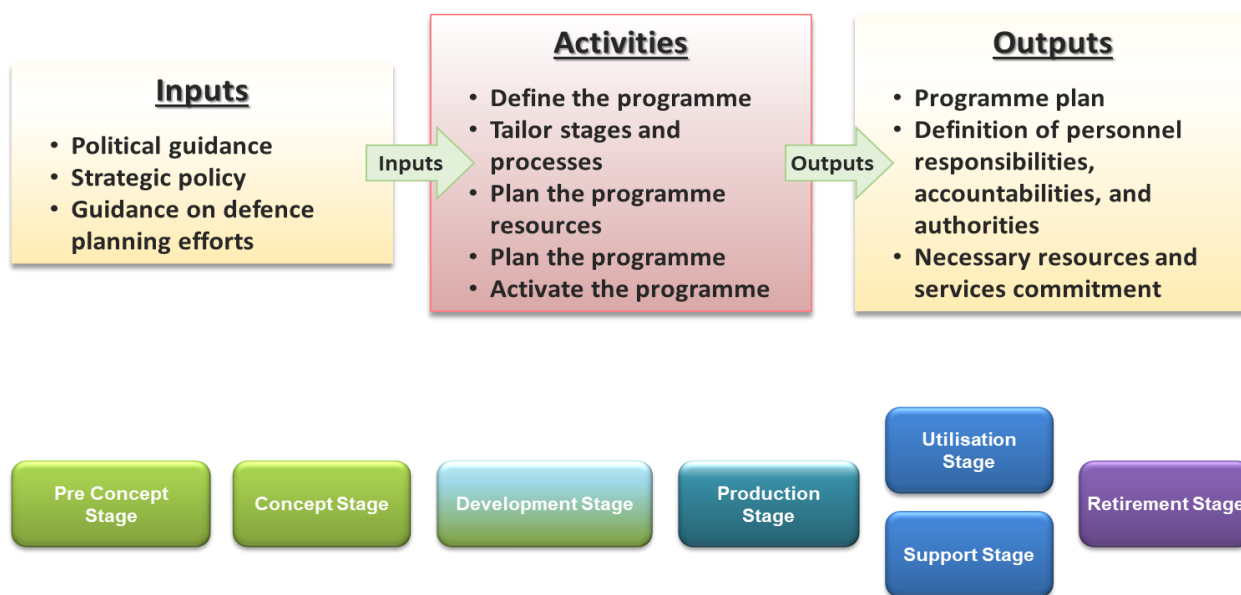


Figure 12: Programme Planning Process

The ILS Processes must contribute to the **activities** to

- define the ILS part of the programme,
- plan the ILS resources as part for the programme resources,
- tailor the ILS activities to stages and processes,
- plan the ILS part of the programme, by defining programme work breakdown structure, identifying ILS relevant stages including applicable milestones and decision gates, defining ILS relevant entry and exit criteria for decision gates and milestone,
- integrate the Integrated Life Cycle Support (ILS) plan into the programme plan,
- activate the programme by obtaining authorization for the ILS activities, the necessary resources to perform the ILS activities.
- check and adjust the programme costs and estimate programme budget
- align ILS part of the programme plan from customer and industry
- combine customer and industry Integrated Life Cycle Support (ILS)
- check and adjust the programme resources plan from customer site and industry
- check and adjust the programme plan to reflect the customer and industry perspectives.

- initiate the implementation of the changed programme plans to satisfy the objectives and criteria set
- prepare and request deactivation approval
- plan transferring the provision of services to new programs (if applicable)
- deactivate the programme

3.6.3.2 Programme Assessment and Control Process

The purpose of the Programme Assessment and Control Process is to provide adequate visibility into the project's actual technical progress (in context of financial expenditure and programme status) and help manage risks with respect to the technical plans. Assessments are scheduled periodically and are undertaken for all milestones and decision/review points or gates in order to maintain good communications with stakeholders particularly when deviations are identified. The process uses these assessments to direct and or redirect the efforts of the project depending on performance.

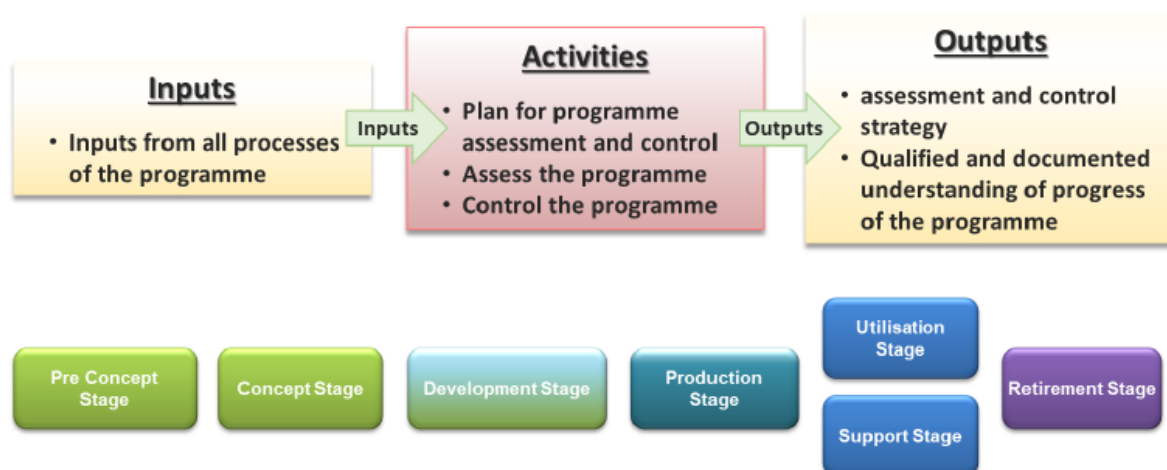


Figure 13: Programme Assessment and Control Process

The ILS Processes must contribute to the activities to

- All relevant ILS specific project milestones, deliverables, schedules have to be covered in ILS plan and ILS maturity reviews must be controlled and if necessary be adapted on regular basis in order to be in line with the NATO objectives
- ensure that industry and NATO take part on regular review sessions (PDR = Preliminary Design review / CDR = Critical Design Review)
- Industry and NATO have to analyse if all ILS requirements for the key milestones and decision gate are achieved and make a decision to proceed or not to proceed
- ensure that all deliverables for the key milestone and decision gate available for Industry and NATO on time
- regular update and harmonization of ILS Milestones and NATO program
- perform (apart from PDR/CDR) regular meetings with the NATO and Industry for ILS information and – data exchange in order to ensure coherence between parties

- any deviation, problems or negative trends impacting the Industry milestones or NATO program must be indicated by the affected party
- results of root cause analysis and defined corrective actions which could have an impact to the NATO program or ILS milestones must be indicated by the affected party
- report has to be prepared to cover all essential ILS information about the result of the assessment of the individual milestones and decision gates.

3.6.3.3 Decision Management Process

The purpose of the Decision Management Process is to organize a structured and documented way to ensure that decisions are made at the right time, on the right level and with a sufficient baseline of information and options.

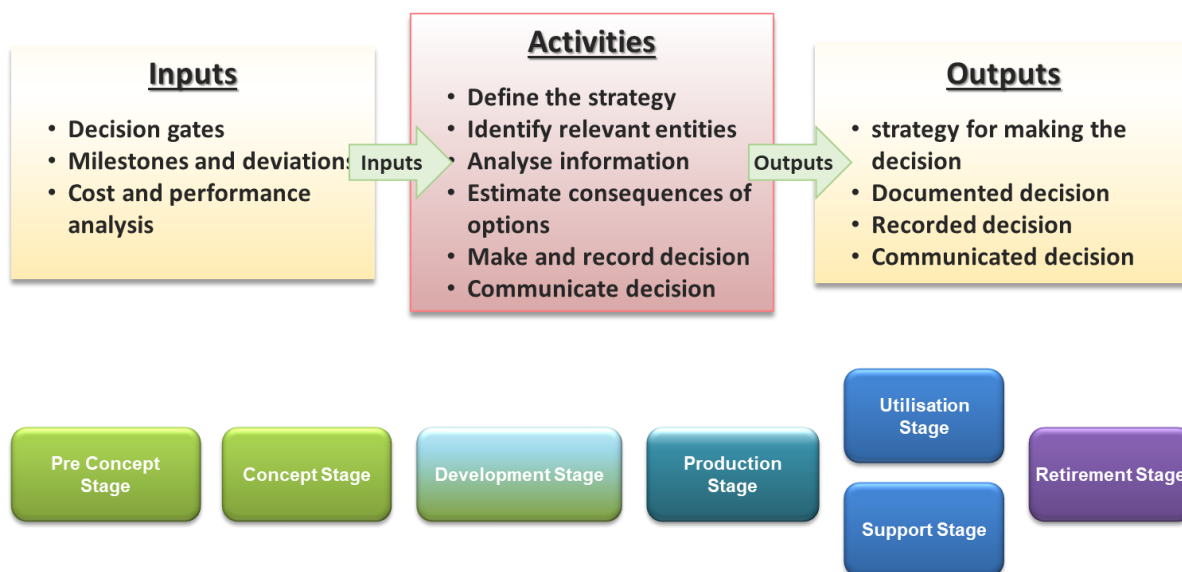


Figure 14: Decision Management Process

The ILS Processes must contribute to the activities to:

- Determine and validate the best support concept for the selected product alternative that was identified through the use of feasibility and trade-off studies.
- Develop the Integrated Life Cycle Support (ILS) plan that identifies key milestones and decision points for support all along the product stages
- Documentation of lessons learned in a systematic and accessible form that is available as inputs into the decision management process.
- Perform life cycle cost analysis. This ILS activity contributes to the decision-making process by providing output data that contributes to the determination of product and support alternatives offering operational or economic benefits that justify the inherent costs.
- Perform product support analysis. Such analysis leads to the development of the SA database which contains support data that could be used to assist in the decision-making process.

3.6.3.4 Risk Management Process

The purpose of the Risk Management Process is to minimize the effects of uncertain events that may occur and would result in adverse consequences to system cost, schedule and technical characteristics. This process identifies, assesses and handles all risks during the entire life cycle, including those that affect the success of the organization, the programme and the technical actions, and those that arise during operational use of the system. It responds to each risk in terms of acceptance, avoidance action or mitigation actions.



Figure 15: Risk Management Process

The ILS Processes must contribute to the activities to

- manage the interface of identified ILS risks in all Life Cycle stages and Life Cycle Management process within the overall risk management plan
- define risk ILS thresholds
- determine which ILS risk could be an impact to the overall program (e.g. deliverables "Tech. Pubs", "Spares", "Training" / certification and validation of maintenance tasks, etc. ...)
- analyse the ILS risks in terms of quality and priority
- selection of the ILS S-Series Specifications entails some risk to the organisations that adopting and implementing it. However, adopting the specification can provide the organisation with new skills and competences that will be required in future contracts of by new contracts.
- perform at the end of the pre-concept stage the visibility and reduction of the remaining ILS process risk in order to be sufficient defined / identified and thus well prepared for all decision in future stages

3.6.3.5 Configuration Management Process

Configuration management (CM) consists of activities that apply over the life cycle of a system, its configuration items, and related system configuration information. CM documents the system's configuration and nonconformances. It supports identification and traceability, the status of achievement of its physical and functional requirements, any nonconformances to requirements or form, fit function, interface and access to accurate configuration information in all phases of the life cycle. It is a management process for establishing and maintaining consistency of a product's performance, functional and physical attributes with its requirements, design and operational information throughout its life.

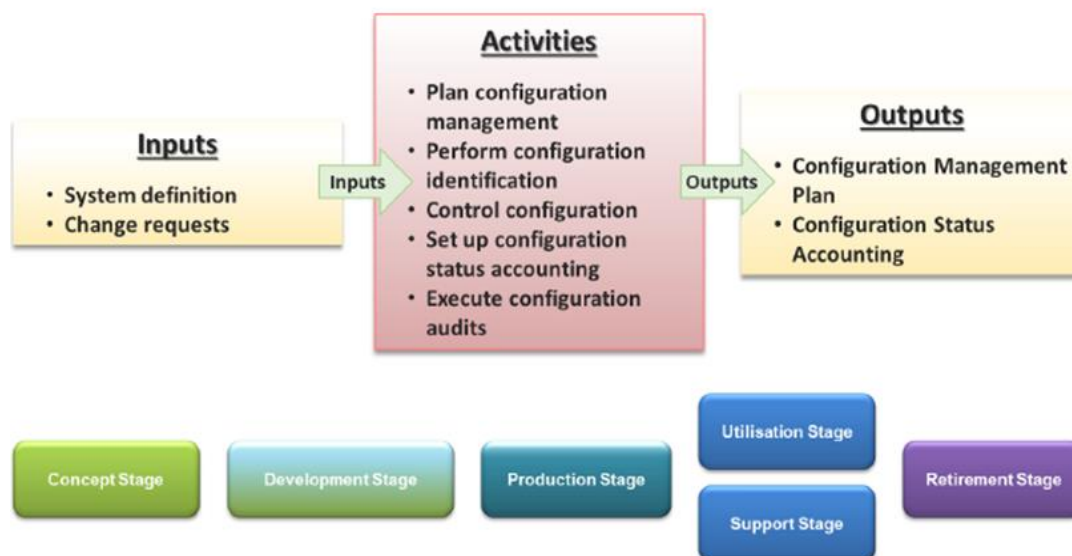


Figure 16: Configuration Management Process

The ILS Processes must contribute to the activities to

- establish and maintain the consistency of the ILS performance of the product and its design and operational information throughout the product life cycle.
- record, update and control in detail ILS information which includes in hardware, software and data
- cover the complete ILS Product Life Cycle and includes the embodiment and control of all ILS modifications impacting especially material support requirements and equipment spares
- ensure the correct identification and version of the configuration. That means to control changes and record the change implementation status of the physical and functional characteristic of the product.
- consider the visibility of ILS in terms of configuration- management- planning- control- accounting- verification and audits
- provide the interface to SA in order to implement and control the different product configurations and consider the implementation of design changes
- align and adjust the ILS configuration activities between NATO and industry

3.6.3.6 Information Management Process

Information Management (IM) is the crucial part of Decision Support Systems as it enables information exchange within and among the constituents in all of NATO Systems Life Cycle Management (SLCM) stages with the right people at the right time based on the right budget. IM also ensures that the necessary information is communicated securely within and through all stages in NATO LCM.

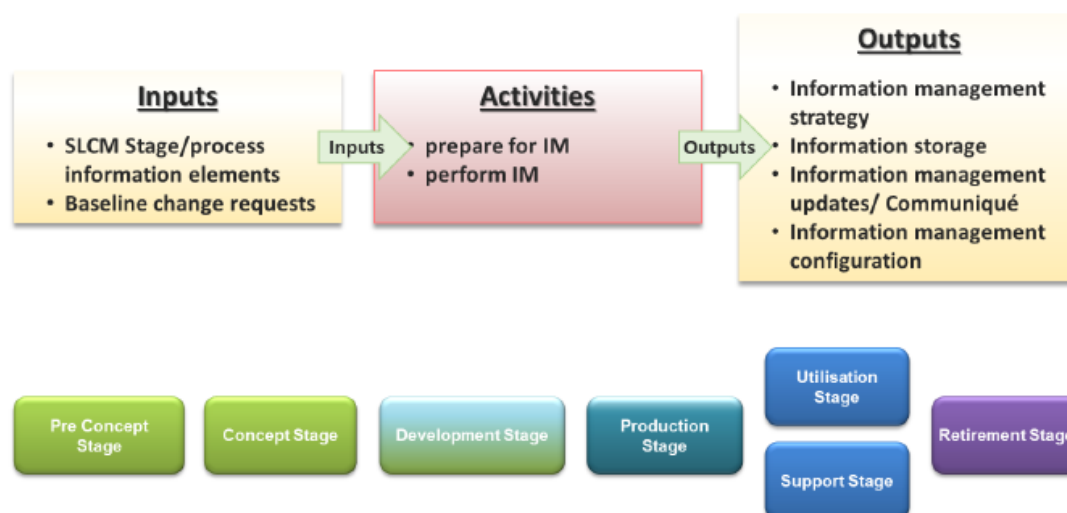


Figure 17: Information Management Process

The ILS Processes must contribute to the activities to

- define the ILS strategy and implement this via ILS Plan. The plan must include the approaches, schedules, resources, meetings, deliverables, identified risks and specific considerations required to perform information management for SLCM. Address the importance of identifying information sharing between industry and customer in MOAs, contracts, or other agreements.
- store all relevant ILS information. Supports the availability for use and communication of all relevant ILS information in a timely, complete, valid, and secure manner
- report detailing the status and results of the ILS activities to relevant/authorised people.
- ensure that any form of ILS-related data is permanent and readable
- ensure that ILS information cover the complete Life Cycle of the product

3.6.3.7 Measurement Process

The purpose of the measurement process is to provide objective data to the decision-making process across the programme, and information that demonstrates the extent to which planned arrangements are achieving their desired output.

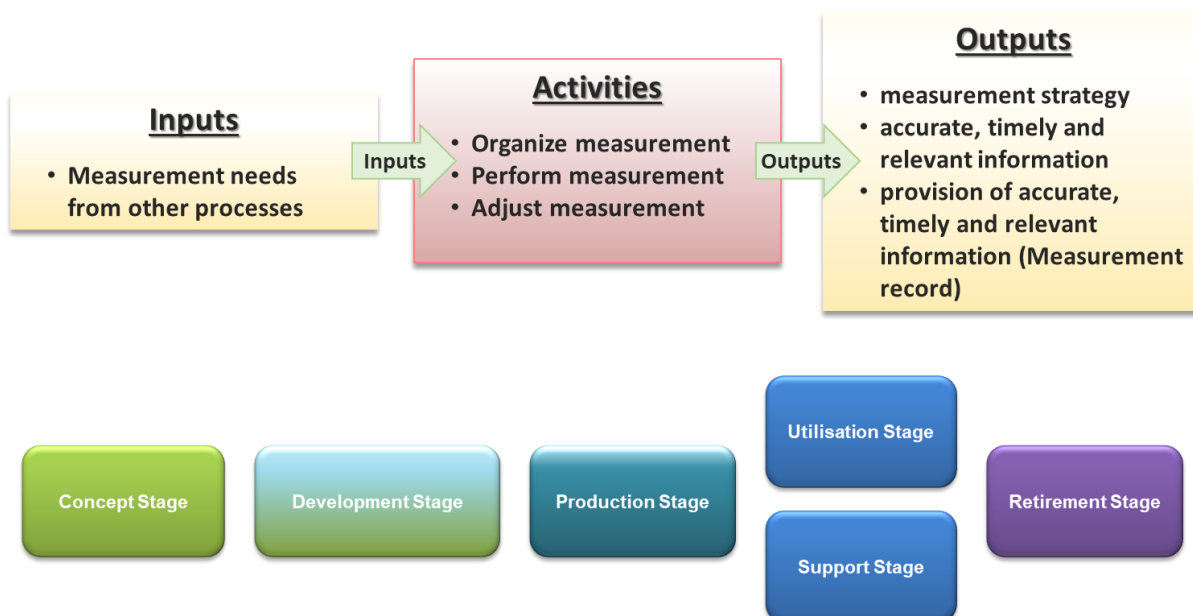


Figure 18: Measurement Process

The ILS Processes must contribute to the activities to:

- Manage in-service ILS/IPS activities by monitoring the operation of the support system and recording its performance
- Documentation of lessons learned in a systematic and accessible form that is available as input data to demonstrate the extent to which desired outcomes are being achieved or not and to what degree.

3.6.3.8 Quality Assurance Process

The Quality Assurance (QA) is an integral part of quality management which is focussed on providing confidence that quality requirements will be met. In the context of NATO acquisition, QS arrangements must be extended to include external providers, i.e. Government Quality Assurance.

The approach to QA must recognize project milestones and the processes critical to their achievement, seeking to provide assurance that intended outputs will be achieved. The approach must also consider the decision-making processes within the project and the data sources used to support decision making.

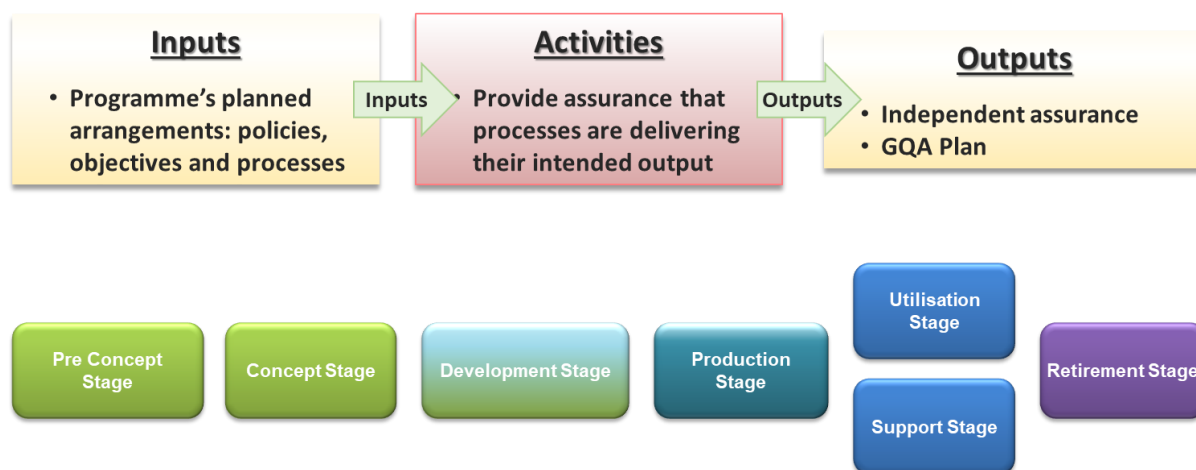


Figure 19: Quality Assurance Process

The ILS Processes must contribute to the activities to:

- Perform support engineering analysis to determine the system performance parameters of a Product, including its testability, and measuring these parameters for product verification.
- Develop the Technical Data Package that will include data categories that address Quality Assurance provisions
- Perform diagnostics, prognostics and health management analysis. The output would be a testability report which would feed into the QA process
- Manage the provisions of the warranty by the tracking of product failures that would feed into the QA process

3.6.3.9 Through-Life Traceability Management Process

The purpose of the Through-Life Traceability Management Process is to ensure system output is aligned to the objectives of the programme through assuring the key attributes and performance indicators of the system can be traced throughout the life cycle of military capability. Using this process the impact of changes over the SLC on capabilities can be identified at all levels of requirements.

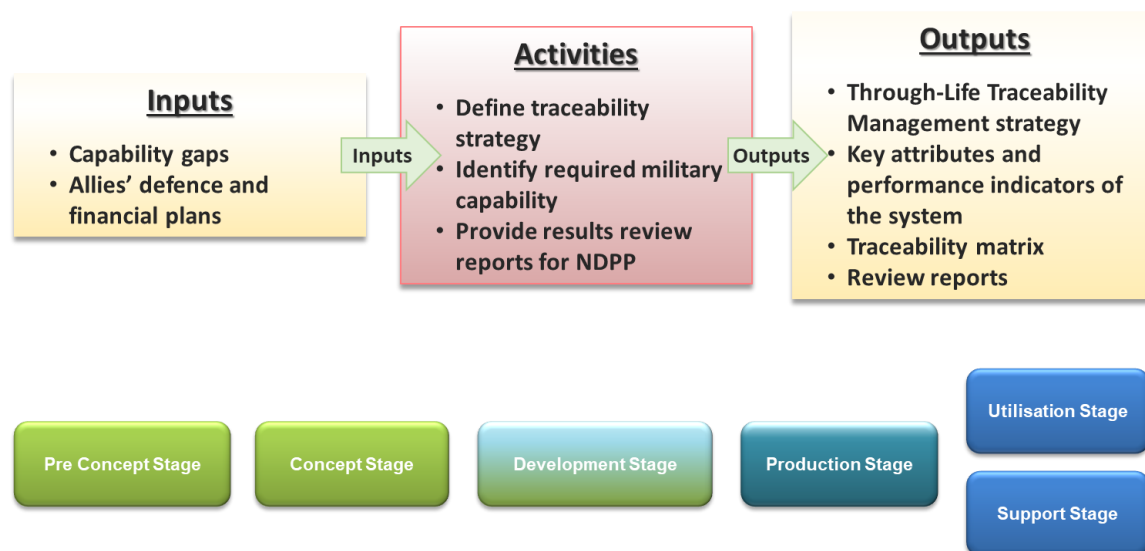


Figure 20: Through-Life Traceability Management Process

The ILS Processes must contribute to the activities to:

- Performance of Supportability Analysis (SA) activities to generate and develop SA data. This activity builds an SA database to enable access to ILS data for definition of data to collect for traceability management
- Perform support engineering analysis that will measure the impact of the five system performance characteristics on a Product that can be used in traceability management
 - Reliability
 - Availability
 - Maintainability
 - Capability
 - Testability

3.6.3.10 Life Cycle Cost Management Process

The purpose of the Life Cycle Cost Management Process is to assist the programs in doing a Life Cycle Cost analysis of the system with the intent of accurately describing the life cycle costs. This process identifies, assesses and handles all costs during the entire life cycle of the system.

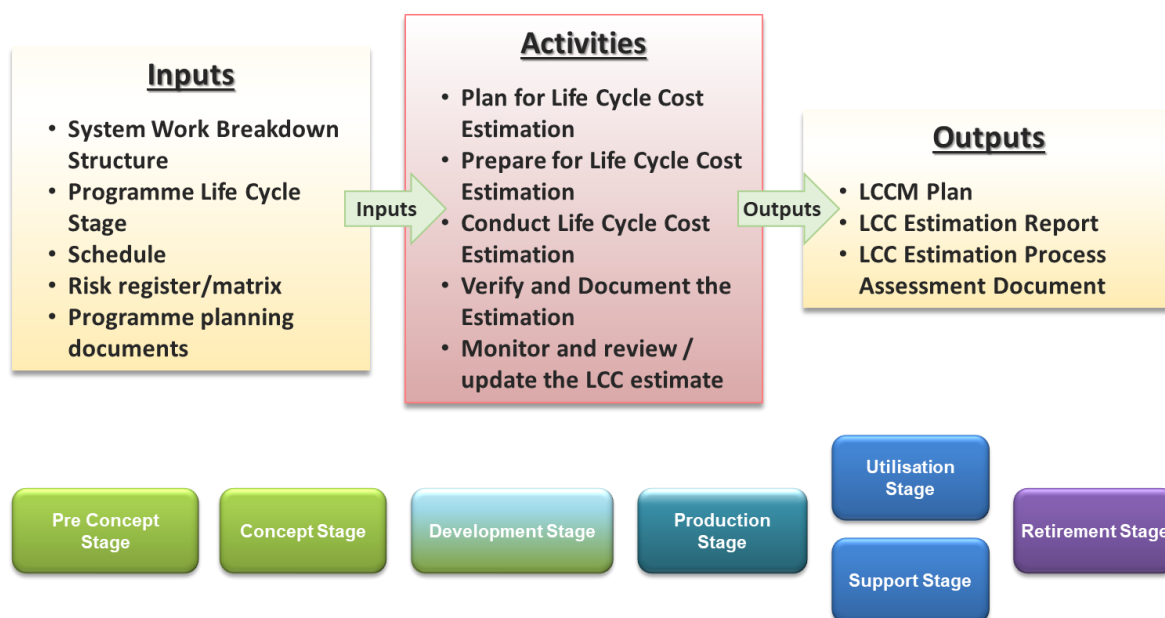


Figure 21: Life Cycle Cost Management Process

The ILS Processes must contribute to the **activities** to:

- Perform Life Cycle Cost (LCC) analysis to determine the most cost-effective option among different competing designs and support alternatives for a Product. The analysis must consider costs along all the product stages.
- ILS Element: Design Interface
- ILS activities: Perform LCC (affordability) analysis (see Para 2.2.2.2)
- Perform Supportability Analysis (SA) to generate and develop SA data to determine scope of supportability and its impact on cost.
- Management of spare stock levels in a manner to achieve efficient stock control in order to minimize overall supply costs during the utilisation and support stages.

3.6.4 Technical Processes

3.6.4.1 Business or Mission Analysis Process

The purpose of the business or mission analysis (sometimes referred to as Operational Analysis) process is to define the business or mission problem (or opportunity) and assess the effectiveness of a range of solution types against existing NATO scenarios, missions or military tasks.

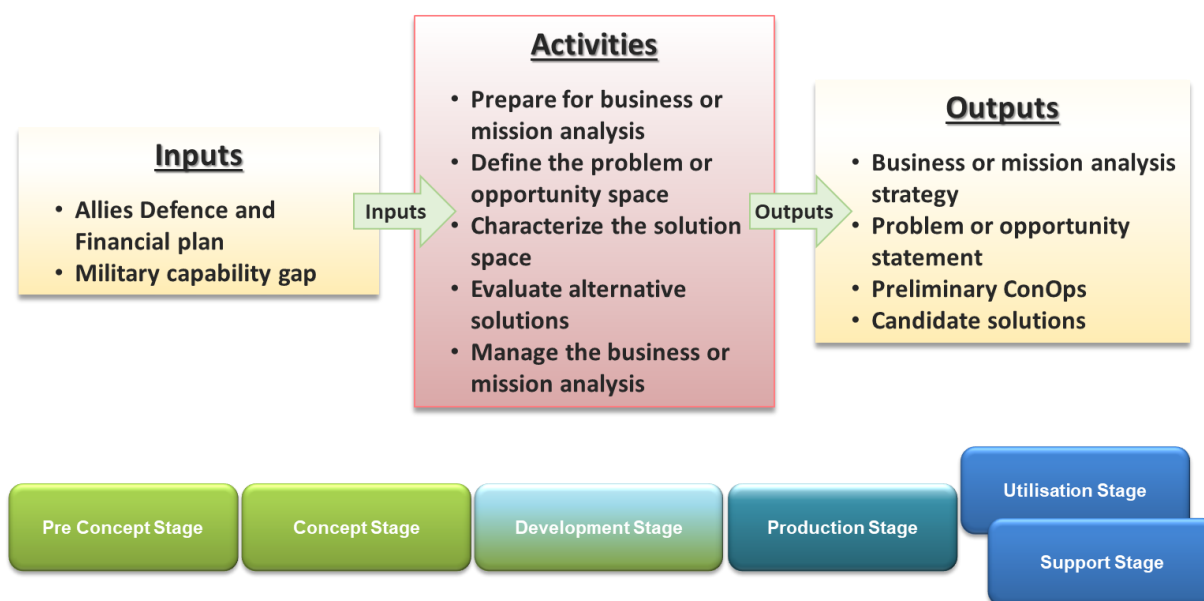


Figure 22: Business or Mission Analysis Process

The ILS Processes should contribute to the activities to:

- Capture the initial ILS-requirements necessary to perform studies.
- Review and understand the mission threats and operational scenarios from an ILS standpoint.
- Obtain agreement on any trade-offs with stakeholders and resolve areas of contention, where ILS is involved.

3.6.4.2 Stakeholder Needs and Requirements Definition Process

The purpose of the Stakeholder Needs and Requirements Definition Process is to provide guidance on capturing inputs from relevant stakeholders and ultimately translating them into defined and approved Stakeholder Requirements.

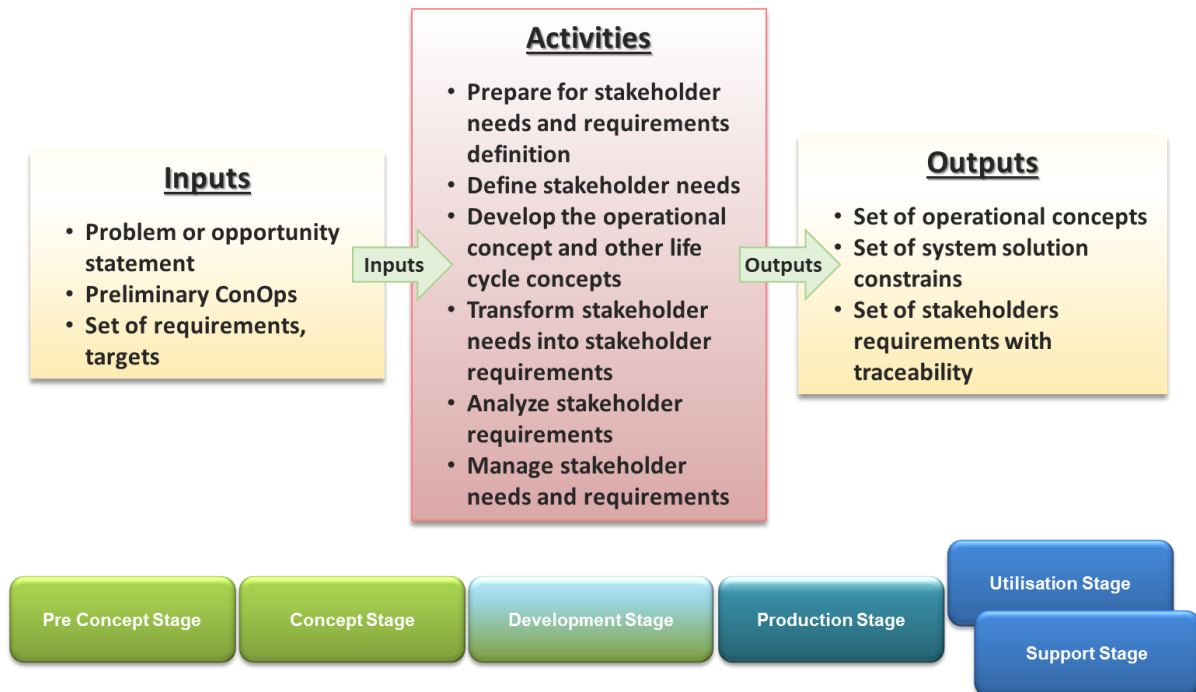


Figure 23: Stakeholder Needs and Requirements Definition Process

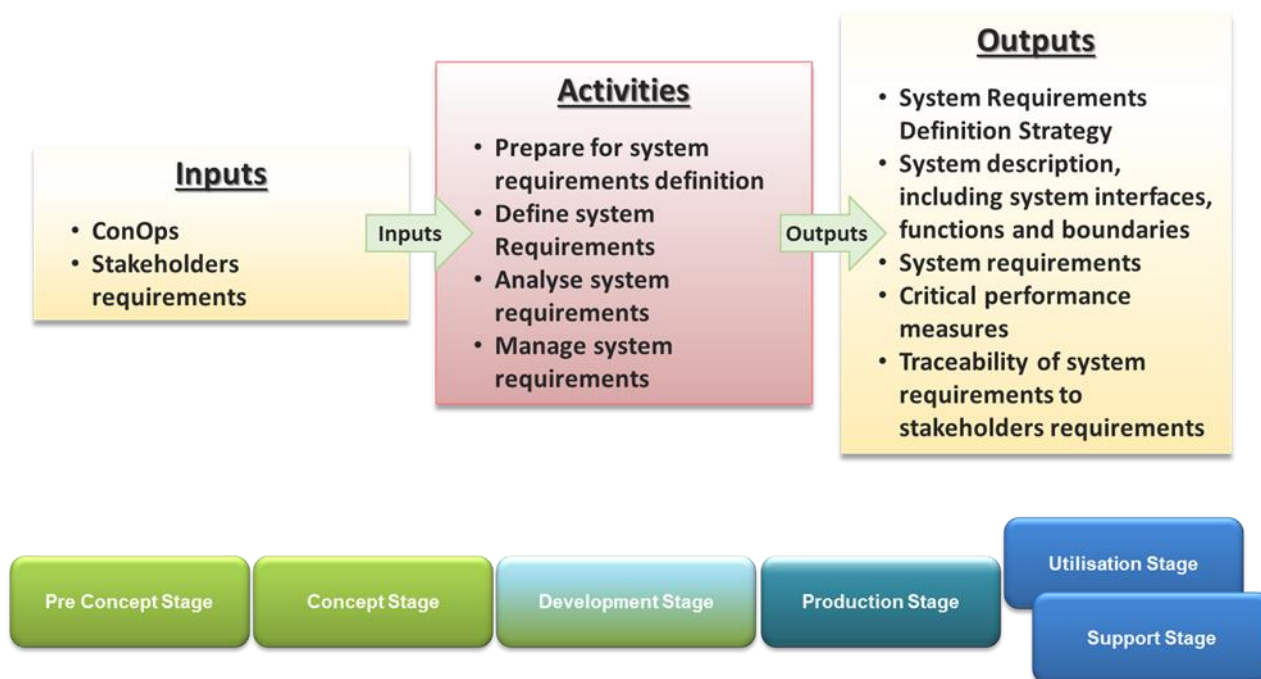
The ILS activities in this process are to support:

- Eliciting stakeholder requirements in the field of ILS:
- Define ILS Requirements:
- Analyse and Maintain ILS requirements during the system life cycle

3.6.4.3 System Requirements Definition Process

The purpose of the System Requirements Definition Process is to translate stakeholder requirements into system requirements and maintain the traceability to the stakeholder requirements.

Figure 24: System Requirements Definition Process



The ILS activities in the System Requirement Definition process are to support:

- Identifying preliminary ILS-related system requirements.
- Define Preliminary ILS-related System Requirements
- Analysis of ILS-related System Requirements
- Manage ILS-related System Requirements
- Maintain bi-directional traceability between system requirements and ILS-related requirements.

3.6.4.4 Architecture Definition Process

The purpose of the Architecture Definition process is to express stakeholder needs, concerns and interdependencies in a set of consistent models that can be used to create different representative viewpoints of the system from a strategic perspective through to an operational and technical level. The NATO Architecture Framework (NAF) is basically a conceptualisation of how to achieve the defined mission and ConOps by decomposing the problem into a manageable set of high-level structures underpinned by different models. These models are then aggregated to create the different viewpoints (the defines these as Concepts, Service, Logical, Physical Resource, Deployed and Metadata).

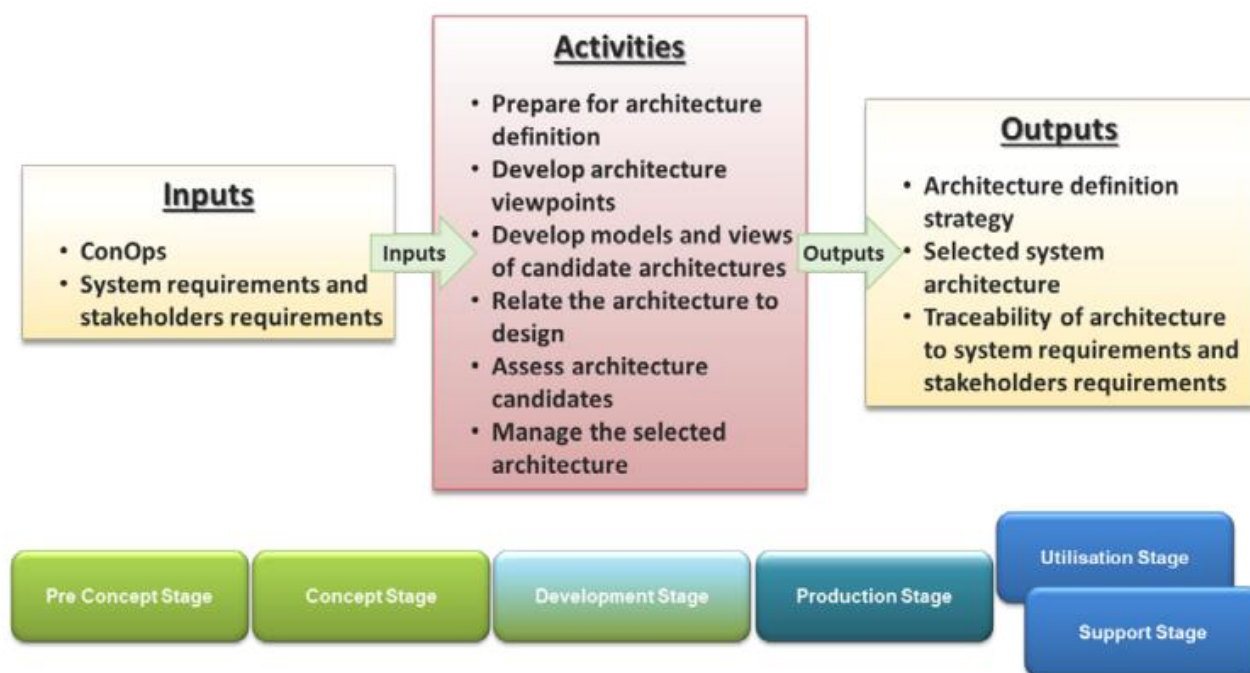


Figure 25: Architecture Definition Process

The ILS **activities** in the architecture process are to support:

- Identification and capturing ILS-related stakeholder concerns, expectations and RAIDO (Risks, Assumptions, Issues, Dependencies and Opportunities)
- Development of ILS-related use cases that provide a clear definition of all the externally observable (operation, support, training and disposal) user functions and environments that the ILS-stakeholders require the system to support.
- Identification of architectural entities and relationships between entities that address key ILS-stakeholder needs and critical system requirements

3.6.4.5 Design Definition Process

The purpose of the Design Definition process is to iteratively develop a system design that provides enough detail to allow implementation of a solution. In addition, the solution must meet the aims and objectives of all stakeholders and be consistent with the outputs of the architecture definition process. This process is normally undertaken collaboratively between NATO and Industry and when done successfully, guarantees an effective SOI for NATO that is efficiently developed and delivered by Industry.

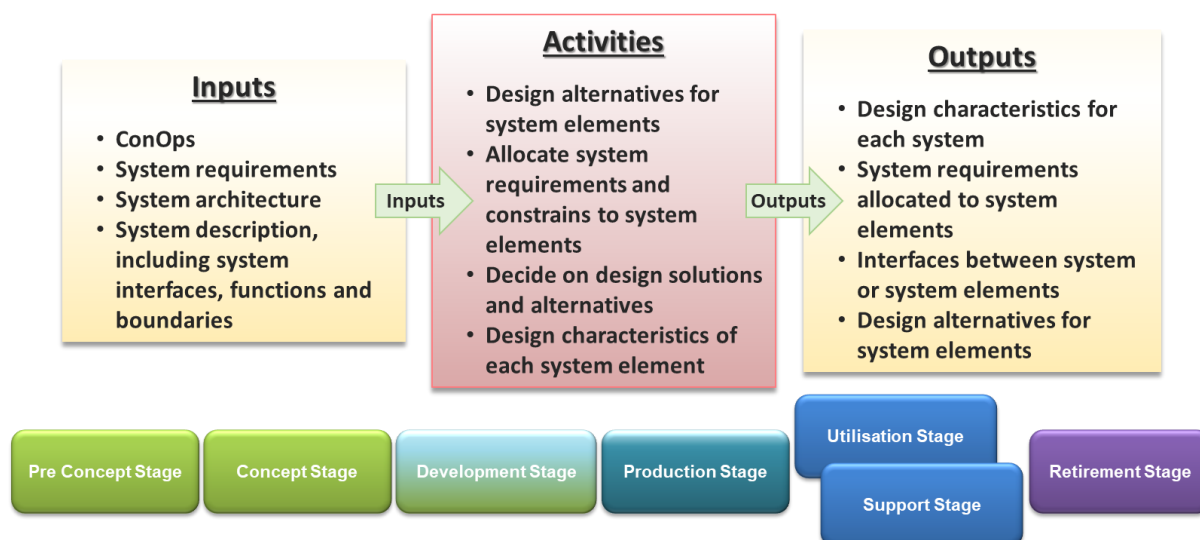


Figure 26: Design Definition Process

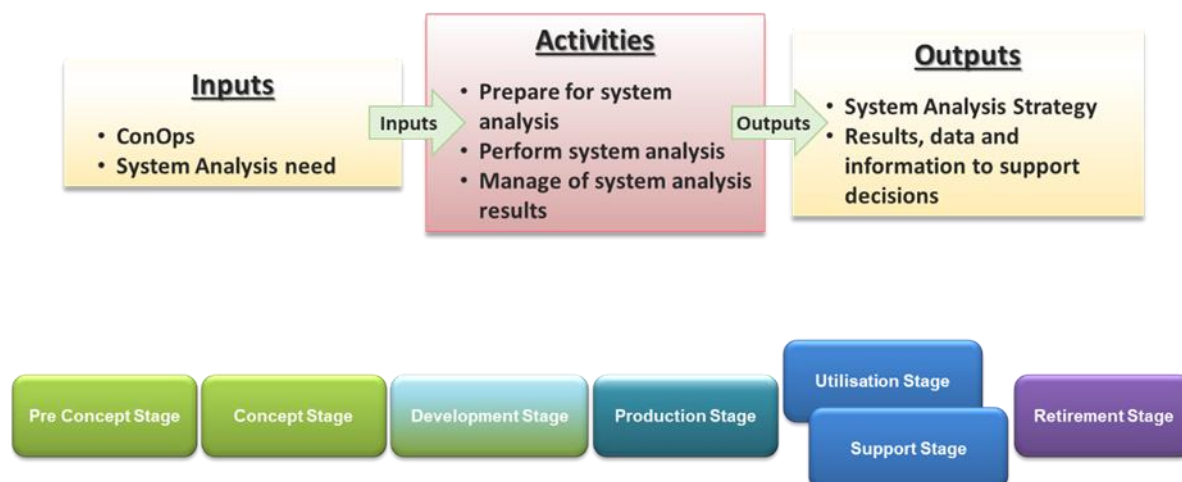
The ILS activities in the Design Definition Process are to support:

- Developing design alternatives for system and major system elements to be able to assess each and make a decision on the most promising solution
- Allocating ILS related system requirements and /or constraints for each promising solution
- Allocating ILS related system requirements and /or constraints to recommended solutions
- Supporting the evolution of design characteristics for each system element in line with ILS stakeholder expectations.
- Allocating the ILS related system requirements to system elements.
- Integrating the system requirements in validation and verification plans.
- Assessing and selecting design alternatives for system elements.
- Defining design characteristics of each system element and ensure they are in line with ILS-stakeholder expectations.
- Allocating ILS requirements to system elements and ensure they are integrated into the validation and verification plan.
- Assess design alternatives for system elements from an ILS point of view and select most promising options including design decisions for all system elements.

3.6.4.6 System Analysis Process

The purpose of the System Analysis process is to aid decision-making by providing a sufficient baseline of data and information about the technical properties of the system from Pre-concept through to Retirement.

Figure 27: System Analysis Process



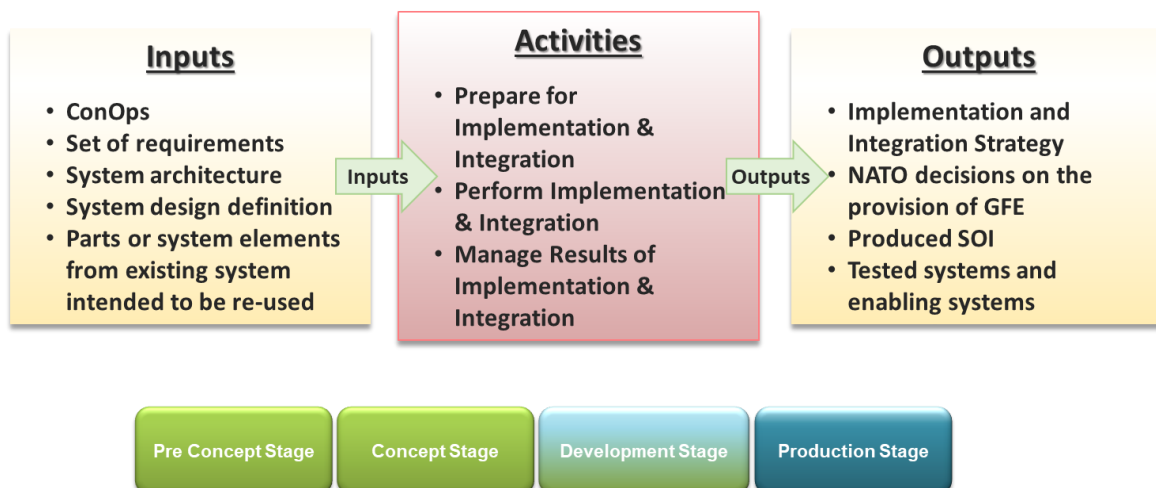
The ILS activities in the System Analysis Process are to support:

- Preparation for system analysis
- Performing system analysis
- Managing system analysis results

3.6.4.7 Implementation and Integration Process

The purpose of the combined implementation and integration process is to realise the elements or components (hardware, software, services and utilisation & support resources) of the system for assembly into a functioning system or set of interoperating sub-systems. While implementation and integration are predominantly performed by industry, it is important for a NATO programme to manage these activities to ensure success.

Figure 28: Implementation and Integration Process



The ILS **activity** in the Implementation and Integration process is to support:

- Preparation for Implementation & Integration
- Performing Implementation & Integration
- Managing the results of Implementation & Integration

3.6.4.8 Verification Process

Verification is an independent process that provides evidence that a product, service or system element complies with the requirements, specifications, regulations, standards and conditions of the system. The Verification process also provide information about anomalies encountered in any information item. Verification is particularly focused during the concept, development and production stages and provides documented evidence that no defects, faults or errors have been introduced.

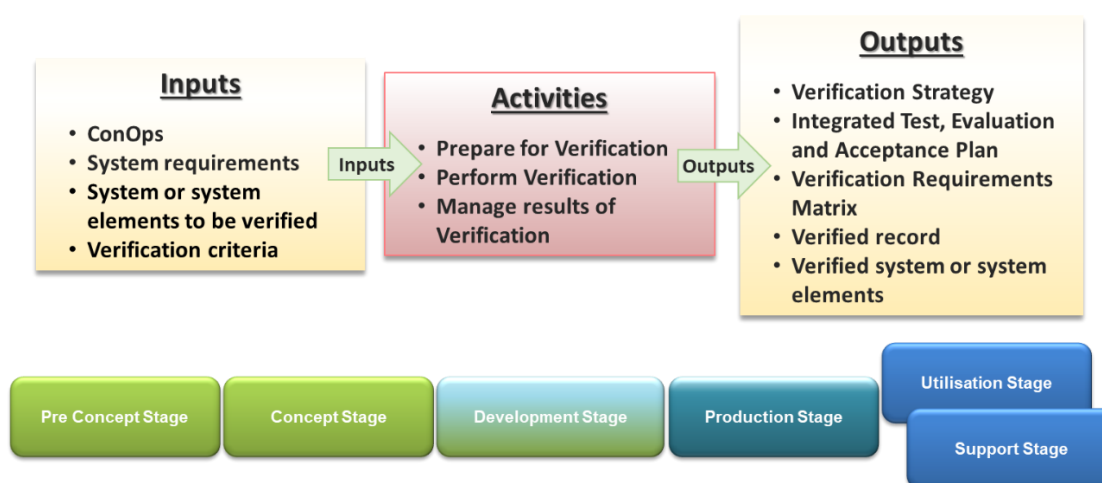


Figure 29: Verification Process

The ILS Processes must contribute to the activities to

- develop and maintain the strategy for verification alongside the ILS requirements definition activities.
- define the necessary activities & procedures to carry out verification.
- Identify the constraints on the verification activities, which include life support requirements
- provide ILS specific inputs to the quality assurance criteria
- Execute verification on all available life support requirements or other information items
- identify any non-conformance and areas for rework
- record the evidence, document the results of the verification actions,
- analyse the results against expectations and success criteria to establish conformance against standards.
- resolve anomalies through the implementation of corrective or remedial actions.
- maintain traceability of the verified system elements with the architecture and requirements.
- generate lessons learned report.

3.6.4.9 Transition Process

The purpose of the process is to instal a new system, sub system or enabling system into its operational environment or to change the operational environment of an existing system including the transfer of accountability and responsibility from one organisational entity to another.

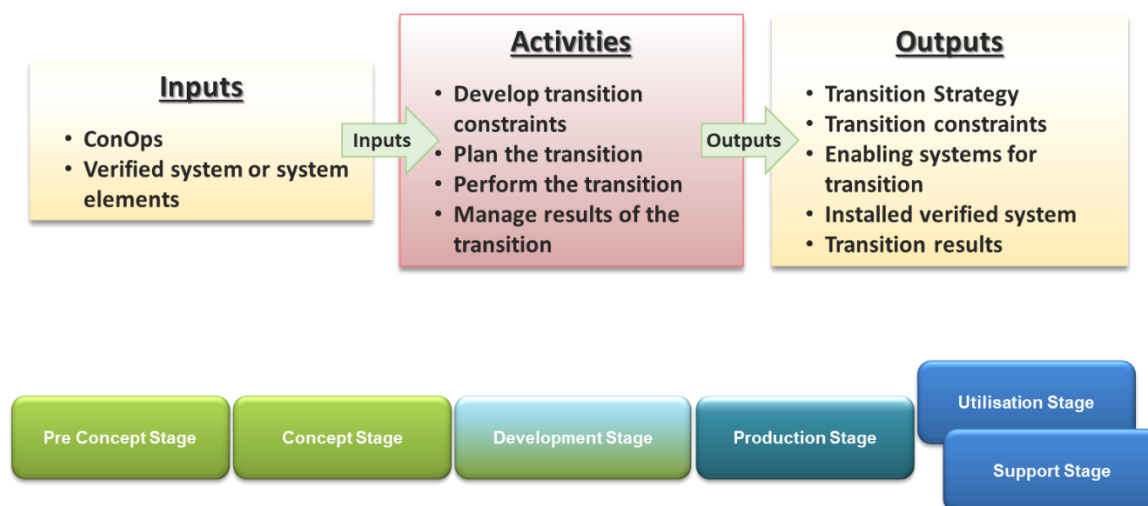


Figure 30: Transition Process

The ILS Processes must contribute to the activities to

- identify the requirements generated by ILS – activities.
- determine necessary support elements to perform transition.
- capture information from industry about all necessary ILS elements / activities
- provide ILS environment in accordance with installation requirements
- receive planed support according to the contracts and admission to the system.
- provide training to the users to ensure they have the appropriate skills, knowledge and expertise to perform future support activities.

3.6.4.10 Validation Process

Validation is an independent assurance process that ensures a product, service or system satisfies the operational needs of the user in the intended environment. Both Verification and Validation are critical components of NATO's quality management system and are defined during the development of the operational and system level requirements.

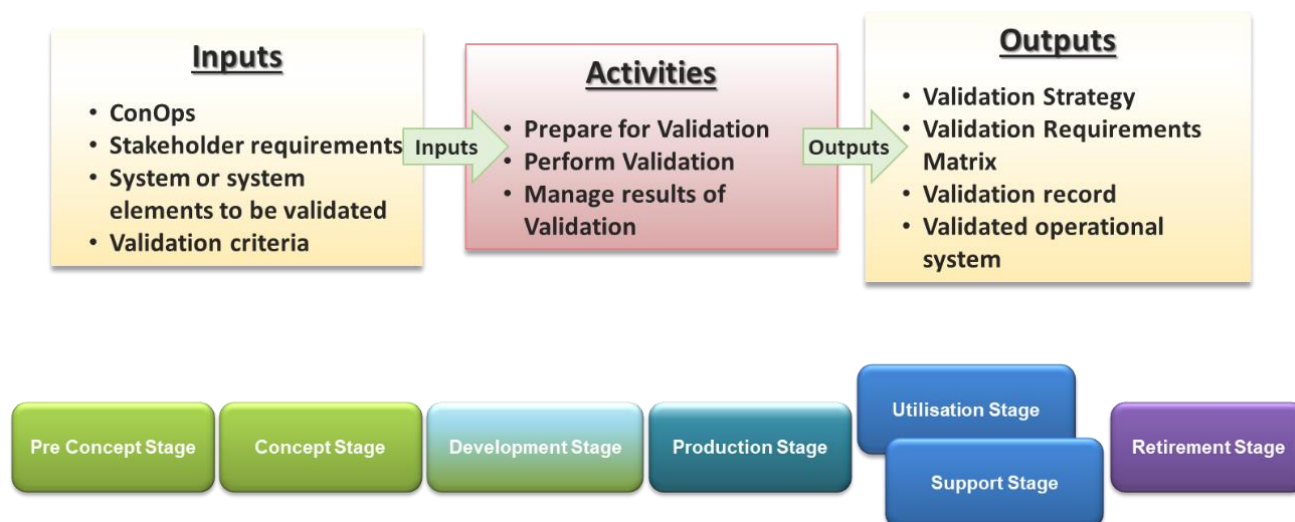


Figure 31: Validation Process

The ILS Processes should contribute to the activities to

- develop a strategy for validation alongside the ILS requirements including the necessary activities and procedures to carry out validation.
- identify stakeholders involved in the validation activities of ILS procedures.
- identify ILS validation constraints.
- perform validation on ILS requirements
- undertake validation actions in the real operational environment to obtain final evidence the ILS fulfils the stakeholder requirements
- undertake validation actions on the relevant ILS information items.
- undertake validation actions on changed system, sub systems or items
- record the evidence and document the results of the validation actions including lessons learned.
- analyse the results against expectations and success criteria to establish conformance.

3.6.4.11 Operation Process

The purpose of the NATO Operation Process is to use the system in a manner which allows the organization to meet the Stakeholder requirements, in support of the objectives of the programme.

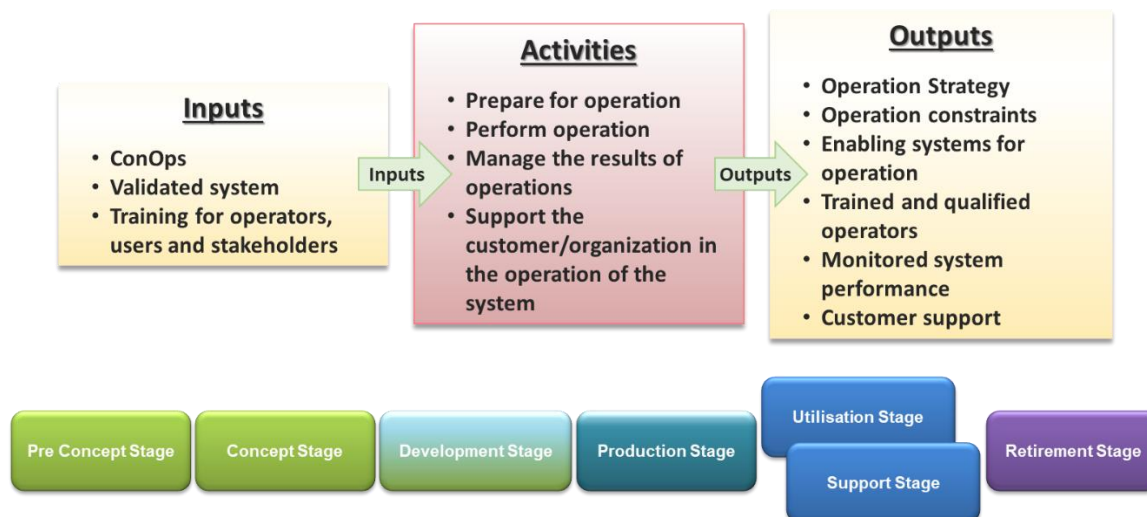


Figure 32: Operation Process

The ILS Processes should contribute to the activities to

- identify Supportability constraints and initiate a support strategy optimising the support elements.
- identify and plan for the necessary enabling systems needed to support operation
- provide Inputs to the Update the support strategy
- define training and qualification requirements for ILS personnel of the system, taking into consideration the final design of the system and the operational requirements.
- develop and validate training manuals for ILS stakeholders.
- plan to assign personnel to be maintenance and support personnel.
- setup the necessary feedback loops i.e. to the supportability analysis and maintenance process.

3.6.4.12 Logistics Support and Maintenance Process

The purpose of the Logistics Support and Maintenance Process is to assist programmes in preparing the support and sustaining the ability of the system to provide a service through its useful life. It comprises all necessary Supportability activities to analyse, plan, perform and report of the sustainment of the system as part of the delivered capability. Based on feedback from monitoring of the operational environment, use profiles and problems through the life cycle corrective, remedial or preventive actions can be taken to restore full system availability.

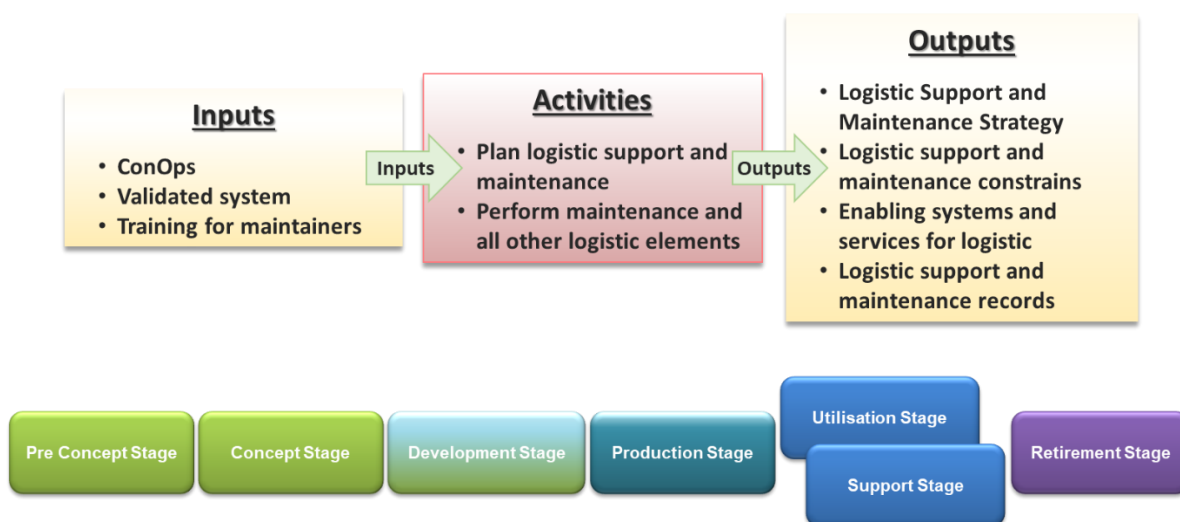


Figure 33: Logistics Support and Maintenance Process

The ILS Processes must contribute to the **activities** to

- prepare a supportability analysis and maintenance strategy.
- provide information to be able to define requirements for sustainment for each option.
- analyse/Establish supportability / sustainment requirements
- develop an Integrated Life Cycle Support (ILS) Plan
- develop an Obsolescence Management Plan
- outline Supportability design solution elements and contribute to Life Cycle Cost (LCC) estimates
- share the programme logistic support and maintenance strategy with industry.
- bring together the established requirements for logistic purposes with the industry system requirements and the design solutions.
- combine NATO or Nation, Agencies and industry ILS Plans (in order to get a complete and coherent ILS Plan that covers all aspects of the programme.)
- check and adjust the system logistic support and maintenance strategy and the ILS Plan
- share the ILS Plan between industry and customer.
- provide and implement all necessary ILS elements
- provide and implement ILS elements as part of the Modification and Upgrade Procedure.

- Obtain the enabling systems, system elements and other services used for logistic and maintenance of the system, monitor replenishment levels of spare parts, and manage the skills and availability of trained logistic / maintenance personnel.
- Perform logistic actions according to the ILS plan.
- Perform Maintenance Actions according to the maintenance plan, provide the general principle.
- Perform Maintenance (corrective, preventive, scheduled).
- Monitor maintenance results
- Establish maintenance history record(s), identify and record trends
- Perform Maintenance actions according to the Maintenance-Plan and the liquidation strategy during Retirement Stage

3.6.4.13 Disposal Process

The purpose of the Disposal Process is to assist the programmes in removing a system, system elements or enabling systems from the operational environment with the intent to end its existence in accordance with all legal and regulatory requirements to safety, security, and the environment

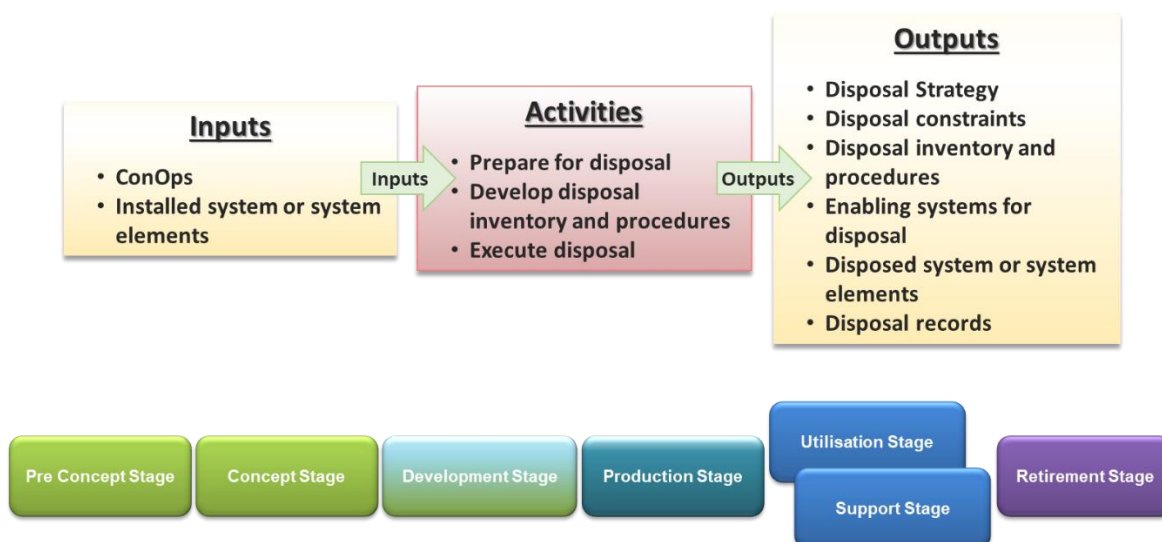


Figure 34: Disposal Process

The ILS Processes must contribute to the **activities** to

- Develop the disposal inventory of system elements, parts and ingredients.

NOTE: The disposal inventory should not be a separate document, it should be part of the documented system breakdown structure in form of attributes and addition descriptions to each item.

- Develop or define and acquire enabling systems needed for disposal
- Maintain the disposal inventory of system elements, parts and ingredients.
- Dismantle the system using ILS – Procedures

4 ROLES AND RESPONSIBILITIES

4.1 ILS Functions

As a part of the introduction of a new system, supportability goals in terms of Reliability, Availability, Maintainability, Health, Safety and/or Environment requirements are defined. These requirements are the baseline for organizing the support (ILS) of the system.

In order to achieve the supportability goals it is important to address ILS related responsibilities and competencies within the organization.

The ILS team must consist of a management function in combination with technical expertise (for each of the required ILS elements) and focal points designated to interface with other programme functional areas and stakeholders. The ILS Management function has the overall responsibility to lead the ILS team, to be the focal point to the programme management and Customer and this management must be present throughout the lifecycle of a system.

The ILS team must ensure the ILS program is developed, managed, executed, controlled, deployed, updated with finding and changes, and sustained as described in this document.

To achieve the goals of Integrated Life Cycle Support, ILS management will interface directly with other programme functional areas to define the system architecture and its alternatives, system quality, system configuration management and testing stages and phases.

The ILS personal team must be resourced with skilled personnel commensurate to the size and complexity of the programme to ensure adequate management and execution of the ILS programme. The number of personnel required in an ILS team may also be influenced by the programme stage as described in AAP-48, as some stages may have more resource demands than others.

The ILS team will identify roles and responsibilities for the management and development of each ILS element, provide procedures for the management, development, execution, testing and control of the ILS programme.

While the ILS functions described above apply to NATO ILS programmes as the Customer, they also are relevant to ILS supplier organizations within Industry. However, Industry ILS organizations may have different structures and responsibilities given their different objectives and requirements.

4.2 Project Management Function

Programme management is responsible for assigning the ILS related requirements and tasks to the personnel within the programme that are responsible for ILS Management and elements. Depending on the size of the programme, the number of personnel required must be adjusted. Project Management may also assign other supportability or programme tasks as a responsibility of ILS.

4.3 ILS Management Function

ILS Management is responsible for the development and performance of the ILS programme. The personnel responsible for ILS management should report directly to those responsible for programme management and should have the same level of authority as the other programme functional management groups. This ensures that the requirements of supportability engineering are treated equally in the development processes. ILS management shall:

- Define the ILS vision and objectives in a manner that each member of the ILS team has responsibility for a specific scope of work within the ILS activities,
- Identify all required ILS elements,
- Designate management for each of the ILS elements,
- Develop the ILS Plan (ILSP),
- Provide procedures for the management, development, execution, and control of the ILS programme,
- Establish methods for effective change and risk management, communication and distribution of deliverables,
- Ensure clear and adequate communication with other the programme functional management groups,
- Train the personnel that are members of the ILS team,
- Tailor the ILS processes for the programme,
- Ensure consistency in ILS terminology and nomenclature,
- Establish routine ILS process assessments and continuous improvement, and
- Monitor ILS program progress via measures and reports produced by the personnel responsible for ILS element management.

4.4 ILS Element Management Function

For each applicable ILS element personnel must be appointed to perform ILS element management.

Depending on the size and complexity of the scope of work, the responsibility for the management of the applicable ILS elements may be consolidated into a single person or distributed amongst a larger number of personnel, up to having one person assigned per ILS element. ILS element management must:

- Have responsibility and authority for the development and execution of the respective ILS elements and products,
- Identify the tasks, roles, responsibilities, and milestones for the respective ILS elements,
- Document and define the products for the respective ILS elements,
- Establish and staff the personnel required to conduct ILS element management,
- Identify the need for specific competencies, skills, and level of expertise required to address the requirements of each ILS element
- Establish the operating environment for the ILS elements which supports the ILS programme,
- Articulate how the tasks required to develop the respective ILS element and products fit into the ILS programme tasks,
- Document the respective ILS element strategy and plan in the ILSP,
- Document the process, internal and external interfaces (e.g., to improve the Product or configuration management) they are using and the key measures (e.g., design changes,

reliability) to be monitored. ILS element management must have the mindset of continuous improvement, monitor activities, and continually make course corrections along the way,

- Develop a set of measures, which are then used to monitor and report progress. These measures can include a financial report and technical measures like a maintainability or false detection rate. The selected measures depend on the programme requirements and structure, and
- Ensure close co-operation and communication with the ILS management, ILS element team leaders and other functional areas within the programme

4.5 ILS Element Subject Matter Expertise Function

For each applicable ILS element, the ILS Element Management must be supported by personnel that have ILS element expertise. Like ILS element Management, the number of personnel required to support the provision of ILS element expertise will be dependent on the size and complexity of the scope of work. Personnel with ILS element expertise may be within the projects ILS team or be resources external to the project that can be relied upon to provide support for ILS element management. ILS element subject matter expertise must:

- fulfil the subject-specific activities and ILS element requirements under the guidance of ILS element management,
- develop the assigned ILS element related products,
- document the products for the respective ILS element,
- interface between programme functional areas,
- interface between different ILS elements,
- cooperate with other ILS element experts, as applicable,
- have expertise in one or more ILS elements and implement the specific requirements in the programme related to the respective ILS elements,
- support ILS Management in programme monitoring (programme control, decision making, impact on the programme, etc.), solve specific problems and coordinate the successful integration / implementation of ILS in the programme,
- have a deep understanding of the ILS process, function and technologies.

4.6 ILS responsibilities in relation with Industry.

Through Contractual arrangements, the majority of NATO programmes/projects will make use of Industry partners to deliver the requisite capabilities. In addition to delivering the SOI, Industry will also be critical in the development and delivery of ILS. Therefore, it is critical that the ILS team and the respective Industry partners are engaged to ensure successful delivery of capability. When engaging with Industry, the ILS team must:

- Establish and ensure a clear understanding of the ILS related contractual requirements,
- Ensure clear and unequivocal communication between the Customer and Supplier on the ILS requirements, expectations and objectives,
- provide a clear description of Customer capabilities in terms of readiness, ownership costs, infrastructure, tools, skills etc.,

- Establish an agreement on the tailoring and parameters required to conduct Supportability analyses to ensure adequate and accurate contract deliverables,
- Explain, from the Customer side, the ILS team, capacity allocation, responsibility definition and decision-making mandates in the different areas of ILS,
- Ensure a clear understanding and agreement about roles and responsibilities of the stakeholders (e.g. Customer; Supplier, OEM) during the programme,
- Provide, as early as possible, information to Industry with regard to changes/ additional Customer requirements,
- Cooperate with Industry in the development of the ILS plan by defining milestones, deadlines of deliverables, establishing clear roles and agreements for approval/rejections of deliverables, dates for reviews with Industry and Customer participation, establishing clear definitions of Customer and Industry responsibilities and defining business rules,
- Ensure agreement on terms, definitions, terminologies, calculation methods and abbreviations,
- Ensure a clear and unambiguous understanding of electronic information exchange (if applicable), and
- In the case of several Customers (Nations), ensure there is a consolidated approach and that there is a single point of responsibility for providing direction.

4.7 External ILS Functions

There are a number of external stakeholders and interfaces with which the ILS team must communicate and integrate with to ensure the execution of the ILS programme is conducted in a coordinated and controlled manner. These external stakeholders and interfaces include, but are not limited to the following:

- **Customer Organization**
The customer organization consists of the end-user of the product. This may be NATO itself, the NATO Nations or the individual defence organizations to which the SOI and ILS programme will be delivered upon completion. The customer organization is critical for establishing the SOI and ILS requirements to be delivered.
- **Systems Engineering**
Responsible for the design, documentation and development of products and solutions, their implementation, integration and testing through the various stages and phases of the product life cycle. More information on Systems Engineering can be found in STANAG 4728 (as underpinned by AAP-20 and AAP-48), in ISO/IEC 15288 and in IEEE 15288-2.
- **Configuration Management and Control**
Responsible for establishing and maintaining consistency of a products performance, functional, and physical attributes with their requirements, design, and operational information throughout their life cycle. More information on Configuration Management and control can be found in STANAG 4427 (and underpinning Allied Configuration Management Publication (ACMPs), ISO 10007, SAE EIA 649C and MIL-HDBK-61B.)
- **Obsolescence Management**
Responsible for planning, identifying, assessing, and handling all risks of diminishing manufacturing sources, and material shortages in addition to technological obsolescence during the entire life cycle. This includes the identification of alternatives for obsolete items,

partial or total redesign, updates and upgrades in combination with Engineering, Configuration Management and ILS. More information on Obsolescence Management can be found in NATO standard STANAG 4597 and Diminishing Manufacturing Sources and Material Shortages (DMSMS)

- **Software Management “SM”**

The required ability to leverage effective management in terms of control and security of software assets (on-premises or in the cloud) for all life cycle stages of the product. SM is fundamental to ensure that all aspects of services during the usage phase (e.g.: failure / defect diagnostic / product configuration / technical manuals / SA database) are closely linked and manageable. More information on Software Management can be found in ISO document for SM 12207 (life cycle software management) and STANREC 4814 Ed. 1 / ISO/IEC/IEEE 12207 (System and Software Engineering – Software Life Cycle Processes)

- **Production**

Responsible for processes to manufacture and deliver products and solutions and to ensure that all support requirements are tested, validated and verified before delivery to the customer.

- **Supply Chain Management**

Responsible for the integrated management of planning, supplying, storing, transporting, and returning of materiel at the lowest cost in the amount and at the time and place it is needed. More information on Supply Chain Management can be found on the NSPA website.

- **Programme Management**

Accountable for the definition, planning and resourcing of the programme in all the stages and phases, while clearly defining input and output criteria and measurable results. The Programme manager is also accountable for the timely provision of the programme deliverables, for their quality and performance with sustainable costs

- **Risk Management**

Responsible to identify and quantify the risks for the broader Programme, their effects (e.g. poor product performance/quality, programme delays, higher costs) and their mitigation (if feasible and cost effective).

- **Data Management**

Data management is responsible for the control and dissemination of data and information. Data Management can include technical, administrative, financial, and management data and information. Data Management ensures the timely flow and recording of data and information and can also be used for historical record and auditing purposes.

- **Financial Management**

FM is integrated part of many life cycle processes and is mainly done and directed by the program planning process and the life cycle cost management. The responsibilities are identifying, assessing and handles all costs during the entire life cycle of the system as well as planning of all budgets in responsibility the program.

- **Procurement Management**

Operational Services are additional post sales services such as customer support services, training activities and maintenance services which should be considered by the countries.

- **Contract Management**

Contract management includes the supervision of contractual negotiations between client

and contractor, implementation of contracts and making changes to contracts for technical, scheduling, personnel or financial reasons.

Contract management refers to all activities within the framework of project management that deal with the development, administration, adjustment, processing and updating of all contracts as part of a project.

Responsible persons on both sides of the contractual partner for the creation, control and monitoring of the contract are named.

- **Human Resource Management**

Responsible for skill assessment, skill development and skill acquirement to satisfy the human resource requirements of programs / products throughout their life cycle.

- **Operational Services**

Operational Services are additional post sales services such as customer support services, training activities and maintenance services which should be considered by the countries.

- **Manage Research and Technology**

Processes to optimize existing or develop new products and solutions. Support works closely with R&D to ensure that all design optimizations and new developments take into account the necessary support requirements in terms of life cycle costs and service performance.

Link to STO (NATO Science and Technology Organization)

- **Testing, Evaluation and Operational research**

Employs a broad range of specialized, technology-based engineering and applied science testing, investigative services and analytical methods to support decision-making throughout all phases of an SOI life cycle. These services help to arrive at optimal or near-optimal solutions to issues such as the selection and specifications of materials and processes, maintenance rationalization and supply chain management. More information on Testing, Evaluation and Operational research can be found on the NATO Science and Technology Organization (STO) website.

- **Quality**

Responsible for determining the processes and resources required to achieve intended results and promoting a culture that pursues continuous improvement throughout its lifecycle. More information on quality can be found in NATO Standard. STANAG 4107.

- **Sales**

Sales functions are not relevant for NATO, the Nation and NATO Agencies.

- **Marketing**

Marketing functions are not relevant for NATO, the Nation and NATO Agencies.

- **Environment, Health and Safety**

EHS aims to protect the environment and maintain the health and safety of personnel and equipment through the development of safe, high quality, and environmentally friendly processes, working practices and systemic activities that prevent or reduce the risk of hazards, accidents and exposure to harmful situations and substances. Policies and legislative and regulatory requirements pertaining to EHS are promulgated by various national and international agencies, such as the Health and Safety Executive in the UK and the Environmental Protection Agency in the USA.

- **Hazardous Material Management**

Hazardous Materials Management includes the procedures, practices and activities to reduce, minimize or eliminate the quantity and toxicity of hazardous materials that are used, stored, or disposed of. Policies and legislative and regulatory requirements pertaining to Hazardous material management are promulgated by various national and international agencies, such Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) in the EU.

- **Intellectual Property**

Involves the management of intellectual property (IP) rights, including inventions (whether patentable or not), patents, patent applications, registered designs and applications thereof, copyright material including computer software, technical information and know-how. The management of IP ensures that all requisite information is available for use within programmes when required, while not infringing on the rights of the IP owners.

- **Controlled Goods**

Ensures the regulation and control of including components and technology (for example, blueprints and technical specifications in paper or electronic format), with strategic significance or national security implications, regardless of where they are manufactured. Such items may include military items, dual-use items (items with both civil and military uses), firearms, items that can be used for torture or capital punishment and goods subject to trade sanctions. Policies and regulatory requirements pertaining to Controlled Goods management include the United Nations Arms Trade Treaty (ATT) and the United States International Traffic in Arms Regulations (ITAR).

- **Cyber Security**

The creation of programme-related information security concepts (InfoSichhK Proj) is a fundamental part of all defence projects. Digitization and the networking of information and communication systems are increasing. Therefore, the implementation of the necessary technical and organizational measures as well as the confidentiality, availability and integrity of the information and data are of essential importance. In the ILS process, these measures must be considered at an early stage and adapted to changes iteratively.

- **Policy Management**

The process of creating, implementing, updating, and maintaining an organization's policies, procedures, standards and business process frameworks to support successful materiel and logistics cooperation with international allies and partners. Policy management enables and supports the delivery and continuous improvement of programs, initiatives, and services through the provision of timely and accurate guidance.

- **Disposal Management**

Responsible for removing a system, system elements or enabling systems from the operational environment with the intent to end its existence in accordance with all legal and regulatory requirements to safety, security, and the environment.

5 SYSTEM SUSTAINMENT FOR SYSTEM LIFE CYCLE STAGES AND PROCESSES

5.1 Introduction

In accordance with defined structure of ALP-10, Chapter 5 applies the theoretical information defined in the previous chapters to real-life scenarios/sustainment environment. Chapter 5 describes the desired schedule for the sustainment activities in relation to the SLCM stages and processes.

Necessary activities, relations, timing, inputs, and expected outputs are defined in the context of the life cycle stages. The level of detail is kept between administrative and practitioner level to establish interoperability while providing freedom for different standardization and implementation needs of countries, NATO organizations, agencies, and industry.

Chapter 5 aims to integrate total NATO Integrated Life Cycle Support scope during the System of Interest (SOI) life cycle, defined by:

- The Life Cycle Stages of NATO Life Cycle Model, (AAP-20)
- NATO System Life Cycle Management Processes, (AAP-48)
- Integrated Life Cycle Support Elements, (this publication, standards and handbooks)
- Maturity of the ILS processes adaption and/or maturity for business models,
- Programme Management and Roles,
- Systems Engineering activities, (ISO 15288, SEBoK, IEEE 15288-2, etc)
- Usage of ILS Specification and Standards.

The Life Cycle stages of a SOI (see AAP-20) are typically:

- **Pre-Concept** – Identify and document stakeholder requirements and risk areas for capability delivery
- **Concept** – develop preliminary system requirements, use cases, and a feasible design solution based on Pre-Concept results
- **Development** – develop a SOI that meets or exceeds the stated requirements and can be produced, tested, evaluated, operated, supported, and retired
- **Production** – manufacture and test the SOI and produce related support and enabling systems as needed.
- **Utilization** – operate the product at the intended operational sites, including modification and upgrades (in parallel with the Support stage)
- **Support** – provide logistics, maintenance, and support services that enable continued SOI operation and sustainable service (in parallel with the Utilization stage)
- **Retirement** – demilitarize and dispose of the SOI at the end of its useful life and remove related operational and support services

A major aspect during the Concepts and Development stages is to design supportability into the system that makes the SOI operable, supportable, and sustainable for the whole life cycle.

After the SOI is produced and has been transferred to the user, the user assumes ownership and operation and support begins with the resources (materials tools, skills) and instructions (Manuals, Supportability Data, Training etc.) defined and delivered in the Concept and Development stages.

The SOI is fielded and starts fulfilling the needs identified during the concept, development, and production stages. As the SOI operates in its intended environment, its capability to fulfil the needs is continually evaluated.

Sustainment requirements include disposal of SOI that are no longer serviceable and the disposal of maintenance and support systems.

In the utilization and support stages a continuous evaluation for new needs as they are identified, is addressed.

Based on the described integration role and philosophy in Chapter 4, Chapter 5 is composed of:

- Create detailed guidance to ILS discipline, (processes and procedures) that can be used to develop national business rules.
- Ensure/facilitate NATO interoperability and minimum requirements for ILS aspects
 - Amongst the NATO nations
 - within NATO and NATO Agencies
 - Amongst NATO / NATO Nations and Industries and
 - Amongst industries
- Provide interaction and integrated work environment for System Engineering and System Sustainment Engineering covering:
 - all system types independently from their complexity, ranging from single Systems (composed of a tree of sub-SOI) to complex Systems of Systems (composed of trees of many SOI),
 - Technology changes and their effects on systems and their sustainment.
- Create Integrated Processes and Information flows,
- Ensure communication and the interactions between all stakeholders (roles) along the life cycle / processes,
- Assessment of system maturity with respect to ILS processes as well as to support models/support contract models.
- Consider alternative support models (PBL, CBL, OBC, etc.),
- Create plug and play sustainment models by describing basic rules to adhere
- Describe what should be done – but not how it should be done
- Consider different standardization documents and create harmonization among them.
- Describe the opportunities and advantages of using standardized data,
- Create connection between potential technologies and innovation.

5.2 Use of Standards and Specifications

Today, there are numerous standards and specifications, in use within the NATO nations, in NATO, as well as among the nations and industry.

Standards and specifications are developed by IEC, ISO, IEEE, EIA, SAE and many other industry organizations, as well as ASD organization and others for different purposes:

- Standards are meant to provide a solid set of processes, mathematical models, methodologies and procedures to generate analyses and data

- The standards have solid bases in physics, mathematics, engineering and other technical and non-technical disciplines that make their use applicable and not debatable every time they are called upon.
- Specifications are meant to provide state-of-the-art shared methodologies to collect, organize, manage, update and distribute data and information, following commonly defined schemas, templates and tools.

Also, frameworks and libraries exist, providing best practices for specific activities applicable to a range of technologies and scenarios but their use shall be made in conjunction (and subordinate) to the Standards and Specifications that use a more rigorous and general approach.

Standards exist for many different areas of expertise/specialty disciplines and many apply to Systems, their design and implementation, their performance, their features and their services.

All data and information generated by the different specialty disciplines need to be collected, analysed, managed under configuration control, extracted and manipulated for reporting and viewing and, of course, stored and distributed in a standardized manner to facilitate exchange and updating.

When considering which standards to use, it is important to keep an eye to the future. The year in which ALP-10 Edition D is published is witness to many Digital technologies emerging/evolving. Now is the time to assess how your organizations wish to implement these emergent and present-day digital opportunities. The Digital Thread is the most important of all these as it provides significant opportunities for Supportability Analysis and management of the information related to Supportability. The linkage between Engineering Designs, Supportability Analysis, Technical Publications and Training Development can be significantly enhanced through the use of Digital Thread practices. The simple ability to pull data for all these activities from a single authoritative source of truth, greatly enhances all these developments and reduces significant rework and workforce requirements. For greater understanding of the Digital Thread and other digital opportunities, please refer to Annex 3 Para 1.

ALP-10 aims to stimulate, embrace and improve the use of both standards and specifications that can make the work of Supportability Engineers efficient and effective, in conjunction with consolidated standardization of methods and data.

In addition to the standards that will be listed below, associated to specific stages and activities of the Systems lifecycles, the use of SAE and ASD/AIA specifications is introduced and explained.

The use of SAE and ASD/AIA specifications meets the need for standardization of supportability analysis, data collection, management, presentation and exchange, implementing essentially interoperability, currently missing due to the different specifications in use in the NATO nations and partner nations.

Thus, one objective of ALP-10, as described in the following sub-chapters, is to propose a thorough strategy for the utilization of coherent specifications, whenever possible, and at the same time use known standards and handbooks for whatever concerns data generation.

5.2.1 Map

The following table shows specifications/standards that shall be used during the Life Cycle of a SOI. This covers many different aspects of Integrated Life Cycle Support Elements, Processes, Roles/Stakeholders and the information about Data Definitions and Data Exchange possibilities. Guidance for the ILS Plan is described at Annex 1 Para 1):

Figure 35: Coverage map of Standards and Specifications with Project Stages

	Specification/Standard	Scope	Life Cycle Stage Coverage						
			Pre-Concept	Concept	Development	Production	Utilization	Support	Retirement
INTERNATIONAL STANDARDS	IEC 60300 Series	Dependability	X	X	X	X	X	X	
	IEC 60706 Series	Maintainability of Equipment	X	X	X	X	X	X	
	IEC 60812	Failure Modes and effects analysis (FMEA and FMECA)		X	X	X	X	X	
	IEC 62550	Spare Parts provisioning			X	X	X	X	
	ISO 10007 ³	Configuration Management		X	X	X	X	X	X
	EIA 649C	Configuration Management Standard		X	X	X	X	X	X
	ISO 9001	Quality Assurance	X	X	X	X	X	X	X
	ISO 62402	Obsolescence Management		X	X	X	X	X	X
	SAE TD-STD-0017	Product Support Analysis	X	X	X	a ⁶	X	X	X
	SAE GEIA-STD 0007	Logistics Product Data	X	X	X	a ⁶	X	X	X
	SAE AS1390	Level of Repair Analysis	X	X	X	X	X	X	
	PLCS (ISO 10303-239.3)	Product Life Cycle Support		X	X	X	X	X	X
	ISO/IEC/IEEE 10303-242	Engineering Data		X	X	X	X	X	X
	IEEE 15288-2	Standard for Technical Reviews and Audits on Defense Programmes		X	X	X	X		
	ISO/IEC/IEEE 15288	Systems Engineering – System Life Cycle Processes	AAP-20 ⁵	X	X	X	X	X	X
ASD Suite	S1000D	Technical Documentation			X	X	X	X	X
	S2000M	Material Management		X	X	X	X	X	X
	S3000L	(Logistics) Support Analysis	X	X	X	a ⁶	X	X	X
	S4000P	Preventive Maintenance	X	X	X	X	X	X	X
	S5000F	Operational/Maintenance Data Feedback					X	X	X
	S6000T	Training Analysis and Design			X	X	X	X	X
	SX000i ¹	ILS Process	X	X	X	X ²	X	X	X
MIL/NATO STANDARDS	STANREC 4174 (and ADMPs)	Allied Dependability Publications	X	X	X	a ⁶	X	X	
	STANAG 4427 (and ACMPs)	Allied Configuration Management Publications	X	X	X	X	X	X	X
	STANAG 4597	Obsolescence Management		X	X	X	X	X	X
	MIL-STD-1388	Logistics Support Analysis/Data	X	X	X	a ⁶	X	X	X
	DEF-STAN 00-60 /00-600	Integrated Logistic Support	X	X	X	a ⁶	X	X	X
	MIL-STD-882E	Systems Safety ⁴		X	X	X	X	X	X
MIL/NATO HDBKS	MIL-HDBK-502A	Product Support Analysis	X	X	X	X	X	X	X
	MIL-HDBK-61B	Configuration Management	X	X	X	X	X	X	X
	MIL-HDBK 1390	Level of Repair Analysis	X	X	X	X	X	X	

X = covered

a = (please pay) attention

¹ ASD/AIA SX000i does not directly adhere to the life cycle stages of 15288² ALP-10 - not covered by the various specification nor by the ASD/AIA SX000i³ Configuration Data may be delivered with 10303-241 - for ALP-10 - ACMPs⁴ Systems Safety - in accordance with MIL-STD-882E / interrelation to ADMPS⁵ The pre-concept stage is defined in the NATO documents AAP-20 / AAP-48⁶ Supportability Analysis does not specifically address production - but during production it may be necessary to undertake supportability analysis if information feedback from Production, results in changes in configuration

Depending on the size and complexity of the project/ program and on the nature of the SOI, the use of standards and specifications shall be tailored on a case-by-case basis.

From Figure 35 it is evident that only combinations of different specifications and standards support the complete Life Cycle and the associated management tasks. Some specifications and standards are high-level documents that describe processes and roles and do not give details about data and information generation, management and exchange, while others provide detailed information.

It is important, during the early stages of a project, to select the right combination of standards and specifications to cover the entire Life Cycle. These should encompass as many of the Integrated Life Cycle Support Elements as feasible, and to implement the: ILS Processes/Business models, Program Management and Roles, Systems Engineering activities and Sustainment Engineering.

Section 5.3 will dive deeper into allocation of standards and specifications to the lifecycle stages and their use, but one should note that it is necessary to decide some common basic rules for

interrelated specifications; (e.g. to define a common system breakdown methodology that can be used through all processes and data exchanges for interoperability). As well, a common approach/method spanning across processes and specifications/standards to implement these processes and the necessary information exchange, is necessary for other management tasks, like Configuration Management, Risk Management, System Safety, Obsolescence Management, etc.

5.2.2 Processes and Standards

A selection of the S-Series of Specifications may cover the whole life cycle of a SOI with respect to the main ILS aspects. This NATO Guidance tries to facilitate the use of the S-Series specifications, and using other specifications for certain processes and stages, if some basic requirements are met.

System Safety and Risk Management are disciplines that are not yet covered by S-Series specifications and the right standards must be carefully selected to avoid information gaps along the exchange of data, reports, decisions, and project / process management along the life cycle stages.

Another aspect to be considered is the use of the versions of the specifications and how these may map/fit together. See Figure 36: Relationship between Processes and Standards.

For standards, unless linked to changing laws and regulations (e.g. System Safety or E/M limits etc.), any recent version shall be considered applicable. Standards remain valid for years and generally introduce minor modifications to address errors, omissions or modified/clearer interpretations between versions.

Sometimes, major releases of standards include new sections/chapters, covering emerging topics or new trends but, in all cases, previous versions still shall apply, under the condition that the version is clearly stated if and when necessary.

For ASD/AIA specifications, the approach shall be different.

- The ASD/AIA specifications have different development histories and alignment between the specifications has not always been ensured on all levels. The issues this creates for the usage of the specifications can be mitigated by the creation of the Guidance Documents at the early stages of a development and implement configuration management for the data.
- Specifications define essential technical requirements, such as for interoperability among projects, programmes, and nations.

In general, ASD/AIA specifications introduce minor or major changes (depending on the issue) in the data structure, formats and exchange therefore it shall be clearly specified what issue/release shall be used in each programme and such issue shall be “aligned” among all the required and applicable ASD/AIA specifications.

The relation between ASD/AIA specifications and international standards is evident and will be better explained in section 5.3; ASD/AIA specifications, as already said, are for data collection, management and distribution and in most of the cases these data are generated in accordance with specific engineering processes and methodologies defined in the international standards.

However, it shall be noted that Supportability data fully rely on a pre-defined and agreed data structure (e.g. a Supportability Breakdown of the SOI), where multiple options are available based on the SOI complexity and project approach.

In addition, data structures of the SOI shall be fully aligned with Configuration Management baselines therefore a clear link between the ALP-10 and the STANAG 4427 exists and shall lead to interchangeable data between CMDDBs (Configuration Management Databases - typical of CM tools) and ILS applications (typical of ASD/AIA specifications). Refer to para 5.4.

The list of topics covered by the ASD/AIA series is provided in section 5.2 above. In each topic, multiple elements of the ILS domain (including safety) shall be analysed, and data generated in accordance with known standards. If the ASD/AIA specifications were adopted, the ideas below describe each specification and the relationship with other standards. The alternative SAE standards are included. Section 5.3 describes the analysis activities for each Life Cycle Stage and their integration with the Systems Engineering design review process section 5.3.

- SX000i – International specification for Integrated Product Support (IPS), providing guidance to the IPS processes and relationships among the other ASD/AIA Specifications. It is linked to the following:
 - IEC 60300-3-12 – Dependability Management – Part 3-12 – Application Guide – Integrated Logistics Support
 - ISO 10303-239 – Standard for Product data representation and exchange. Product Life Cycle Support (PLCS)
 - DEF-STAN 00-600 – Integrated Logistics Support
 - MIL-HDBK-502A – Product Support Analysis Handbook
 - Defence Acquisition Guidebook
- S1000D – International Specification for Technical Publications using a Common Source Database (CSDb), providing guidance to the development, management and distribution of Interactive Electronic Technical Publications. The data, part of the IETPs, are collected from SA activities (MTA, OTA etc.) and Product (engineering) documentation and interface with the SA Database (S3000L) and Material Database (S2000M). Additional applicable standards are:
 - ASME Y14.44-2008 – Reference Designations for Electrical and Electronics Parts and Equipment
 - STE100 – Simplified Technical English
 - MIL-STD-38784B – US Department of Defense standard practice: General style and format requirements for technical manuals
- S2000M – International specification for Material Management, providing a structured approach for provisioning data requirements, collection and management. The provisioning data are generated through:
 - IEC 62550 – Spare Parts Provisioning
 - RM-4720-PR – A system approach to base stockage of recoverable items
 - RM-5078-PR – A multi-echelon technique for recoverable items control
 - AR 700-82, OPNAVINST 4410.2A, MCO 4400.120: three identities for the Joint Regulation Governing the Use and Application of Uniform Source Maintenance and Recoverability (SMR) Codes
- S3000L – International procedure Specification for Logistics Support Analysis (LSA), providing the definition of processes, general requirements and related information exchange governing the performance of SA during the life cycle of the SOI. Detailed SA processes (e.g. Design for supportability) and data generation (SA Breakdown Structure – SBS or Product breakdown Structure – PBS, Level of Repair, RAMT models/ allocations/ predictions, FMECA, RCM etc.) can be found in:
 - SAE TA-STD-0017 – Product Support Analysis
 - MIL-HDBK-502A – Product Support Analysis Handbook
 - MIL-HDBK-338B – Electronic Reliability Design

- MIL-HDBK-470 – Designing and developing maintainable products and systems
- IEC 61703 – Mathematical expressions for reliability, availability, maintainability and maintenance support terms
- SAE AS1390A – Level of Repair Analysis
- MIL-HDBK-1390 – Level of Repair Analysis Handbook
- IEC 60300 series – Dependability Management (various parts)
- ISO 10302-239 – Product Life Cycle Support (PLCS)
- RADC-TR-77-287 – A Redundancy Notebook
- IEC 60812 – Failure Modes and Effects Analysis (FMEA and FMECA)
- MIL-HDBK-2165 – Testability handbook for systems and equipment
- IEC 60300-3-11 – Dependability Management – Part 3-11 – Application Guide – Reliability Centered Maintenance (RCM)
- IEC 62402 – Obsolescence Management
- S4000P – International specification for developing and continuously improving preventive maintenance. The source data are generated in the SA process and eventually refined through the interaction with the S5000F. S5000F – International procedure specifications for in-service data feedback. Detailed processes for data collection and management can be found in:
 - ISO 10302-239 – Product Life Cycle Support (PLCS)
 - IEC 60300-3-2 – Dependability Management – Part 3-2 – Application Guide – Collection of dependability data from the field
 - IEC 60300-3-11 – Dependability Management – Part 3-11 – Application Guide – Reliability Centered Maintenance (RCM)
- S5000F – International Specification for in-service data feedback. The source data are generated in the SA process initially, and after introduction, data is provided by in-service systems for: Operating Hours, Inventory transactions, and maintenance work orders at all levels of maintenance.
 - MIL-HDBK-2155 – Failure Reporting Analysis and Corrective Actions Sheet (FRACAS)
- S6000T – International Specification for Training Analysis and Design. The source data are generated in the SA process and TNA (see references below), included in the IETPs (S1000D) and eventually refined through the interaction with the S5000F. Applicable standards are:
 - Bi-SC 075-007 – Education and Individual Training Directive (E&ITD) 075-007.
 - Bi-SC Directive 075-003, Collective Training and Exercise Directive
 - SCORM – Shareable Contents Object Reference Model

As a minimum the Standards and the Specifications to be used shall cover:

- Systems Engineering, integrating all the other disciplines
- Supportability Analysis (including Workforce and Personnel, Support and Test Equipment)
- RAMT (modelling, RBDs, -allocation, -prediction, -assessment, FMECA, ESS etc.)
- Reliability Development Growth/Testing, Environmental Stress Screening as applicable
- Material Management, Material Supply (including modelling and calculations for spares quantity optimisation and the different types of spares lists required by customers)
- Obsolescence Management
- System Safety
- Technical Information
- Training Analysis and Design

- IT System Support (e.g. for Training, Manuals, RAMT, SA Dataset and software, modelling and simulation, calculations etc.)
- Facilities and Infrastructure (e.g. workshops, test environments, technical buildings, warehouses, systems enablers like UPSs, HVACs, Power Generation and Distribution, etc.)
- Configuration Management
- Risk Management
- Quality Management

The selection of the standards and specifications shall be accompanied by a set of Guidance Documents that exactly describe the use/tailoring of each specification/standard and the processes, interoperability criteria, base rules, roles/stakeholders and data exchange.

In order to orchestrate the overall process-/information flow, there must be an ILS Strategy / ILS Plan (see Annex 1) that handles overall / thorough information / process flow on top of the necessary disciplines and their related / selected specifications and standards.

Interoperability between different specifications/standards is not easily defined. The different specifications have all been written at different points in time and only for the one purpose they are planned for. The S-Series of specifications each cover one specific topic, but with the ambition to make them interoperable.

The interoperability shall be planned interdisciplinary, combining the knowledge, and adjusting the needs of engineering specialties, support analysis, material management, Technical Information, training, in-service support/sustainment. This is necessary, to setup an environment, that facilitates cooperation, exchange, feedback and system / support optimization along the total lifetime of the system.

Figure 36, derived from the ASD/AIA SX000i Specification, shows the interrelationships between analytical processes, the workflow interactions, and the standards and specifications that can be used to achieve a coherent analytical approach and data set for life cycle support.

- The specifications S2000M and S1000D have a long history of development with many different versions. Both shall use the same system breakdown and therefore work closely together (attention must be given to combine the correct version of each specification to the other).
- S3000L, S4000P, S6000T and S5000F are also closely related and work on the same information base. These specifications have been developed later than S1000D and S2000M and are able to use the same product breakdown as selected for S2000M and S1000D. This allows a continuous flow of information from the SA through material management to Technical Information and training.

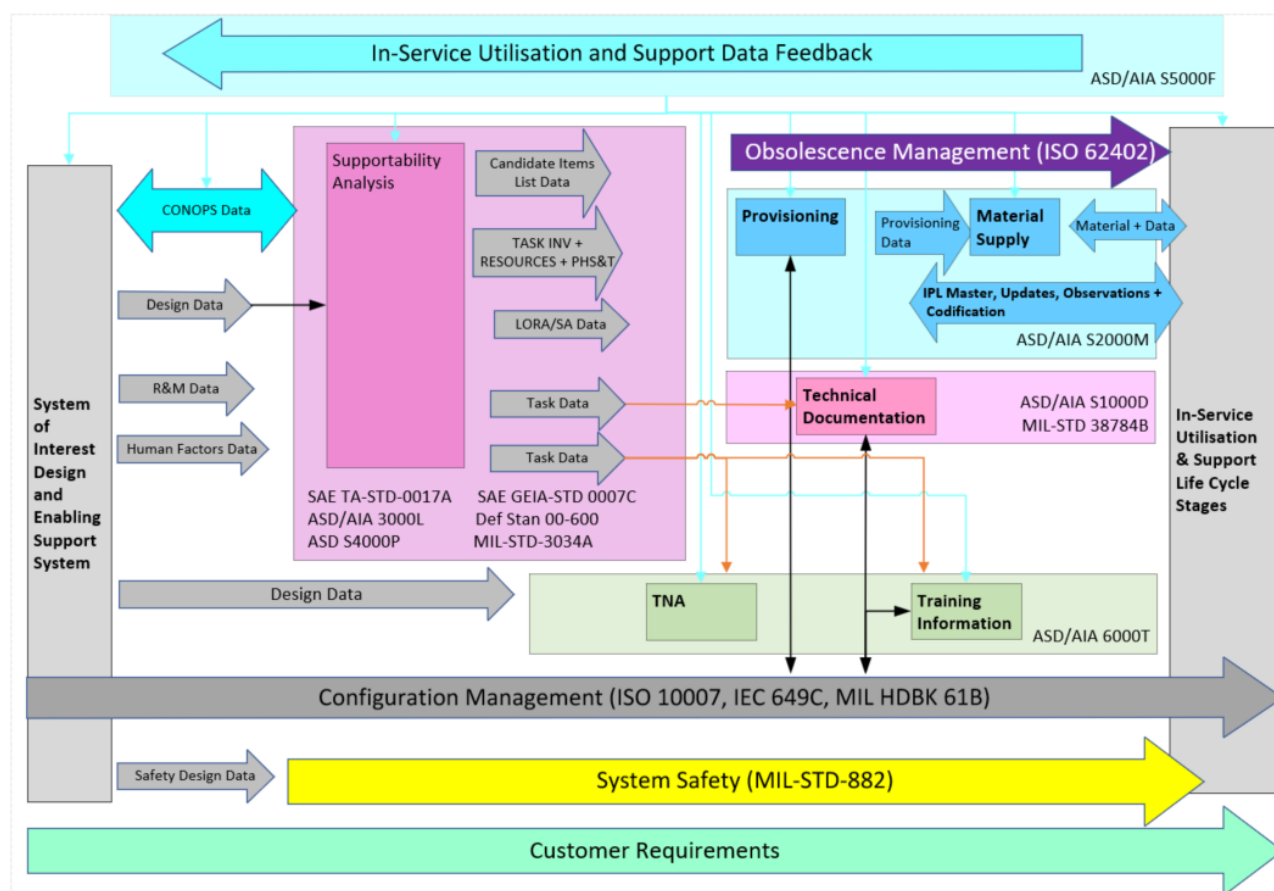
It is absolutely necessary, that this “common breakdown” has to be derived / coordinated with the respective system breakdown levels in engineering for the particular configuration. In addition, the way how major and minor configuration changes will be handled along the respective S-Series specifications, as well as the applicability of information has to be planned, and set up in the very beginning. That demands an interdisciplinary approach, documented in the ILS plan and concept, broken down and documented into the various business rules / guidance documents, as described above.

S1000D provides the opportunity to handle training information based on the Technical Information as planned in the Training Analysis and Design specification S6000T.

For the In-Service stage feedback can be collected and processed using the S5000F specification. This allows continuous update/correction of the information (analysis, material management, Technical Information, training, etc.) during the Utilization and Support stages of a SOI. In addition, in-service maintenance optimization (ISMO) is possible, if the respective information will be analysed, as described in S4000P with the corrective maintenance data of supportability analysis. The optimization will only be realized, if the results of these analyses will be integrated in the design of the System as necessary.

The guidelines provided by ASD/AIA SX000i can help to establish a standardized approach to product life cycle data and processes using the above-mentioned specifications for the ILS Strategy/ Plan, as well as for the respective business rules / guidance documents.

Figure 36: Relationship between Processes and Standards



While S3000L and S4000P are the latest specifications of the S-Series suite, for the SA process other specifications are in use:

- SAE TA-STD-0017A
- SAE AS1390
- SAE GEIA-STD-0007
- SAE TA-HB-0007-1
- SAE GEIA-HB-0007
- MIL-HDBK-502A

- DEF-STAN 00-60/00-600
- MIL-STD 1388

These specifications can be used in combination with the other-S-Series specifications as shown in Figure 36 although the data formats and structures and the breakdowns might be difficult to harmonise with the ASD/AIA S-Series suite.

MIL-STD-1388 was developed in 1973 by the U.S. Department of Defense (DoD) and was / is used in many programmes all over the world. It has a disciplined approach to define the required operational support for a system (SA) and other associated Integrated Life Cycle Support objectives (management tasks) during the acquisition design and development stages. The standard was cancelled in 1996 but is still used as best practice and relies on a series of other old Military Standards and Handbooks that have been mostly re-used and transposed into international standards and specification that represent the state of the art for the ILS discipline and elements.

DEF-STAN 00-60 / DEF-STAN 00-600 are standards developed by the U.K. Ministry of Defence that replaced the MIL-STD-1388 in 1998. These specifications have been used in the UK and in the Australian Department of Defence and others. They use a similar approach to the MIL-STD-1388-2B and add aspects of Material Management (S2000M) and Technical Information (S1000D) to the data model. The analysis is almost identical to 1388-1A. These DEF-STAN are available in various versions.

SAE-TA-STD-0017A Product Support Analysis was derived from the Logistics Support Analysis (LSA) tasks as previously defined in 1388-1A and updated them into the civilian standard. This analysis approach develops the content of Mil Std 1388-1A and adds Obsolescence Management, and Disposal Management. The 1388 Tasks become activities, but the user of 1388 can easily understand this standard. To better understand how to implement SAE TA-STD-0017A, MIL-HDBK-502A was developed as implementation guidance for Defence systems.

SAE-GEIA-STD-0007 Logistics Product Data was first published 2007 by GEIA (Government Electronics and Information Technology Association) which was later purchased by SAE International as a standard along with two companion handbooks. SAE GEIA-HB-0007 and SAE GEIA-HB-0007-1 were published as guidance on how to implement SAE GEIA-STD-0007. It is based on the MIL-STD-1388 integrated data model but uses the XML format for data exchange (like S3000L). This approach makes it easier for users of the MIL-STD-1388-2B to convert existing SA Records to a more modern exchange framework. This standard has made several improvements over recent revisions to include alignments with S1000D and ISO 10303 AP239 PLCS to better enhance data exchanges between compatible systems.

An important work is to combine the different processes and information of the different disciplines with the approach given by the S-Series and other standards. Define the:

- Objectives of the processes
- Requirements
- Validation method of the requirements
- Processes and deliverables
- Data elements required to support the SOI, which are tailored in the Guidance Document (GD).

For this reason a document for each standard/specification (business rules / guidance document) shall be written to cover at least:

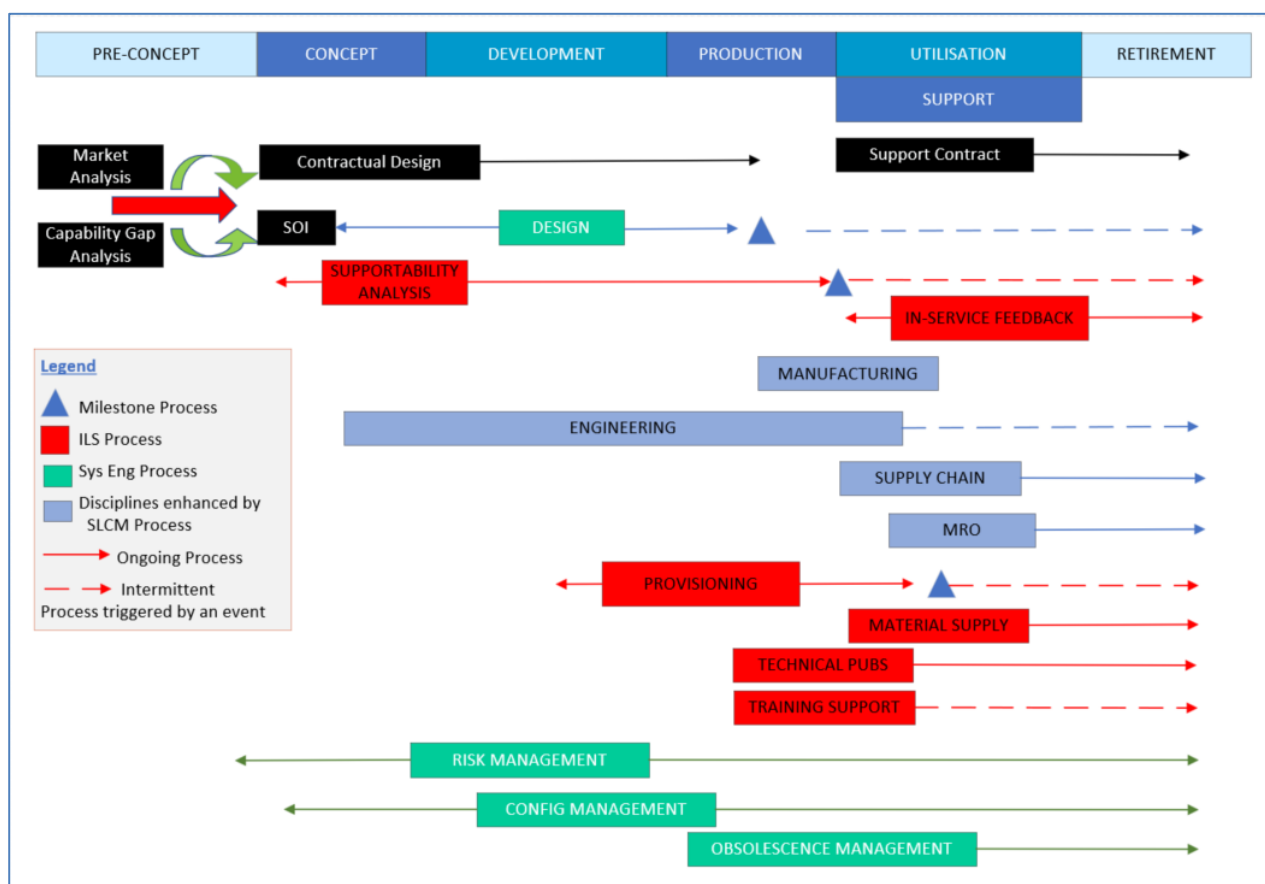
- Tailoring of the specification: which options/processes/data are needed
- Rules for data exchange/storage
- Roles and Responsibilities
- Interoperability with other ILS disciplines/domains
- Engineering activities and Sustainment

5.3 Life Cycle Stages

SLCM provides a generic concept for stages and processes, and it is necessary to tailor the model and the processes to the specific needs of the individual programmes and projects.

For maximum effectiveness, ALP-10 shall be used in conjunction with AAP-20. AAP-20 provides guidance for the management of a programme throughout the system life cycle and addresses, in detail, the management effort required to provide through-life support to a materiel solution along the life cycle stages (see 3.2 and 3.5). While AAP-48 does not tailor the NATO SLCM, users of AAP-48 are responsible for tailoring the SLCM of AAP-20 for the programme and aligning the processes, activities and tasks to that model (see 3.3, 3.4 and 3.6). See Figure 37.

Figure 37: System Life Cycle Management – Life Cycle Stages – Processes



AAP-20 and AAP-48 are intended to support and complement national acquisition policies and not replace them. One of the central concepts of these NATO standards is the contrast of Life Cycle Stages to Life Cycle Phases.

System Life Cycle Management (SLCM) is a methodology that combines all necessary processes to ensure the reliability and economic availability of systems throughout their entire life cycle. This is to be done, while also optimising current and future support of systems by setting up and implementing cost effective support, and facilitating cross organizational information flow.

System Life Cycle Management therefore orchestrates system sustainment from a business point of view, and its results are inputs to other organizational processes, like Engineering, Production, Service & Support, etc.

SLCM is meant to deliver a higher system quality, performance, effectiveness and sustainability by designing supportability into the system and (re-)using and exchange accurate and timely information with all stakeholders. By implementing a process of integrated, information management that establishes a resilient, thorough, and optimized distribution of data throughout the whole life cycle of the system, close cooperation with other business areas like PLM, ERP, Configuration Management, etc can be enabled. The information base and exchange with the other business areas (within industry, cross-industry as well as within national organizations and/or NATO organizations and Agencies) is necessary to facilitate technical discussions as well as provide a valuable business-related information source to assess risks and derive new operational capabilities.

The life cycle stages concept is meant to be like stairs. In each stage there are processes (some in parallel) in a certain phase of itself. Stage by stage these processes evolve and interact. If for example In-Service Information is raised and transported back, this means to jump down the stairs from the In-Service stage to the development stage into the in-service maintenance optimization which is part of life-long-SA. From there on, results of these evaluations and analysis may have implications to system design, engineering and the follow-on processes in the ILS field. So, the respective process-parts effected by this change shall interact and will be continued as described in AAP-48 and in this publication.

The use of ALP-10, ILS in NATO, will lead to a more effective and efficient provision of capabilities.

In addition to AAP-20 and AAP-48, it is useful and recommended to use guidance from international standards/specifications for specific domains and activities as described in para 5.2).

- For the domain/activity of Integrated Life Cycle Support (ILS) – including Supportability Analysis (SA) – one from several specifications can be used that fits best to a planned project, either due to the given requirements or interests of stakeholders or best practices achieved by using them in earlier projects:
 - ASD/AIA S3000L
 - SAE TA-STD-0017
 - SAE GEIA-STD-0007
 - DEF-STAN 00-60/ 00-600

Together with ILS all other processes/activities must be considered and may use specific specifications/standards (see table in Figure 35):

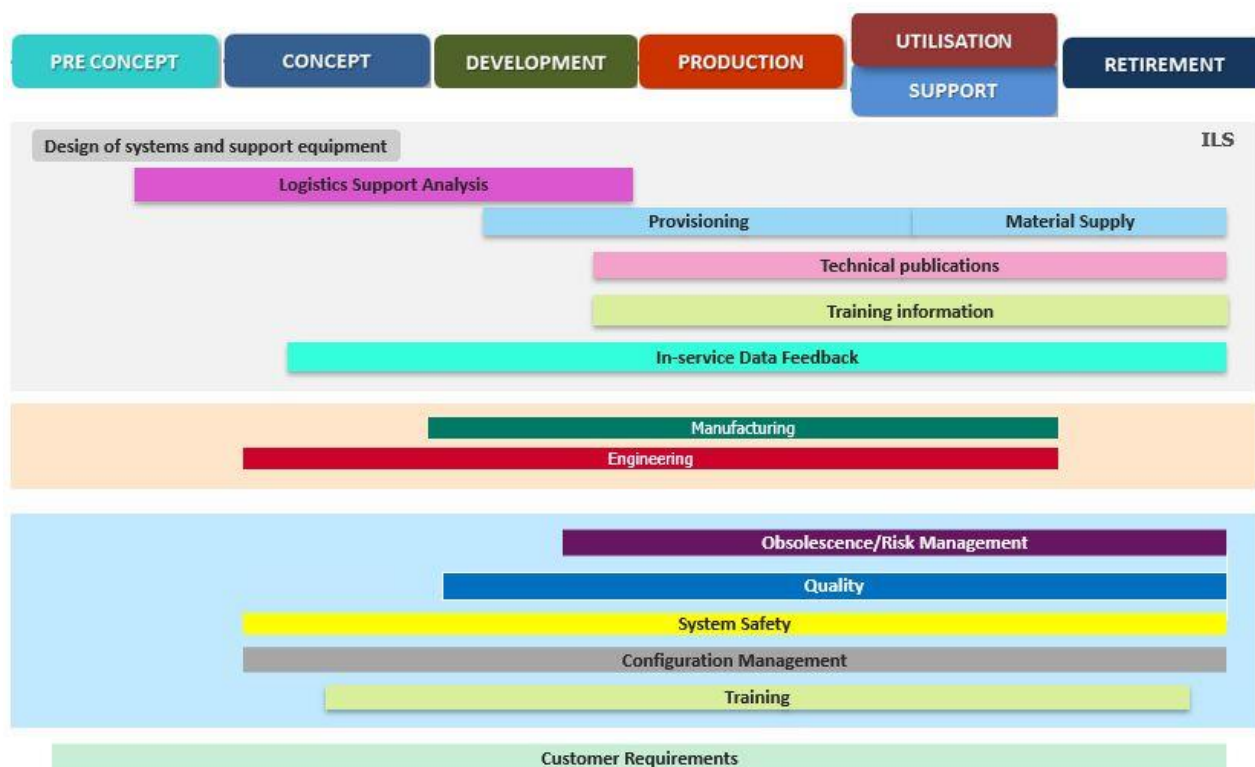
- Systems Engineering
- Material Management

- Technical Information
- Training Analysis and Design
- Configuration Management
- Risk Management
- Obsolescence Management
- System Safety
- Environmental Management
- Quality Management

When the set of specifications has been selected a common breakdown, flow of information for all processes, tasks and guidelines must be implemented. See Figure 38.

For each of the life cycle stages the active ILS elements are described with standards and processes. These will occur in the sequence they become active in a programme rather than in the order shown in Table 2.

Figure 38: Life Cycle Stages and Major Activities



5.3.1 Pre-Concept Stage

The Pre-Concept stage is the first in a series of steps for a project to introduce a new System of Interest with Capability Gap analysis and to develop the User Requirements.

The contribution by ILS elements active in each stage will be described, as will the processes where elements interact within and external to the ILS team. The correlation with the AAP-48 processes active in each stage will also be related to the ILS Elements and content.

The initial activities undertaken in this stage are conceptual, and requirements start to form as the concepts crystallise towards possible physical solutions and the various alternatives.

This stage explores alternatives but does not decide which is taken forwards.

The activities in this stage are undertaken by the Customer or Buyer of the SOI.

5.3.1.1 Requirements and Requirements Capture

The User Requirements Document (URD) and Key User Requirements, Supportability Objectives, System Requirements Document (SRD), Support Concept for the SOI are important in this stage.

The Requirements are the responsibility of the Customer/ Buyer

ILS and Supportability input to URD (non-functional requirements) is important and covers:

- Operability
- Interoperability
- System Safety
- Security
- Environment
- Support
- Engineering Standards.

Supportability requirements in URD/SRD are to be recorded in a Requirements Database. Refer to para 2.2.2.3

The System Requirements Document (SRD) is derived from the URD.

- The SRD defines what the SOI must do to achieve the URD.
- The SRD must include a detailed support strategy in response to the URD support requirements.
- The SRD must justify the Supportability Objectives

Support Maturity Levels can be monitored during the project stages.

- SML1 for URD
- SML2 for SRD

The ConOps is developed to describe a range of operation scenarios for the SOI.

5.3.1.2 ILS Management

5.3.1.2.1 ILS Strategy

Strategy will consider the level of development required from:

- Full Developmental Item

- Non-Developmental Item
- Military Off the Shelf (MOTS)
- Commercial off the Shelf (COTS)

The ILS Strategy must document the ILS and Supportability Objectives, the type of equipment, the specifications it must meet, and how it is to be supported. The ILS Strategy is the responsibility of the Customer/ Buyer

In conjunction with the ILS Strategy, the Support Concept must be developed to highlight the balance between support objectives and through life cost of achieving them.

The ILS Strategy must also define the standards to be used and how data will be shared and reused across the ILS elements . If ITIL4 is also used for IT based programmes, the strategy must state how this will be integrated.

Implement programme stage names to be used:

- NATO: Preconcept, Concept, Development, Production, Utilisation, Support, to Retirement
- UK: CADMID:
 - Concept, Assessment, Demonstration, Manufacture, In-Service, Disposal
- USA: MSA, TD, EMD, PD, O&S:
 - Material Solution Analysis, Technology Development, Engineering Manufacturing and Development, Production and Deployment, Operations and Support

The ILS Plan content will be determined by the ILS Strategy as will the activities that follow.

5.3.1.2.2 ILS Plan

The ILS Plan is the Customer view of the ILS requirements. The ILS Plan relates to the Systems Engineering Management Plan (SEMP), and the design reviews of ISO 15288. In a contractual arrangement, bidding contractors may be required to create Integrated Support Plans (ISP) that respond to each ILS requirement.

The ILS Plan will include an organisation chart of the groups contributing to the customer ILS Team. The contract may request that the responding ISP includes an organisation chart and provides a Work Breakdown Structure showing who undertakes the activities and when on behalf of the contractor.

The ILS Plan will detail what will be delivered to the Customer and include the acceptance criteria for customer deliveries.

The ILS Plan will describe the ILS approach to be applied throughout life and the data processes used in introduction are to be used for modifications and upgrades.

The ILS Plan will include in-service feedback concepts for how usage, maintenance and inventory transaction data will be captured and analysed. It will describe how reliability and maintainability, and repair will be monitored through life.

The ILS Plan will contain supportability goals, support strategy, Supportability Analysis (SA) strategy and all associated element plans. For the Contractor, the ILSP guides their responding Integrated Support Plan (ISP), subordinate work and logistics support system.

They shall respond, in part or in whole, depending on contracted requirements. Refer to 2.2.1.3 and Annex 1, Paragraph 1

5.3.1.2.3 *Supportability Analysis Plan*

Create an SA Plan that details the analysis tasks to be undertaken by the Customer ILS Team during the project stages before Development.

The SA Plan shall guide the implementation of the SA Strategy and help develop the maintenance concept. The SA Plan shall include comparative analysis to aid understanding of supportability strengths and weaknesses of past Systems.

Opportunities for standardisation shall be explored across equipment, Support and Test Equipment, supportability analysis, process and data exchange standards. Refer to 2.2.1.3, and Annex 1 Paragraph 2.5

5.3.1.2.4 *ILS Organisation*

The ILS Manager will form an ILS team, which will develop and evolve as the project takes shape. The composition of this team and the functions they are required to perform is described further in Chapter 4.

Depending on the project specific requirements, the ILS Manager may be required to form sub-groups to address the following:

- Supportability and Life Cycle Cost analysis
- Training and Training Equip
- Packaging Handling Storage and Transportation (PHS&T)
- Reliability
- Support and Test Equipment (S&TE)
- Facilities and Infrastructure
- Disposal
- Supply Support Procedures
- Obsolescence Management
- Configuration Management
- System Safety
- Environmental Protection

The ILS Manager will draft the ILS aspects of the Concept stage Statement of Work (SoW) and begin to draft the Development stage SoW during the Pre-Concept Stage.

5.3.1.3 *Use Study*

The Use Study Report is developed from the Concept of Operations (ConOps) document. It describes how the new System of Interest is intended to operate and what existing support facilities are available that could be reused. These facilities and other resources can include: Repair, Training and Training equipment, storage, personnel, support and test equipment. A good Use Study is helpful in standardisation and non-proliferation efforts.

The Use Study will record the outgoing system identity, its quantity per location for use and support, the maintenance levels used, training philosophy, existing operating and maintenance facilities and support resources, including personnel.

The Use Study will consider the viable support solutions available. A matrix shall be created and used to compare the benefits, LCC and supportability of each System Concept. The identification of the possible support solutions will help to shape ideas for contract frameworks which will best encourage the combination of development and support and incentivise the supplier to make sound decisions. The Use Study must address both peacetime and conflict scenarios. Refer to: 2.2.2.3

5.3.1.4 Life Cycle Cost Modelling

The first Whole Life Cost (WLC) model for each alternative Concept must be created to enable Concept selection. Each model shall be supported by a Master Data and Assumptions Log (MDAL). This will help to start the budget and finance planning, which will be required as the project develops. Refer to: 2.2.2.2.

5.3.1.5 Outputs from Pre-Concept Stage

URD and SRD

ILS Plan

Use Study

LCC Analyses of Alternative concepts and MDALs

5.3.1.6 Processes

Planning

Develop ILS Plan (see 2.2.1.3, and Annex 1, Paragraph 1)

Supportability Analysis and Maintenance Process

Analyse Alternatives (see 2.2.1.2)

Also refer to **Annex 2**, para 1.

5.3.2 Concept Stage

5.3.2.1 Introduction

This stage is used to refine and assess the alternative concepts and decide upon the Concept to be adopted. Contractors are encouraged to be involved in the development of concepts for the Systems of Interest and support solution options. The System Requirements Document will be developed from URD during this stage. The main design review from ISO15288 in the Concept Stage is the System Functional Review (SFR). The perspective of project stages differs between Customer and Contractor. Annex 4 of AAP-48 presents Figure 53 which shows the mismatch during Pre-Concept and Concept, and the closer alignment from Development onwards.

5.3.2.2 ILS Management

5.3.2.2.1 ILS Plan

The ILS Plan will continue to develop as details about the concepts become more mature, to:

- Identify the operational and organisations requirements. Improve the early supportability requirements, including R&M as details about the concepts become more mature.
- Identify the Procurement strategy and Supportability Analysis Strategy and Set the Logistics Support Date (LSD) to be consistent with System and support resource delivery.
- Identify the outline ILS Element Plan for Customer ILS Plans and take feeds from ILS element working groups to feed requirements into ILS Plan.
- Identify assessment and evaluation criteria for suppliers tendering for the SOI.
- Identify the Programme management requirements including training, personnel and skill requirements, including the date for Training Ready to start, to ensure trained staff are available before the SOI is delivered. This start date is usually before LSD.

Refer to: 2.2.1.3 and Annex 1, Paragraph 1

5.3.2.2.2 ILS Organisation

The Customer ILS Team will increase in size as System Concept options become clear and a broader set of skills is required. The ILS Manager and Team will contribute to the next Decision Gate business case.

The Contractor ILS Team will develop and aim to demonstrate that the requirements are understood.

5.3.2.2.3 ILS Statement of Work for Development Stage

The ILS Manager will contribute to the development of a draft SoW for the ILS activities required during the Develop and Production stages. It will describe the activities that a contractor must complete to fulfil the Tender requirements. It will detail the engineering and support requirements, with review processes to ensure supportability is designed into the SOI.

The SoW shall identify the Contract Deliverable Requirements List (CDRL), delivery content, format, and acceptance criteria to ensure delivery of a blank analysis report is not considered acceptable. Refer to: 2.2.1.7

It will identify the standards to be used across ILS and how they will integrate the flow of activities and use of data to ensure support is maximised and LCC minimised. It will state the data exchange or interchange requirements. The Contract terms and conditions will clarify Intellectual Property Rights (IPR) and ownership.

5.3.2.3 Design Interface – Supportability Analysis

The Design Interface ILS element includes:

- Supportability Analysis
- Reliability, Maintainability, Safety and Testability

- Human Factors

In the Concept Stage the focus is on supportability requirements, but also analysing alternatives. All three groups above will contribute to the requirements capture process and assessing alternatives.

This section describes the activities within Supportability Analysis and the other disciplines are described in the paragraphs that follow. The points below direct the activities that must be considered.

The Use Study will be updated as information on Concepts and alternatives becomes clearer.

Identify the standards to be used for Supportability Analysis to minimise the life cycle cost and maximise the design influence to benefit SOI supportability. Refer to: 2.2.2.3 and 2.2.2.4

An SA Strategy will be developed to outline the required analysis tasks for Developmental Items which can include:

1. Comparative Analysis
2. Technological opportunities
3. Standardisation
4. Supportability and related Design factors
5. Functional Requirements
6. Support System Alternatives
7. Evaluation of Trade-Off
8. Supportability, Test, Evaluation and Verification

The Supportability Case will be developed to describe how:

1. ILS requirements were identified
2. How the ILS Organisation is functional for the project
3. The ILS Strategy is viable/valid
4. The budget identified meets the through life needs to fund the activities and requirements of the ILS Plan
5. An assessment of the support strategy has endorsed the approach and related ILS standards

Evaluate the Trade-Off between the competing concept alternatives to determine the best to take forward to development or delivery contract.

Identify the supportability requirements for the best SOI applicable to Logistics Support Analysis for inclusion in Development stage SoW.

Identify the deliverable analysis and reports for the SA activities and feed into the ILS Plan and SoW. Consider SA Data base reports and which areas will be managed in detail, and which require a summary overview level. SA Reports must be selected with this in mind to support the other ILS Elements and their data needs. FMECA/RCM are based on the functional layout of the SOI and are the basis for the definition and assessment of maintenance and repairs activities. For S&TE this aspect needs an SA approach where

Candidate items and design data with parameters shall be captured to aid the obsolescence management process.

Identify the review processes applicable to Supportability analysis and output reports.
Identify the review stakeholders including other ILS elements.

Identify the design reviews that require supportability design review questionnaires. Identify the requirements for each questionnaire to ensure supportability correctly embedded in the design.

Identify the requirements for Supportability Test, Evaluation and Verification (STEV) planning and reporting. Identify the connection between design review questionnaires and STEV reporting to validate the performance of supportability design requirements.

Refer to: 2.2.1.3, 2.2.2.3 and 2.2.2.4

5.3.2.3.1 *Design Interface – Reliability Maintainability, Safety and Testability*

Identify the supportability requirements for the best SOI applicable RAMT for inclusion in Development stage SoW. Refer to: 2.2.2.3 and 2.2.2.4

Identify the programme plan requirements for RAMT activities and include these within the ILS Plan including STEV requirements. Refer to 2.2.2.3

Undertake initial predictions for R&M to influence System and Supportability requirements. Refer to: 2.2.2.3 and 2.2.2.4

Identify the RAMT requirements based on what is possible/viable from the modelling. Refer to: 2.2.2.3 and 2.2.2.4

Create a Safety Case report to assess hazards and mitigation by adopting standards or processes. Refer to: 2.2.2.3 and 2.2.2.4

Identify the deliverable analysis and reports for the RAMST activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to RAMST analysis and output reports. Identify the review stakeholders including other ILS elements.

5.3.2.3.2 *Design Interface – Human Factors*

Identify the standards to be used for Human Factors analysis to maximise the design influence to benefit operator efficiency and short maintenance times. Refer to: 2.2.2.3 and 2.2.2.4

Identify the programme plan requirements for Human Factors analysis and feed into ILS Plan. Refer to: 2.2.1.3

Identify the supportability requirements applicable to Human Factors analysis. Refer to: 2.2.2.3 and 2.2.2.4

Identify the deliverable analysis and reports for the Human Factors activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to Human Factors analysis and outputs. Identify the review stakeholders including other ILS elements.

5.3.2.4 Supply Support

Review of URD, SRD, ILS Strategy and Use Study to determine resource budgets for spares and S&TE and any options.

Develop a Supply Support Strategy for the Concept being taken forward to contract.

Identify the provisioning standards and processes to be used, how data will be received and used and integrated with the Inventory management System. Refer to 2.2.4.2, 2.2.7.2, and 2.2.11.2

Identify the stakeholders within inventory management introductory processes, including NATO Codification to ensure stakeholders understand the plan. Refer to 2.2.4.3

Identify potential GFE stakeholders and quantify assets held by location for reuse by the SOI. Identify the remaining usage service life for potential GFE. Refer to :2.2.1.11

Identify the deliverable analysis and reports for the Supply Support activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3, and 2.2.4.2

Identify the review processes applicable to Supply Support outputs. Identify the review stakeholders including other ILS elements.

5.3.2.5 Support and Test Equipment

Identify the analysis and equipment introduction standards to be used for Support and Test Equipment (S&TE) to minimise the life cycle cost and maximise the benefit of supportability analysis. Refer to 2.2.5.2

Identify the programme plan requirements for S&TE and feed into ILS Plan. Refer to: 2.2.5.2

Identify the supportability requirements applicable to S&TE. Refer to 2.2.2.3, and 2.2.2.4

Determine which of existing S&TE has potential for reuse by contractors or modified for trained Customer personnel. Refer to Use Study and 2.2.2.3, and 2.2.1.11

Identify the procurement strategy for S&TE. State how items already in-Service will be identified to the Contractor for reuse. State how new items not in-Service will be identified in the analysis outputs and included within the Initial Provisioning procedures. Refer to 2.2.4.2, 2.2.4.3, 2.2.4.4, 2.2.5.2, and 2.2.5.3

Identify the deliverable analysis and reports for the S&TE activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3, and 2.2.5.2

Identify the review processes for S&TE analysis and output reports. Identify the reviewing stakeholders including other ILS elements.

5.3.2.6 Training and Training Support

Review of URD, SRD, ILS Strategy and Use Study to determine personnel requirements and training options.

Develop a Training Strategy for the Concept being taken forward to contract.

Use the Training Strategy to detail the standards required of training providers, the key programme dates.

State how the review of training material will benefit flow of information from Technical Information for operators and maintenance staff.

State how the review of training material will benefit from supportability analysis for training and training equipment requirements.

Identify the review processes applicable to Training analysis and output reports.

State how the review of training material will benefit from interaction with any other ILS Elements. Identify the review stakeholders including other ILS elements.

Identify the deliverable analysis and reports for the Training and Training Equipment analysis activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

5.3.2.7 Technical Information

Identify the standards for Technical Information analysis to benefit from supportability analysis and maximise the sharing and reuse of data across ILS.

Identify the programme plan requirements for Technical Information analysis and feed into ILS Plan.

Identify the ILS elements that can reuse Technical Information Data Modules

Identify the deliverable analysis and reports for the Technical Information activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to Technical Information analysis and data modules. Identify the review stakeholders from engineering design and other ILS elements.

5.3.2.8 Packaging Handling Storage and Transportation

Identify the packaging protection standards and processes applicable to PHS&T.

Identify the supportability requirements applicable to PHS&T

Use Health and Safety regulations (National and International) to identify hazardous substances not to be used. Aim to minimise use of hazardous materials to keep storage and disposal costs to a minimum for Life Cycle Cost efficiency.

Identify any transportability and mobility requirements for the SOI, by land, sea and air as applicable. Identify the System(s) to transport the SOI for each mode of transport.

Identify any storage and storage facility requirements for the SOI and its resources.

Identify the deliverable analysis and reports for the PHS&T activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to PHS&T analysis and output reports. Identify the review stakeholders including other ILS elements.

5.3.2.9 Facilities and Infrastructure

Identify the standards for Facilities analysis to benefit from supportability analysis and maximise the reuse and sharing of data across ILS.

Identify the programme plan requirements for Facilities analysis and feed into ILS Plan.

Identify the ILS elements that can feed into the Facilities activities.

Identify the deliverable analysis and reports for the Facilities activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to Facilities analysis and output reports. Identify the review stakeholders including other ILS elements

5.3.2.10 IT System Support

Identify the standards for IT System Support data requirements and data exchange to benefit from supportability analysis and maximise the sharing of data across ILS.

Identify the programme plan requirements for IT System Support analysis and feed into ILS Plan.

Identify the review processes and data validation with practical demonstrations applicable to IT System Support analysis.

Identify the ILS elements that can interface with the IT System Support activities, input data or require outputs from the system by data exchange.

Identify the deliverable items and reports for the IT System Support activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes applicable to IT System Support analysis and output reports. Identify the review stakeholders including other ILS elements

5.3.2.11 Environmental Conditions and Recoverability

Identify the standards for Environmental Conditions and Recoverability data requirements to benefit from supportability analysis and maximise the environmental benefit whilst keeping within budget and LCC constraints across ILS.

Identify the programme plan requirements for Environmental Conditions and Recoverability analysis and feed into ILS Plan.

State the recoverability ambitions for LRUs in the SOI, in terms of: Repair, recovery for recycling, and minimising landfill disposal.

Identify the ILS elements that can interface with the Environmental Conditions and Recoverability activities, input data or require outputs from the system by data exchange.

Hazardous product use to be minimised to eliminate where possible disposal costs

Identify the deliverable items and reports for the Environmental Conditions and Recoverability activities and feed into the ILS Plan and SoW. Refer to: 2.2.1.3

Identify the review processes and data validation with practical demonstrations applicable to Environmental Conditions and Recoverability analysis. Identify the review stakeholders including other ILS elements

5.3.2.12 Outputs from Concept Stage

ILS Plan

Statement of Work for Development Stage

5.3.2.13 Processes

Planning...

- Develop further the ILS Plan (see 2.2.1.3)
- Plan the outline Initial Provisioning Programme and need for long lead time items lists (see 2.2.4.2)
- Develop and Manage the Contract (See 2.2.1.7)
- Develop the Statement of Work (SoW) for Development stage (see 2.2.1.7)

Supportability Analysis and Maintenance Process

- Perform Life Cycle Cost Analysis of Alternatives (see 2.2.2.2)
- Perform Supportability Analysis to determine the Supportability requirements (See 2.2.2.3)
- Plan the Logistics Support Date and Ready for Training Date (See 2.2.1.3)

Also refer to Annex 2 para 1.

5.3.3 Development stage

5.3.3.1 Introduction

This stage often starts with an Invitation to tender (ITT) or Request for Quotation RFQ and tendering process to determine the Supplier for SOI and often for the follow-on initial support period. In the Tender response the Contractor will develop an Integrated Support Plan responding to the Customer ILS Plan. Contractor will form an ILS Team to take on roles required to analyse requirements, to flow down the contract and practical requirements into supplier contracts, as well as to develop and deliver the support solution.

The standards, processes and outputs of ILS elements are described below in a sequence that reflects the occurrence of each element in the timing of a normal or generic project, accepting that variations do occur. The Logistics Support and Maintenance process described by the graphic of Figure 33: Logistics Support and Maintenance Process is a useful cross reference for the activities in the Development Stage to prepare the support for the SOI to successfully operate.

The primary standard for Systems Engineering and the System of Interest is ISO 15288-2023. The design review stages are now defined in ISO/IEC/IEEE 24748-8: 2019 and no longer in

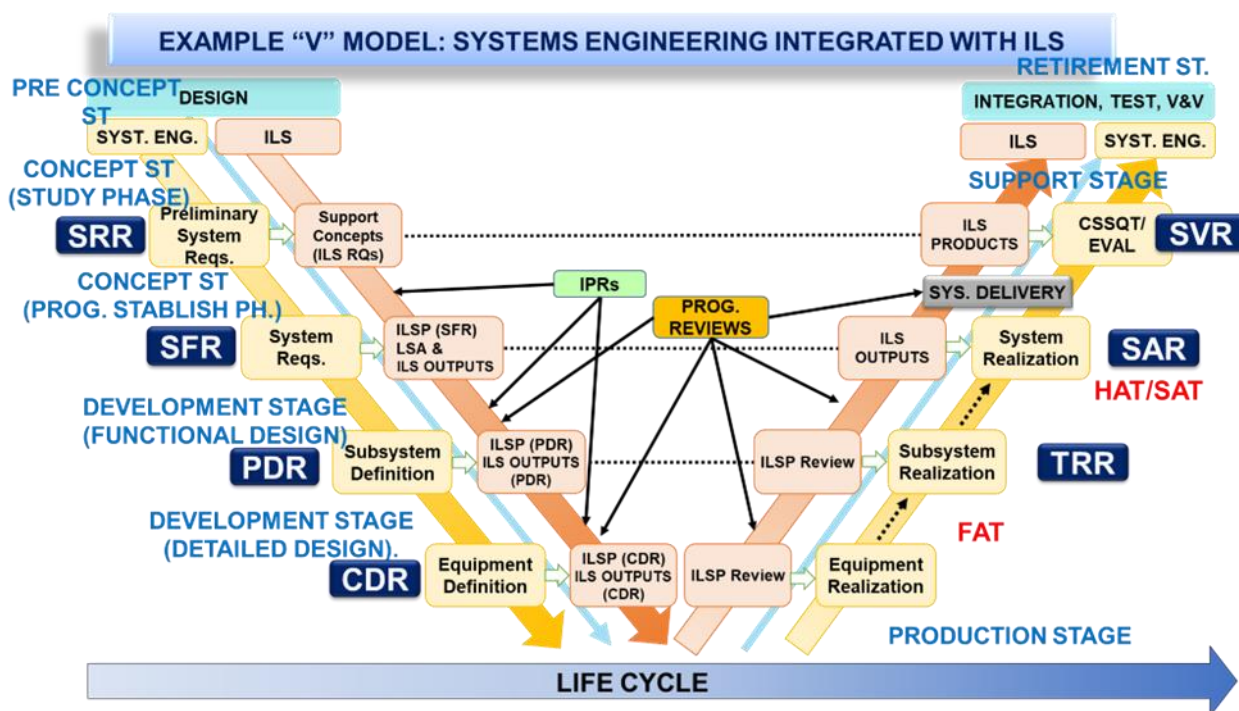
ISO 15288: 2023. The main design reviews during the Development stage from ISO/IEC/IEEE 24748-8: 2019 are:

- System Requirements (SRR)
- Preliminary Design (PDR)
- Critical Design (CDR)
- Test Readiness (TRR)
- Functional Configuration Audit (FCA)
- System Verification Review (SVR)

Figure 39 below shows the Systems Engineering design reviews integrated with ILS activities in an example maritime project. In a normal programme the two reviews below are part of the Production Stage (see 5.3.4).

- Production Readiness (PRR) or Manufacturing Readiness Review (MRR)
- Physical Configuration Audit (PCA)

Figure 39: Example Systems Engineering V Diagram Aligned with ILS Activities



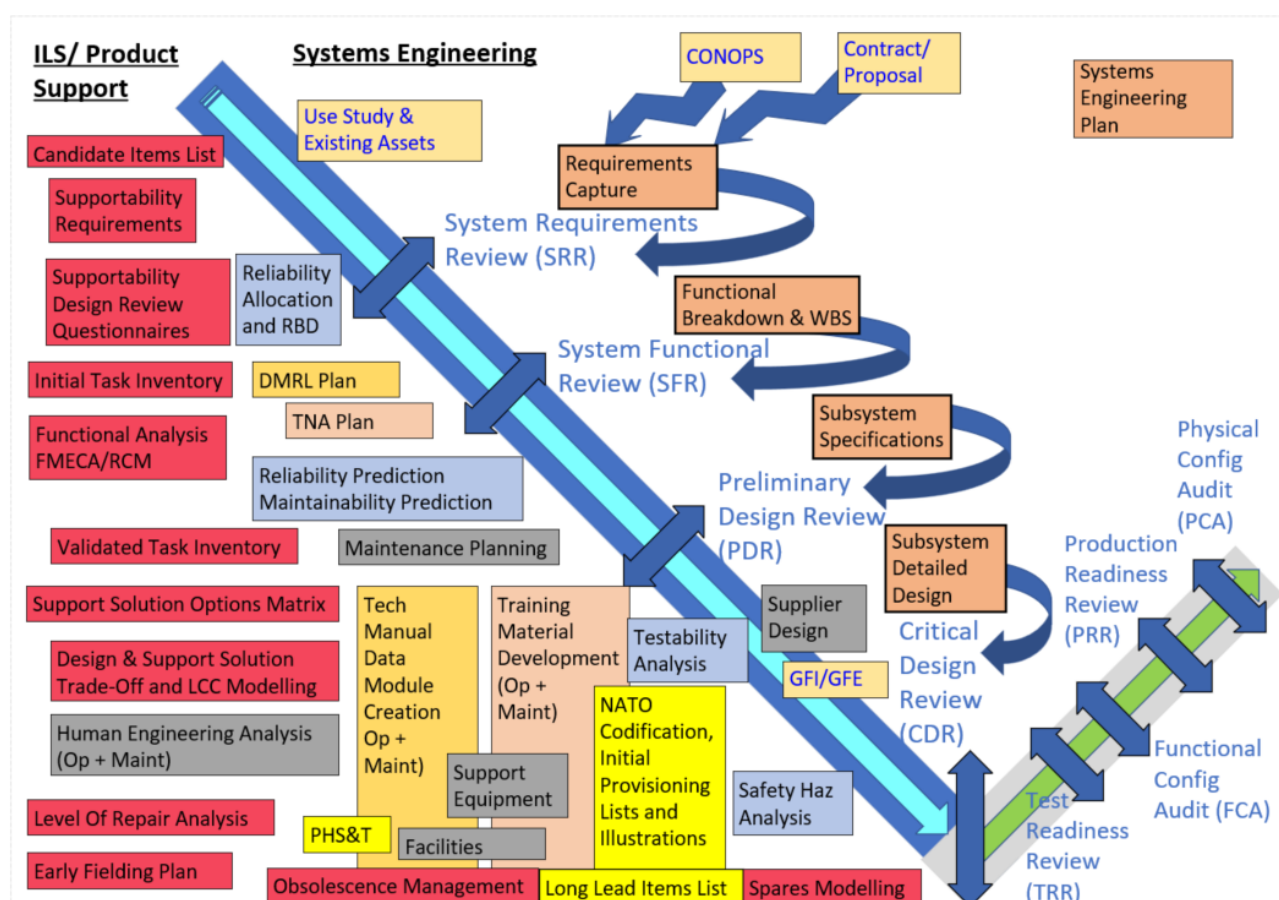
It is very important for the whole ILS team to understand the Systems Engineering plan and schedule of design reviews at subsystem and System level. The supportability analysis and Design Interface time scales need to be managed to meet the design review deadlines. Supportability influence will be delayed or lost or become ineffective if the ILS Plan is not aligned with that of Systems Engineering. The left-side of the V deals with requirements decomposition into a solution, and the right-side addresses the integration, validation and verification that the requirements are embedded within the SOI.

Standardisation methods must be used to minimise LCC and reduce design variation proliferation. The greater the number of variants, the greater the life cycle cost and a lower interoperability for NATO will result. Variant designs using Usable On Codes (UOC) and Model Identifiers (MOI) must be used sparingly to maximise integration and ease of support.

In

Figure 39 the V diagram of Systems Engineering shows the design reviews and activity prepared for each review. The Reviews are aligned with the activities of ILS on the left of the V. Top-down functional FMEA can proceed early in the design cycle after the System Requirements Review. The Top-down approach is preferable to Bottom-up hardware FMEA to avoid delay that often occurs for Vendor data. It allows the Reliability Centred Maintenance to start far sooner than it otherwise would for hardware based FMEA. Design influence opportunity is wasted/lost if there is delay.

Figure 40: ILS Integrated with Systems Engineering



In Figure 40 this overview graphic conveys a deeper level of ILS content rather than exact timing, and the sections below will look at each design review in term and the generic activities that support these reviews. The figure has a timeline running from left to right across the graphic, and as you follow down the V from the System Requirements Review (SRR) down to the Critical Design Review (CDR) the design develops over this time and becomes ready for production as the V rises on the right-hand side. This conceptual flow is repeated in the more detailed graphics for each design review in the text below.

5.3.3.2 ILS Management

There are many aspects to integrate in the Development Phase and this is a very busy time that is helped by good planning. The ILS Plan schedule of work must fit together with the Systems Engineering Management Plan design reviews. The development of supportability design review questionnaires and supportability design requirements must occur to meet the early design review timescale. These ILS outputs must not come as a shock to the engineering management and their arrival should be expected. The ILS Plan, developed in the response to Tender or RFP/RFQ must be created through regular meetings with the Systems engineering team. This level of integration at the planning level will enhance the probability of successful supportable SOI.

5.3.3.2.1 Standards for ILS Management

The standards to be used for ILS Management may be driven by the customer or by internal choice. It is important that the standards selected work very well together for analysis, data sharing and reuse across the ILS elements.

5.3.3.2.2 Processes for ILS Management

Most of the planning must have taken place in the preparatory stages and only adjustments to existing plans should be necessary in this stage. The Contract Data Requirements List must identify all the deliverable items across the ILS elements and managing this aspect of the contract will be a major activity for the ILS Manager and team.

Planning

- Plan and Manage Guidance Conference. (See 2.2.1.4)

Supply processes

- Deliver ILS Outputs (see 2.2.1.7)

Supportability Analysis and Maintenance Processes: tasks undertaken by ILS Manager's team:

- The management of engineering data configuration (see 2.2.1.6)
- Document lessons learned during the Development stage as events occur. (see 2.2.1.5)

5.3.3.2.3 Outputs for ILS Management

It is normal for the ILS outputs to be stated in a Contract Data Requirements list (CDRL). This list will contain Data Item Descriptions which detail each of the outputs. The CDRL may list the outputs for all ILS Elements, so that the ILS Manager is responsible for all these deliverable reports and items. Refer to ILS Plan Guidance in Annex 1, at Para 1.

5.3.3.3 Design Reviews

The design reviews within a 'normal' development programme are explained below. The processes, inputs and outputs are described for each design review and shown in each graphic. Design reviews held in the Production stage are described at Para 5.3.4.1.

5.3.3.3.1 System Requirements Review

The SRR purpose is ensure top level requirements are adequate to support requirements analysis and design activity for the system to proceed to initial system design with acceptable

risk. Buyer and supplier must each understand the system and performance requirements, and these are consistent with budget, programme schedule risk and any other constraints.

This review occurs fairly early in the series of design reviews and brings together requirements identified in the Contract and Industry proposals. It is planned to be held when requirements capture is likely to reach a maturity to support further analysis. Some supportability requirements can be additional to the contractual minimum listing as comparative analysis and standardisation approaches can reveal lessons to be learned from past projects. In Figure 41 the V diagram of Systems Engineering is shortened and amplified to look in detail at the System Requirements review stage.

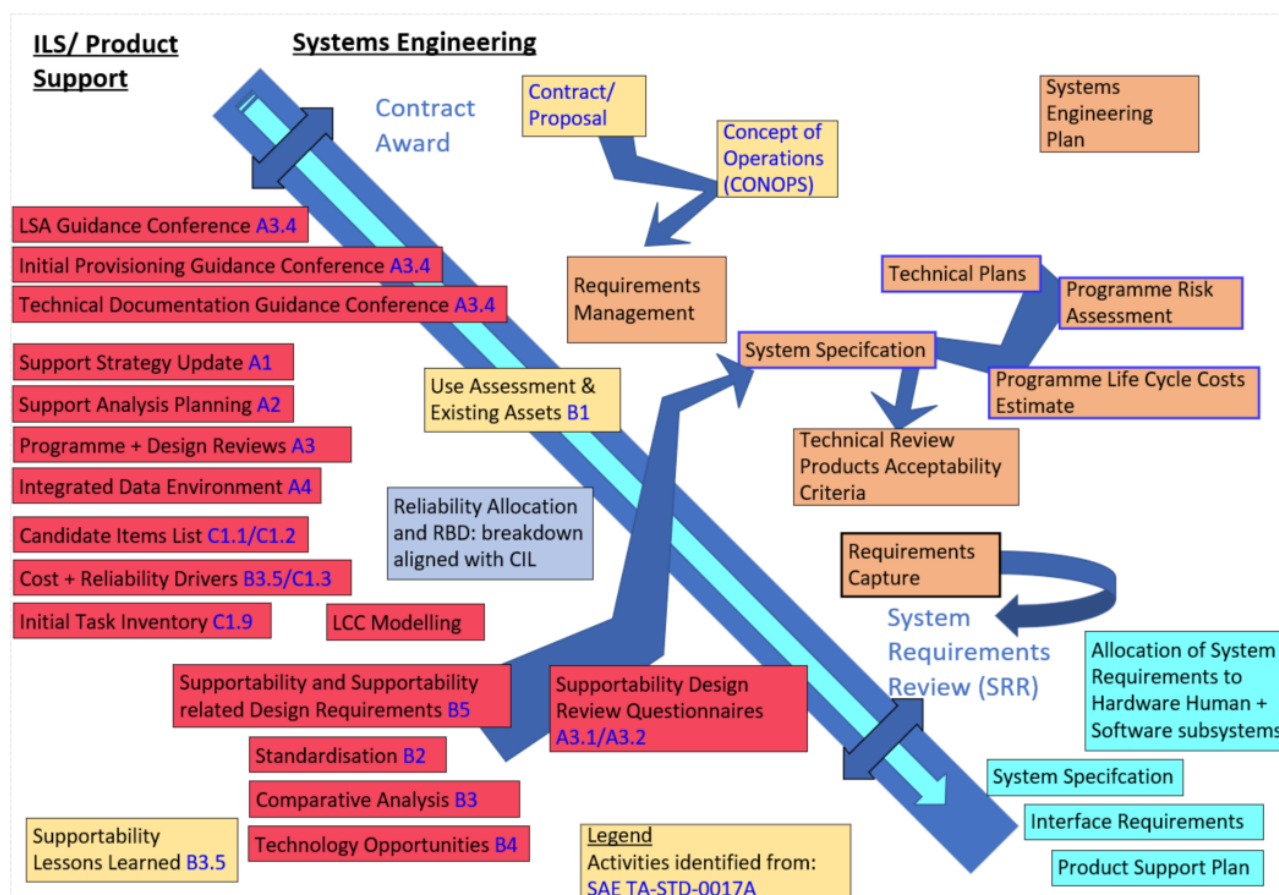
The four main Systems Engineering technical input products reviewed at the SRR are listed below, and once acceptance criteria have been developed for these, preparation for SRR is completed for Systems Engineering:

- Technical Plans and the System Specification
- Programme Risk Assessment and the Programme Life Cycle Cost estimate.

The ILS inputs to the SRR are:

- Supportability and Related Design Requirements
- An SRR Supportability Design Review Questionnaire completed with systems engineering responses
- An Use Study to aid standardisation (design and support processes) and to maximise reuse of existing customer and other resources/facilities
- Candidate Items List (CIL) of Maintenance Significant Items (MSI) and Structurally Significant Items (SSI)
- An initial Task Inventory of operator and maintenance tasks, based upon the CIL
- A Reliability Block Diagram based on an allocation of requirements
- An early Life Cycle Cost model, derived from the Baseline Comparison System (BCS)
- Supportability Lessons learned from the BCS

Figure 41: System Requirements Review



The supportability analysis on the left, with reliability and maintainability details added gives a deeper insight into activity timing than the introductory overview graphic. In the supportability side, a number of Guidance Conference take place to agree contractual interpretations of process and data requirements. Once the Guidance Documents recording the agreements are published the analysis can start in earnest. Supportability Design Review Questionnaires are an important aspect as are the Supportability Requirements derived from Standardisation and Comparative Analyses activities. If these are not prepared and discussed with Systems Engineering early enough to be presented at the SRR the design influence opportunity is greatly reduced. The activity descriptions in Figure 41, Figure 42, Figure 43, and Figure 44 **Error! Reference source not found.** includes the Activity reference for Table 1 of Mil HDBK 502A. For example, A.1 refers to Activity 1.

The main SRR Systems Engineering outputs, shaded turquoise in lower right corner of the SRR graphic, are listed below.

- Allocation of System Requirements to Hardware, Human and Software subsystems
- System Specification
- Interface Requirements
- Product Support Plan

5.3.3.3.2 System Functional Review

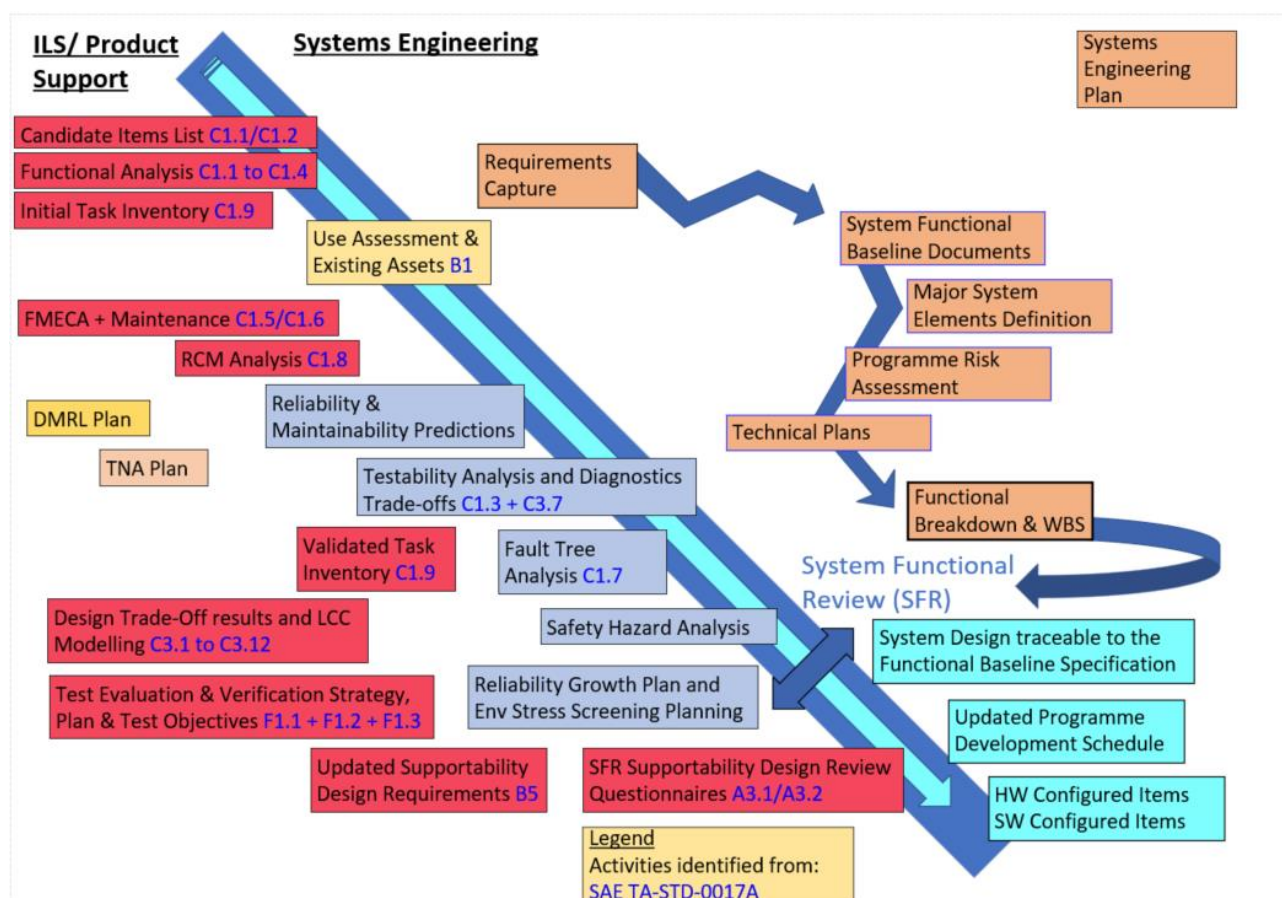
The SFR occurs after the System Requirements Review. In the Figure 42 V diagram of Systems Engineering looks at detail in this design review stage. Its purpose is to ensure that

the system design can proceed into preliminary design with acceptable risk and that system and function performance requirements are consistent with budget, schedule, risk and other constraints. Refer to Figure 42.

The four main Systems Engineering technical input products that are reviewed at the SRR:

- Technical Plans
- System Functional Baseline Documents
- Major System Elements definition
- Programme Risk Assessment

Figure 42: System Functional Review



The ILS inputs to the SFR are:

- The Reliability and Maintainability predictions
- An early FMECA Report
- The early Testability analysis for coverage of failure modes
- An SFR Supportability Design Review Questionnaire complete with engineering responses
- An early Safety Hazard and Fault Tree Analysis
- The Supportability Test, Evaluation Verification Plan to de-risk achievement of supportability requirements, e.g. System MTBF or a key component overhaul life or MTBF
- The plans for Reliability growth and Environmental Stress Screening

- An updated LCC model and outputs

For supportability, functional analysis is the priority, and the initial Task Inventory will be validated by the FMECA and RCM analysis.

The design review questionnaires for supportability continue to ensure that supportability requirements are embedded in the design. In addition to supportability analysis, the Training Needs Analysis planning and Technical Information Data Module Requirements planning start from the basis of the Candidate Items List and initial Task Inventory. For Reliability and Maintainability, prediction analysis and reporting are undertaken. For the Safety aspects, Hazard and Fault Tree Analysis starts as does Testability analysis to ensure that maintainability requirements are achievable and that high diagnosis success with low ambiguity group size results.

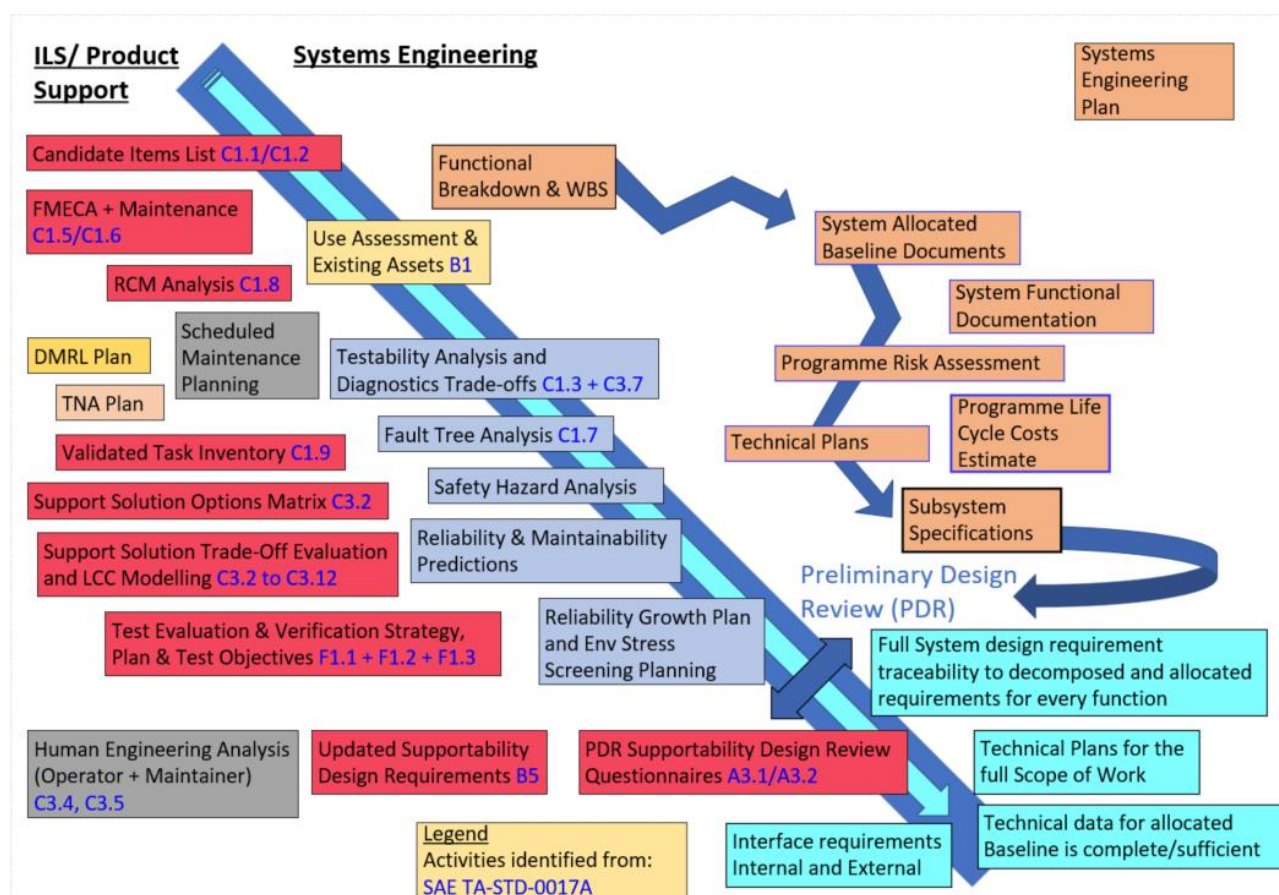
The main SFR Systems Engineering outputs, shaded turquoise in lower right corner of the SFR graphic, are listed below.

- System Design traceable to the Functional Baseline Specification
- Updated Programme Development Schedule
- Hardware and Software Configured items are defined

5.3.3.3.3 *Preliminary Design Review*

The purpose of the Preliminary Design Review (PDR) is to ensure design is mature enough to proceed to detailed design and meet the stated performance requirements within budget, schedule, risk and other programme constraints. Refer to Figure 43.

Figure 43: Preliminary Design Review



The PDR has five main input products for Systems Engineering:

- System allocated baseline documentation
- System functional documentation
- Technical plans
- Program risk assessment
- Program life-cycle cost estimate

The focus for supportability continues with functional analyses and extends to support solution options analysis and trade-off. Many trade-off options are possible from Activity 11 ranging from design, support solution, skills, diagnostics, system transportability and facilities. Human engineering analysis starts in this phase leading up to PDR and continues through to Critical Design Review (CDR).

To improve the focus on supportability at design reviews often needs a shift away from a production and installation mindset. This results in the customer's operator and maintainer personnel becoming a higher priority in design thinking. The way that items are grouped or associated in the engineering drawing structure must be logical for supportability and enable the correct part to be purchased as a spare. Installation concepts should not be the primary factor. The ILS inputs to the PDR are:

- Updated Reliability and Maintainability predictions
- FMECA and RCM Reports

- Support Solutions Options Matrix and early trade-off results, see JSP 886, Vol 1, Part 4
- Human Engineering analysis
- Testability analysis for coverage of failure modes
- A PDR Supportability Design Review Questionnaire complete with engineering responses
- Safety Hazard and Fault Tree Analysis
- Updated plans for supportability Test, Evaluation Verification to de-risk achievement of supportability requirements, e.g. System MTBF or a key component overhaul life or MTBF
- Updated plans for Reliability growth and Environmental Stress Screening
- Updated LCC model and outputs
- Updated Task Inventory based upon the FMECA and RCM Report results
- Training Needs Analysis (TNA) plans based on the Task Inventory
- Data Module Requirements List (DMRL) plans based on the Task Inventory

To balance the focus on supportability, the ease of production must start to be considered from PDR onwards in preparation for CDR to ensure that production is efficient and cost effective. This must not undermine but enhance life cycle costs.

In Figure 43 the PDR review Systems Engineering outputs, shown shaded turquoise in the lower right corner of the PDR graphic, are listed below:

- Full System Design Requirement traceability to decomposed and allocated requirements for every function
- Technical Plans for full scope of work
- Technical Data for allocated Baseline is complete/sufficient
- Interface requirements both internal and external

5.3.3.3.4 *Critical Design Review*

The purpose of the Critical Design Review (CDR) is to ensure that the detailed design is adequate to proceed to fabrication, system integration, demonstration and test, being able to meet the stated performance requirements within budget, schedule, risk and other system constraints.

The CDR follows PDR when the detailed design of the initial product baseline is complete and ready for fabrication and the products for review are prepared. Refer to Figure 44.

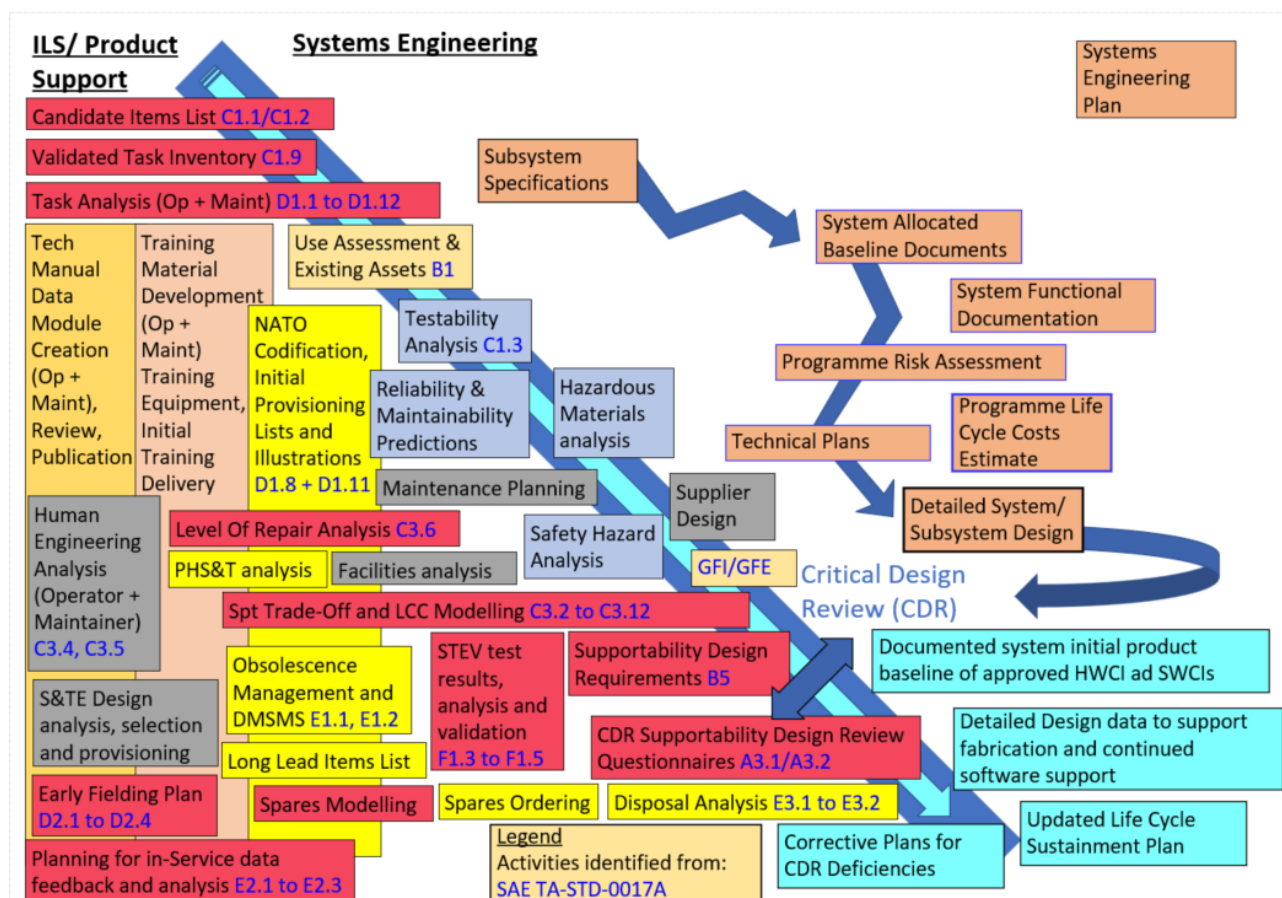
The CDR Systems Engineering inputs are:

- System product baseline documentation.
- System functional or allocated or product baseline documentation.
- Technical plans.
- Program risk assessment.
- Program life-cycle cost estimate.

The Supportability Design Review questionnaire also provides an input to every design review. These ensure that supportability requirements identified in early supportability analysis, and accepted in time for the SRR are embedded in the design that goes into production. From a customer perspective, the CDR is a very important event. It will attract

much scrutiny and good preparation of Systems Engineering and Supportability analysis is essential for a successful conclusion.

Figure 44: Critical Design Review



The ease of production shall be considered at CDR to ensure that, although supportability is of primary importance for the next 30 years of operational and support life that production is efficient and cost effective.

The design and supportability activities are more detailed and intensive in the period between PDR and CDR, which is usually longer than the interval between other design reviews.

The ILS inputs to the CDR are:

- Updated Reliability and Maintainability predictions.
- FMECA and RCM Reports revised to reflect design change since PDR.
- Support Solutions Options Matrix and trade-off evaluation.
- Human Engineering analysis for operator interfaces and maintainability design influence.
- Updated Testability analysis for failure mode coverage to include design changes.
- A completed CDR Supportability Design Review Questionnaire and responses
- Updated Safety Hazard and Fault Tree Analysis.
- Early test results for the Supportability Test, Evaluation Verification programme to monitor progress towards achievement of supportability requirements.

- Early results for Reliability growth and Environmental Stress Screening.
- Initial analysis on Early Fielding Plan to identify resources for delivery to operating and maintenance locations, including GFE.
- Updated LCC model and outputs.
- Training Needs Analysis (TNA) output and course development.
- Common Source Database (CSDB) and Data Modules for Technical Publications.
- Initial Provisioning Lists and spares ordering for long lead time items for LSD delivery.

The main outputs of the CDR, shown shaded turquoise in the CDR graphic, are:

- A documented system initial product baseline of approved HWCI and SWCI.
- Detailed design data to support fabrication and continued software support.
- Updated life cycle sustainment plan.
- Corrective plans to CDR deficiencies.

5.3.3.3.5 *Test Readiness Review*

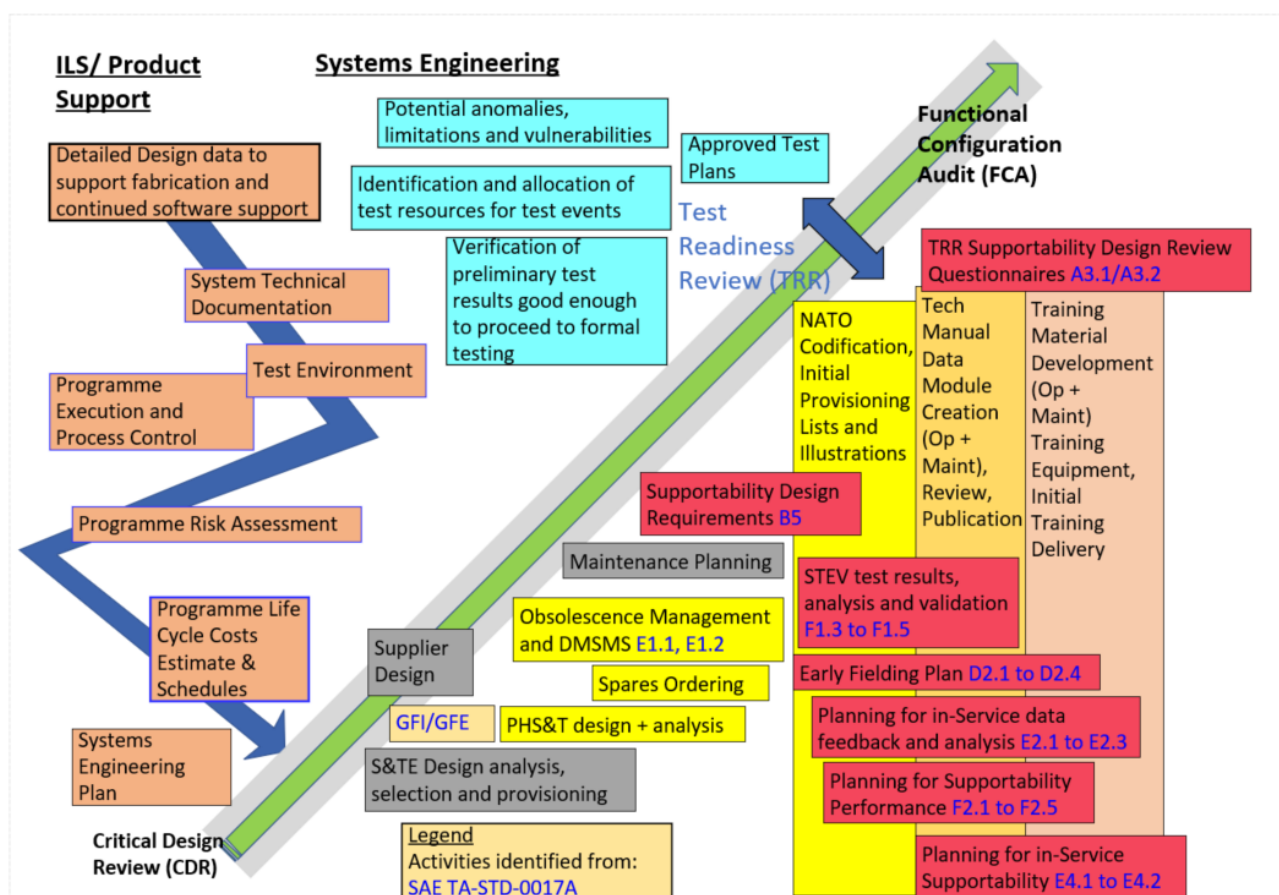
Purpose of the Test Readiness Review (TRR) is to assess test objectives, methods/procedures, test scope, safety, and readiness of buyer. It ensures that the test resources have been fully identified and obtained.

The timing of the TRR is set prior to formal testing, and all applicable documentation for system elements under test are sufficiently robust to support a successful test.

The Systems Engineering inputs for TRR, shaded beige in Figure 45 are:

- System Technical Information
- Test environment
- Program execution and process control
- Risk assessment
- Program life-cycle cost estimate and schedules

Figure 45: Test Readiness Review



Whilst the systems engineering team is focussed on test preparation for the test phase, supportability activity across ILS is continuing to complete analysis so that products can be delivered in time for the Logistics Support Date (LSD). The ILS inputs to the TRR are:

- A completed TRR Supportability Design Review Questionnaire and responses.
- Early Fielding Plan to identify resources for delivery to operating and maintenance locations, including GFE - timing to suit needs of project – may be later at PRR.
- Training Delivery schedule to provide trained personnel for first SOI delivery.
- Training material (operator and maintainer) prepared for delivery.
- Packaging design work completed.
- NATO Codification completed for new resources: spares, Special to contents or Category 1 Containers and new S&TE.
- Maintenance plan for scheduled maintenance of the SOI.
- Early outputs for Obsolescence Management and Diminishing Manufacturing Sources and Material Shortages (DMSMS).
- Early plan for in-service feedback of data exchange for: operating hours, maintenance work orders and inventory transactions to enable supportability to be continuously improved in the Utilisation and Support life cycle stages.
- Evidence of spares and other resources on order to meet delivery by Logistics Support Date.

It is necessary that spares, support and test equipment, Technical Information, facilities, and trained operator and maintenance personnel are ready to receive the first systems delivered

so that operations can begin. The Early Fielding plan contributes to this as does the order administration that follows.

The main Systems Engineering TRR outputs, shaded turquoise in the TRR graphic, are:

- A plan to address technical issues that might occur during the test.
- A list of anomalies, limitations and system vulnerabilities for the planned test events.
- Verification that preliminary/informal testing has given satisfactory results to formal testing to start.
- Verification that safety releases are provided to ensure personnel safety during testing.
- Approved test plans that identify and allocate all test resources.

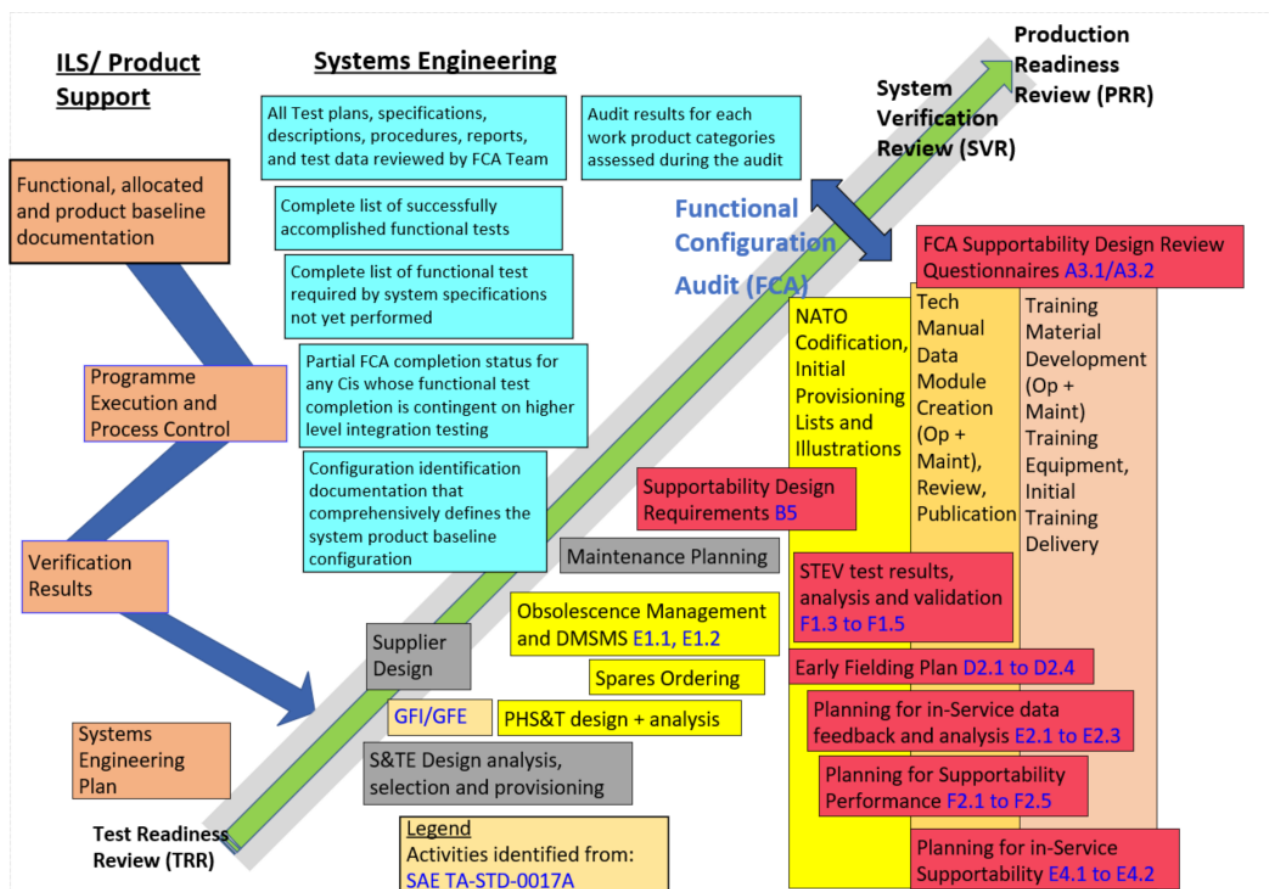
5.3.3.3.6 *Functional Configuration Audit*

The purpose of the Functional Configuration Audit (FCA) is to confirm that:

- The configured Items actual performance based on results of approved verification methods (test, demonstration, analysis or inspection) satisfies the performance requirements in the functional and allocated baselines
- For those performance requirements that cannot be completely verified during testing, adequate analysis or simulation using approved methods has produced validated data to permit assessment of an acceptable risk level that system performance will satisfy those requirements
- The initial product baseline documentation (drawings, parts lists) accurately reflects the physical configuration for which the test data and any analysis and simulation data are verified

See Figure 46:

Figure 46: Functional Configuration Audit



The Systems Engineering FCA inputs are:

- Functional allocated and product baseline documentation
- Programme execution and process control
- Verification results

Supportability activity leading to this Audit will continue to with ordering support resources to meet the LSD requirements. There is keen interest to ensure that the As Designed SOI (with its functional and supportability analysis) matches the data captured by the As Tested for verification SOI, and the As Built/As Support SOI. Any anomalies must be resolved to eliminate any gap between design, production, verified and supported SOI.

The FCA systems engineering outputs are:

- Record of all test plans, specifications, drawings, procedures, reports and test data reviewed by the FCA team
- A List of successfully completed functional tests
- A complete list of any functional tests required by the system specification or other test plans that have not yet been performed
- Partial FCA completion status for any CIs whose functional test completion is contingent on higher-level integration testing
- Audit results for each of the work product categories assessed during the audit

- Configuration identification documentation that comprehensively defines the system product baseline configuration that is the object of the FCA work products.

5.3.3.3.7 *System Verification Review*

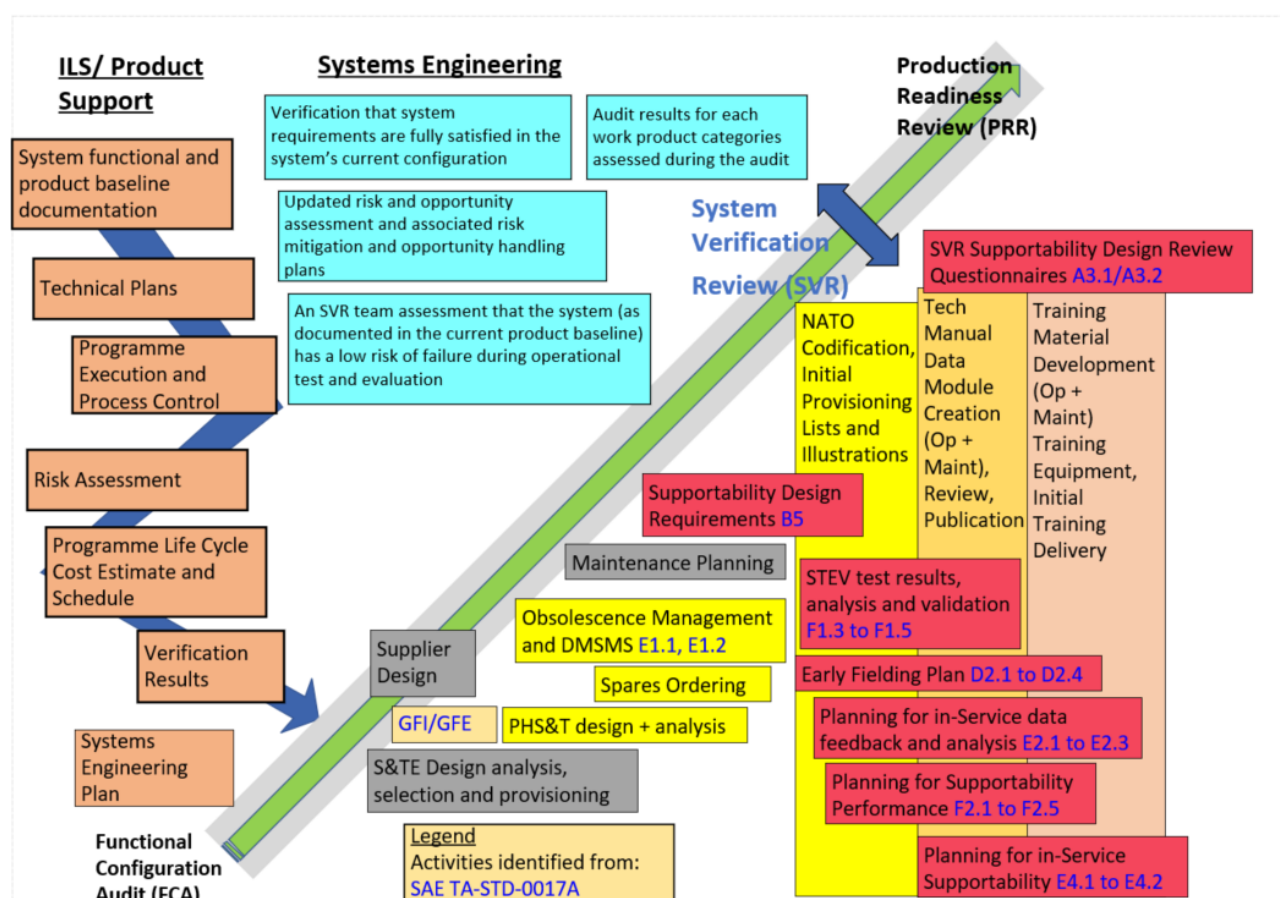
The purpose of the System Verification Review (SVR) is to verify that the as-tested system meets the requirements in the system functional baseline and is ready to proceed to the next phase with acceptable risk.

The System Verification Review (SVR) inputs, the items to be review, are:

- System functional and product baseline documentation
- Technical plans
- Program execution and process control
- Risk assessment
- Program life-cycle cost estimate and schedule
- Verification results

Supportability activity leading to this Audit will continue to with ordering support resources to meet the LSD requirements. There is keen interest to ensure that the As Designed SOI (with its functional and supportability analysis) matches the data captured by the As Tested for verification SOI, and the As Built/As Support SOI. Any anomalies must be resolved to eliminate any gap between design, production, verified and supported SOI. See Figure 47.

Figure 47: System Verification Review



The SVR systems engineering outputs are:

- The specific versions under configuration control of the system functional and product baselines examined during the technical review
- List of all test plans, descriptions, procedures, reports and validated test data that were reviewed by the SVR team
- Review results for each of the work product categories assessed during the technical review
- Verification that system requirements are fully satisfied in the system's current configuration
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- An SVR team assessment that the system (as documented in the current product baseline) has a low risk of failure during operational test and evaluation (OT&E)

Note that the SVR may be conducted concurrently with the Functional Configuration Audit (FCA).

5.3.3.4 Design Interface – Supportability Analysis

The range and depth of analysis is guided by the strategy applied to the level of design freedom for each item. A limited range of tasks/processes is applicable to Commercial Off

The Shelf (COTS) items, to identify the maintenance procedure, resources required to support the item and its reparability. For items with full design freedom, a greater range of tasks/processes must be applied to influence its supportability and through life cost to the customer. When integrating new design with items managed by International Traffic in Arms Regulations (ITAR) there are additional administration requirements to become a signatory and gain access to data essential to analysis to avoid unnecessary delay in a programme.

The Systems Engineering process will identify design reviews using ISO 15288 to reduce the risk of the design progressing with insufficient detail or understanding of requirements or requirements being viable. The tailored list of design reviews is normally agreed between Customer and Contractor as being appropriate for the SOI and processes used. The SA Plan must integrate its schedule with the design review process to maximise design influence for supportability. Design Review questionnaires must be developed for each major review to include all supportability aspects relevant to the SOI.

The Systems Engineering Team shall work closely with ILS team to ensure regular flow of design information, configuration management, and support concerns are exchanged and concluded prior to every design review stage. This teamwork will aim to maximise supportability benefits whilst keeping the Life Cycle Cost as low as possible. It is often the situation that the Systems Engineer will know very little of ILS/IPS concepts or processes. It is important that relationships and a shared understanding develops so that a joint ambition to deliver a supportable design can result. Some examples are:

- The ILS/IPS engineer will most likely need to explain that supportability requirements need to be developed, in addition to those in the contract requirements to ensure that a properly supported product is designed and delivered. The ILS/IPS engineer must understand the Systems Engineering plan of design reviews to ensure these supportability requirements are developed in time for the right design review.
- The ILS/IPS engineer will most likely need to explain that Reliability Centred Maintenance (RCM) is analysis to derive preventative maintenance based upon the FMEA output and seek help in recording the FMEA to ensure good data exists to start RCM.

The Development stage sees the SA Strategy being implemented. The analysis tasks resulting from the Task Tailoring are scheduled to fit in with the System Engineering Management Plan. This will ensure that early analysis to capture and refine supportability requirements will be completed before the System Requirements Review (SRR). Waiting until Preliminary Design Review (PDR) to submit the support requirements is often too late as the requirements management process is reluctant to accept them. Sub-system requirements will have already been created to flow down detail to the design work, and reworking those would be an unwelcome overhead. Functions and requirements are flowed into subsystems design early in the systems engineering process, and availability and reliability values are allocated to subsystems to start the prediction activity during the transition from functional to physical design.

As the functional design moves into a physical design, a Candidate Items List (CIL) must be created with the Systems Engineering team. This will be a common breakdown structure for use across the ILS Team and include hardware and software items. Candidate Items are selected for Maintenance Significance and structural or Safety Significance. Guidance on candidate item selection is available in ASD/AIA S3000L.

The inclusion of an indicative and valid Item Price in the data early enough in the design process allows analysts to assess cost drivers and focus effort where it will give the best benefit. It is also helpful for LCC and finance modelling, as placing items in meaningless cost bands is to be discouraged as it is very unhelpful for design influence. A good place to start is the Candidate Items List and this will maximise the benefit of understanding the high and low value items.

The CIL is used to create a Draft Task Inventory of prospective operator and maintenance tasks to aid planning for the Technical Information Data Module Requirements List (DMRL), Training Needs Analysis, Human Factors design influence and the Maintainability Prediction. The operator tasks will be validated by the Human Factors analysis. The maintenance task inventory will include both corrective and preventative tasks. This draft Task Inventory will be validated by the FMECA for corrective maintenance and by the Reliability Centred Maintenance (RCM) for the preventative maintenance.

LCC modelling must be used to track the support cost of an SOI at each design review to ensure the right balance between support requirements and affordability.

LCC models must be used to evaluate and trade-off and support the decision process for major design or support solution choices. The LCC models must include System breakdown, operating systems, the maintenance activity and resource use, the supply and repair loops. The LCC models used must not be pure finance models, but models capable of sensitivity analysis to assess the impact of change on reliability, operating rate or fleet size, etc.

The standards used for supportability analysis and the related data recording are complex and flexible to allow tailoring for project needs. Within 60 days of Contract, Guidance Conferences are held with Customer, Supplier and Subcontractors to document agreements on process and data for: SA, Supply Support and Technical Information. The events are often held separately for each element, with Supportability first, Supply Support and lastly Technical Information. The Guidance Conference must be used to motivate teams to set achievable timescales and adopt workable processes that help data sharing across ILS elements and between Customer and prime contractor. Configuration management of the design data and data sharing for reviews is a significant workload and processes must be understood by all.

Functional Analysis to determine failure modes and confirm Candidate Items List and Task Inventory. FMECA to be used as input for Reliability Centred Maintenance (RCM) and Level of Repair Analysis (LORA).

Design influence for supportability is the key theme of SA for both hardware and software items. Supportability Analysis is essential to influence the design, and this continues during Maintenance Task Analysis which includes: transportability assessment, provisioning data and illustrations, Codification screening as well as procedural steps and resource identification for the Tech Manual with resources identified. The data resulting from these analyses is important for sharing across ILS which reinforces the integration across ILS elements.

Data sharing occurs between:

- SA and Supply Support for provisioning
- SA and Tech Docs for Procedural Data Modules
- Tech Docs and Training for reuse of operating and maintenance procedures

- SA and S&TE for S&TE identification, design data, and S&TE selection
- SA and Trg for Training and Training Equipment identification and requirements
- SA and Maintenance through the LORA for maintenance planning
- SA, Maintenance and Facilities through the LORA for Facility identification and requirements.

The ILS/IPS team have many interfaces during the Development stage, and some of these are listed below:

- System Engineering team for data exchange on design requirements, design data, agree candidate items and the system breakdown for supportability analysis, to feedback results of supportability analysis, etc.
- Configuration management to receive design data and agree the Candidate Items list with Systems Engineering
- Customer ILS Manager to review analysis and exchange data, and agreements or direction.
- Internal Management for reporting project progress and budget expenditure
- Procurement team to ensure items are purchased with the right quality and long-term support objectives in mind and not always the cheapest price. Also flow down of standards and supportability requirements to suppliers and subcontractors as required.
- Commercial Team to agree on the source and accuracy of indicative price data for supportability analysis to be effective early in the design. An ILS/IPS engineer cannot focus on cost drivers if the price data is very vague or a guess.
- Production or Manufacturing Team to gain an understanding of their needs to ensure that the designed, built and supported product are all to the same standard and the Production Team share concerns to avoid three different standards of configuration to exist making ongoing support expensive.
- ERP System team to ensure that the analysis needs of the ILS/IPS team are not inhibited by inability to access the right data at the right time from the ERP system, be that Price, Purchase Lead Time or other commercially controlled data relating to repair or level of repair analysis.

5.3.3.4.1 *Supportability Analysis Results Recording*

The supportability analysis activities defined in the standards below are normally recorded in a logistics database. Historically, this was using Mil Std 1388-2A or 2B, or Def Stan 00-60 for UK projects. Within Mil Std 1388-2B there is guidance on the database tables to be populated for a selection of SA Tasks: 205, 301, 303, 401, 501. The analyst is recommended to use this guide (1388-2B, App D, Table II) with the Data Selection Sheet (DD Form 1949-1 was used with Mil Std 1388-2B). Data within 1388-2B is defined by Data Element Definitions (DED) and these are numbered 1 to 516 and are populated in relational tables named XA to XI and then AA through to JE.

If the requirement is to use the SAE GEIA-STD-0007C then a different understanding of the data is required. SAE GEIA-STD-0007 is a completely integrated XML data exchange and interoperability standard (a Common Data Model). Storage is achieved and managed independently by the acquirer. SAE GEIA-STD-0007 does not prescribe or mandate a storage format.

Data is specified by Data Type Definitions with Data Number Type numbered from: 1010 to 5940 in steps of 10. Appendix C of the GEIA-STD-0007C contains the Data Selection Sheet organised by the Entities which are named like the 1388-2B database tables: XA to XZ, and then AA to SD. There are more tables and data types than the earlier standard to meet the contemporary support requirements. There is guidance on data population in the handbook SAE GEIA-HB-0007C during each life cycle stage, and notes covering: data tailoring contracting, data selection and a data map with information on use of key/major fields: LCN, UOC, PLISN, etc.

5.3.3.4.2 *Standards for Supportability Analysis and Data Exchange*

If a common standard set was adopted by all nations for supportability analysis and data exchange, the interoperability achievement for supportability would be greater. Standards for Supportability Analysis and Data Exchange can work together in pairs and the list below provides options that should suit most nations:

- IEC 60300-1 Dependability Management
- IEC 60300-2 Guide to Dependability Management
- IEC 60300-3-12:2011 Dependability Management – Application guide – Integrated Logistics Support
- IEC 60300-3-3:2017 Dependability Management – Application guide – Life Cycle Costing
- SAE TA-STD-0017A + SAE GEIA-STD-0007C + SAE GEIA-HB-0007C + SAE TA-HB-0007-1A
- ASD/AIA S3000L and ASD S4000P + ASD/AIA S3000L
- ASD/AIA SX000i specification for Integrated Product Support (IPS)
- Def Stan 00-60 Pt1 (SA Tasks) + Def Stan 00-60 Pt0 and Pt2 (LSAR) (Cancelled)
- Def Stan 00-60 Pt3 Software Supportability Analysis (Cancelled)
- Def Stan 00-600 refers to other standards without defining the analysis tasks.
- Integrated Product Support (IPS) Elements Guidebook
- MIL-STD-1472: Design Criteria for Human Engineering
- DOD-HDBK-743A Military Handbook Anthropometry of U.S. Military Personnel
- UK JSP 886 Vol 7 Part 3 Supportability Analysis
- UK JSP 886 Vol 7 Pt 8.15 Supportability Engineering – Gatekeeper Role In Utilisation of Common Defence Materiel
- UK JSP 886 Vol 7 Part4 Software Support
- ITAR: International Traffic in Arms Regulations, US government regulations controlling distribution and use of technical data to non-USA citizens

The analysis tasks are set out in the first standard in the pairings above. Implementing these tasks should derive the supportability requirements, to be checked at design reviews. Functional analysis will record how the SOI works and fails and identify the maintenance requirements and resources to keep the SOI available for operation use.

Most standards for supportability analysis and data exchange do not integrate fully with standards for provisioning data or technical publications. Whilst the ASD/AIA/A4A S1000D is being more widely adopted for Technical Information, national procedures vary for provisioning, so data, processes and data exchange are less standardised. The ASD/AIA

S-Series of specifications were developed to integrate across the ILS element boundaries, as was Def Stan 00-60, and the S-Series can offer an integrated solution for the new project.

Whilst Human Factors is a Design Interface element, the related standards are shown in the Workforce and Personnel section below. Refer to: 5.3.3.11.1

5.3.3.4.3 *Processes for Supportability Analysis*

Planning

- Prepare ILS Element Plans (see 2.2.1.3, and Annex 1, para 1)
 - Prepare the SA Plan and SA Strategy of tailored SA Tasks
- Plan SA Guidance Conference and plan the SA Guidance Document (see 2.2.1.4)

Supportability Analysis and Maintenance Process

- Perform Supportability Analysis to identify Supportability Requirements (see 2.2.2.3, and 2.2.2.4)
- Analyse Supportability Requirements to derive Design Review Questionnaires for each Design Review: SRR, PDR, CDR, TRR, PRR (see 2.2.2.3, and 2.2.2.4)
- Perform Supportability Analysis to identify Design Review observations for each design review: SRR, PDR, CDR, TRR, PRR (see 2.2.2.3, and 2.2.2.4)
- Perform Supportability Functional Analysis both FMECA and RCM (see 2.2.2.3, and 2.2.3.6)
- Perform Supportability Analysis for Trade-Off and Trade-Off Evaluation (see 2.2.2.3, 2.2.2.4 and 2.2.2.2)
- Perform Maintenance Task Analysis (MTA) for design influence to recommend alternative design where support constraints are not met, e.g. MTTR (see 2.2.2.3, and 2.2.3.5)
- Perform Level of Repair Analysis for maintenance planning (see 2.2.2.3, 2.2.2.4, and 2.2.3.4)
- Perform Supportability Early Fieldling Analysis (see 2.2.2.3 and 2.2.2.2)
- Perform Supportability Post Production Support or DMSMS Analysis with assistance from Sustaining Engineering (see 2.2.2.3, 2.2.2.4, 2.2.1.11, 2.2.4.3 and 2.2.12.2)
- Perform Life Cycle Cost analyses (see 2.2.2.2)
- Develop SA Database to record the results of Supportability Analysis (see 2.2.2.4)
- Perform Human Factors design influence (see 2.2.2.3 and 2.2.8.2)

Supply process

- Provide the SA Guidance Document (see 2.2.1.4)
- Provide Design Review Questionnaires for supportability requirements to meet design review schedule, for: SRR, PDR, CDR, TRR, and PRR (see 2.2.2.3)
- Provide an updated Life Cycle Cost model to reflect the latest design prior to each major design review: PDR, CDR, TRR, and PRR (see 2.2.2.2)
- Provide report on Supportability requirements for the System of Interest for the System Requirements Review (SRR). This must cover: Standardisation, support lessons learnt from the Baseline Comparison System, New Technology opportunities and Risks and Supportability and Related Design Requirements (see 2.2.2.3, and 2.2.2.4)

- Provide a Candidate Items List of Maintenance Significant, and Structurally Significant Items (MSI and SSI) for use by whole ILS Team and Systems Engineering (see 2.2.2.3)
- Provide a draft Task Inventory of Corrective and Preventative Maintenance and Operator Tasks (see 2.2.2.3)
- Provide a validated Task Inventory for maintenance using outputs from FMECA and RCM (see 2.2.2.3)
- Provide a list of Hazardous Maintenance Tasks, based on input from Environmental Conditions and Recoverability: Hazardous materials and Environmental Conditions, Human Factors: assessment of hazardous tasks, and PHS&T: Hazardous materials in handling, storage and transportation. This output must be used by Technical Information and Training to ensure material carries the correct warnings and cautions, and training eliminates risk as far as practicable (see 2.2.2.3, 2.2.2.4, 2.2.9.2, and 2.2.13.2).
- Provide report of support solutions options and trade-off evaluation for support of the SOI (see 2.2.2.3, and 2.2.2.2)
- Provide a report of Early Fielding Analysis with assistance from Sustainment Engineering (see 2.2.2.3, 2.2.2.2, and 2.2.12.2)
- Provide a report on Post-Production Support with assistance from Sustainment Engineering (see 2.2.2.3, 2.2.2.4, 2.2.12.2, 2.2.13.2, and 2.2.1.11)
- Provide a report on Supportability, Test, Evaluation and Verification (STEV) plans, activity test results and conclusions, to reduce the supportability risks for the SOI, with assistance from Sustaining Engineering (see 2.2.2.3, 2.2.2.4, and 2.2.12.2).
- Provide Logistics data to customer for Review Identify the spare parts and other resources required for maintenance (see 2.2.2.4)

5.3.3.4.4 *Outputs from Design Interface – SA*

The outputs from the Development stage can be numerous. Deliverable items are usually controlled by a Contract Data Requirements List (CDRL) and each deliverable item or dataset will be defined by a Data Item Description (DID). Below is a list of the minimum deliverable items/datasets expected:

- **Candidate Items List** – to help manage configuration, planning for Supply Support, Technical Information, Maintenance and Training. Shared with all elements within ILS and Systems Engineering Team. Specification for CIL to include:
 - LSA Control Number (LCN), (or some other form of Breakdown Element Identifier), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE),
 - Commercial Data: Indicative Item Price, Purchase Lead Time
 - Position in System Structure: Indenture level, quantity fitted per higher assembly.
 - R&M data: MTBF, MTTR to replace the LRU, initial SMR Code
- **Task Inventory** of operator and maintenance tasks – to help planning for Maintenance, Technical Information, and Training. Shared with all elements within ILS and Systems Engineering Team. Specification for Task Inventory to include:
 - LSA Control Number (LCN), (or some other form of Breakdown Element Identifier), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Code, Task Frequency (per year). Both corrective and preventative maintenance tasks must be included. Operator tasks can be

included also if helpful for integration across ILS elements (Tech Docs, Training, Human Factors, etc)

The Supportability analysis tasks can give rise to a number of reports that summarise the analysis findings to help communicate results for decision makers and the customer. Detailed data resulting from the analysis will be recorded in the Logistics database, and the higher-level summaries are useful for decision makers and management who do not have database access or related navigation skills. A list of typical reports is shown below to help planners decide on the best scope for their project.

- Supportability Design Review Questionnaire for each Design Review
- Standardisation Requirements report
- Baseline Comparison System Report
- Technological Opportunities Report
- Supportability Requirements for System Design Report
- Functional Analysis Report
- Trade-Off Opportunities Report
- Trade-Off Evaluation Report
- Maintenance Task Analysis and Resource Planning Report
- Early Fielding Analysis and Plan
- Post Production Support or DMSMS Analysis Report
- Test, Evaluation and Verification Report
- Life Cycle Cost Modelling Report
- Level of Repair Analysis Report

Summary reports can be derived from the logistics database and used for design review purposes. The current industry standard for LPD summary reports is SAE TA-HB-0007-1A, an enhancement of MIL-STD-1388-2B, and contains 54 summary reports. These SAE TA-HB-0007-1A summary reports are protected by copyright and are based on the integrated data and functional areas of SAE GEIA-STD-0007C. Those from MIL-STD-1388-2B for Supportability Analysis and the other ILS elements below within the subsections of para 5.3 are provided for example purposes:

- **SA Report to Manage SA** Standardisation – Standard SA Report options (Mil Std 1388-2B) include: LSA-010. Specification for SA Report to manage SA Standardisation to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Item Name RNCC, RNVC, NSC, NC, NIIN, NCAGE from Alternative suppliers, Item Price, Unit of Issue
- **SA Report to Manage SA** New & Critical Items – Standard SA Report options (Mil Std 1388-2B) include: LSA-006 and LSA-039. LSA-006 looks at tasks being critical for exceeding a support requirement by a factor. LSA-039 looks at strategic material criticality, for raw materials. Specification for SA Report to manage Critical Items could include:
 - Critical Criteria Narrative, Critical Criteria metric (Task Frequency/MTTR), Metric value/factor, LSA Control Number (LCN), ALC, LCN Nomenclature, Part

Reference Number, Manufacturers Code (NCAGE), Task Code, Task Identification, Task Frequency, Task Elapsed Mins

- **SA Report to Manage R&M** – Standard SA Report options (Mil Std 1388-2B) include: LSA-027, LSA-058. LSA-027 provides a failure rate summary, repair policy and the maintenance events. LSA-058 looks at failure modes, failure cause, and redesign narrative. Logistics Considerations are also recorded. The links between failure modes, Safety Hazard Severity Code, Task LCN, Task Code, and Elapsed Time are shown with Failure Mode Criticality Number. Specification for SA Report to manage R&M to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure Mode, Failure rate, FRT MB, MTBF, MTBF MB, MTTR to replace, Parent Assembly LCN, Parent Item Name, Ref Number, NCAGE, Task LCN, Task Code, Task Identification, Elapsed Time, MTTR.
- **SA Report to Manage FMECA and Corrective Maintenance** – Standard SA Report options (Mil Std 1388-2B) include: LSA-056. Specification for SA Report to manage FMECA and Corrective Maintenance to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure Mode Identity, Failure Mode Ratio, Failure Model Cause, Method of Detection, Compensating Design Features, Failure Mode Criticality, Corrective Maintenance Task Identity, Task Code, Task Frequency
- **SA Report to Manage RCM and Preventative Maintenance** – Standard SA Report options (Mil Std 1388-2B) include: LSA-050. Specification for SA Report to manage RCM and Preventative Maintenance to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure Mode Identity, Failure Mode Cause, Failure Mode Ratio, Method of Detection, RCM Logic Used, RCM Logic Results, Preventative Maintenance Task Identity, Task Code, Task Frequency/Task Interval, Component Overhaul Life
- **SA Report to Manage Planned Maintenance Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-023, LSA-033, LSA-016, LSA-003, LSA-019. Specification for SA Report to manage planned Maintenance Data to include:
 - LSA Control Number (LCN), ALC, UOC, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Item Category Code, SMR Code, Quantity per assembly, Item Price, Purchase Lead Time
 - Maintenance Concept Narrative, Maintenance Plan Rationale,
 - R&M Data : MTBF, MTBMA, MTBR, MTTR, Max TTR and Percentile
 - Task data grouped by maintenance level: Maintenance Level, Task Identity, Task Code, Task Frequency, Training Required, Facility Required, Task Resources Identity (Item Name, Reference Number, NCAGE, NSN, and Quantity)
- **SA Report to Manage Support and Test Equipment (S&TE) Candidate Items** – Standard SA Report options (Mil Std 1388-2B) include: LSA-071 and LSA-074. Specification for SA Report to manage Support and Test Equipment Candidate Items to include:
 - S&TE Item Name, Reference Number, Manufacturers Code (NCAGE), Item Category Code, Indicative Item Price, Purchase Lead Time (PLT), S&TE Repair Policy, S&TE MTBF, Task LCN, Task Code, Task Identification

- **SA Report to Manage S&TE Design Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-070, LSA-072, LSA-076. Specification for SA Report to manage S&TE Design Data to include:
 - S&TE Reference Number, Manufacturers Code (NCAGE), S&TE Item Price, Purchase Lead Time, S&TE SMR Code, NSN, RNCC, RNVC
 - S&TE Functional description
 - Dimensions (L, W, H, Weight), Test Parameters, Calibration Interval
 - Associated Adapters/Connectors: Reference number, NCAGE, Item Name, NSN, Unit Under Test LCN, UUT LCN Nomenclature, UUT Reference Number, UUT NCAGE, UUT Item Name, UUT NSN. UUT SMR Code.
 - Supersedure Data: Superseded by Reference Number, Superseded by NCAGE, Reason for supersedure.
- **SA Report to Manage Facilities Design Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-012. Specification for SA Report to manage Facilities Design Data to include:
 - Facility Name, Facility Reference Number, Manufacturers Code (NCAGE), Facility floor dimensions (L x W Unit of Measure), floor area,
 - Facility Capability (Task LCN, Task Identity, Task Code), Facility Capacity (Task Frequency, Task Elapsed Time), Facility S&TE Identity
 - Facility Requirements: Maintenance requirements, Utility requirements, Training Requirements, Storage requirements, Other Requirements
- **SA Report to Manage Personnel Requirements Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-075, LSA-065, LSA-001. Specification for SA Report to manage Personnel Requirements Data to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE),
- **SA Report to Manage Technical Information and Maintenance Task Analysis Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-019. Specification for SA Report to manage Technical Information to include:
 - LSA Control Number (LCN), ALC, UOC, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Item Category Code, Task Identity, Task Code, Sub Task Number, Task procedure steps narrative, Task elapsed time, Task resource skill code, Task Resource Parts Identify (Item Name, Reference Number, NCAGE), and Quantity, Task Resource S&TE Identify (Item Name, Reference Number, NCAGE) and Quantity, Task Resource Facility Identify and Quantity, Hazardous Maintenance Procedure Code
- **SA Report to Manage Supply Support Data** – Standard SA Report options (Mil Std 1388-2B) meet the USA DoD Provisioning system and includes: Bill of Materials LSA-080, Hardware Breakdown Tree LSA-126, Provisioning Requirements LSA-036. For European project ASD/AIA S2000M provides a dataset more aligned with the introduction of equipment and inventory management systems. Specification for SA Report to manage Supply Support to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), MTBR, Repair policy (SMR Code), PLT, a commercially valid Item Price, Repair Turn Around Time, Scrap Rate for Repair,

- **SA Report to Manage PHS&T Data** – Standard SA Report options (Mil Std 1388-2B) include: Packaging LSA-025 and LSA-026, Hazardous Materials LSA-078, Transportability LSA-085. Specification for SA Report to manage Packaging to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Dimensions: L, W, D, Weight, and Measurement Bases
 - Packaged Dimensions: L, W, H, Weight, and Measurement Bases
 - Packaging Level of Protection, SPIS or Packing Drawing Reference.
 - Hazardous Material Precautions, Labelling for Hazardous material requirements.
 - Support resource requirements for packaging (Parts, S&TE, etc.): Reference Number, Item Name, NCAGE, Quantity required.
- **SA Report to Manage Training Requirements and Equipment Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-011, LSA-014, LSA-071, LSA-075. Specification for SA Report to manage Training Requirements and Equipment Data to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task LCN, Task Code, Task Identification, Task Freq, Task Elapsed Time, MTTR, Training Type Required, Training Equipment Required,

5.3.3.5 Design Interface – RAMST

The Reliability, Maintainability, Safety and Testability activity is a key influence in design to ensure the produce achieves the required Availability. The Systems Engineering team work closely with reliability engineers to ensure that the parts selection programme uses items with the right qualities and derating factors to minimise the reliability risk.

An R&M Programme Plan must be created to manage the analysis and reporting, and it will probably include the elements below:

- Carry out derating analysis and influence Parts selection processes with Systems Engineers.
- Create Reliability prediction when the physical design breakdown is available, and use the common SOI breakdown:
 - This breakdown must use a numbering identifier and configuration that is common with the Candidate Items List used by the whole ILS Team.
 - Record results in Logistics Dataset for use across the ILS elements.
 - Track changes in design and update the prediction to ensure it always reflects the as built design until superseded by field data for through life support.
- Create a Maintainability prediction to align with the initial Task Inventory, when it is published.
 - Record results in Logistics Dataset for use across the ILS elements.
 - Track changes in design and update the prediction to ensure it always reflects the as built design until superseded by field data for through life support.
- Undertake Failure Modes, Effects and Criticality Analysis (FMECA) to eliminate undesirable failure modes and validate the corrective maintenance in the initial Task Inventory.
 - To keep in step with Systems Engineering design reviews, commence Top-down FMEA in preference to a hardware based FMEA. This will enable the Design Interface programme to remain on track and not delayed from lack of Vendor data.

Delays result in loss of supportability design influence and missed opportunities, because the design review has moved the System design forwards, and it is difficult to recover the loss of influence.

- Record FMECA results in Logistics dataset.
- Track changes in design and update the Failure Mode analysis and report to ensure they always reflect the as built design through life.
- Plan and conduct any accelerated Reliability testing to de-risk the Reliability Key Performance Indicators for the SOI.

A System Safety Programme Plan must be created to manage the system safety analysis and reporting. The Hazard Analysis for the Safety Case must follow one of the recognised standards to ensure the SOI is safe to operate and maintain. Fault tree analysis must be used to support the Hazard Analysis.

5.3.3.5.1 *Standards recommended for RAMST*

- IEC 603003-10:2001 Dependability Management – Application Guide for Maintainability
- IEC 60812: Failure Modes Effects and Criticality Analysis
- IEC 61078: Analysis techniques for Dependability RBD and Boolean methods
- Mil HDBK 217F: Reliability Prediction of Electronic Equipment
- Def Stan 00-040 Reliability and Maintainability: Management Responsibilities and Requirements for Programmes and Plans
- Def Stan 00-042 Reliability and Maintainability: Assurance Activity
- Mil Std 1629A: Failure Modes Effects and Criticality Analysis.
- S4000P: International specification for developing and continuously improving preventive maintenance.
- S3000L: International procedure specification for Logistics Support Analysis (LSA)
- Mil Std 472: Maintainability Prediction
- DI-MNTY-81585 USA DID for Reliability Test Plan
- DI-MNTY-81604 USA DID for Maintainability/Testability Demonstration Test Plan
- DI-MNTY-81603 USA DID for Maintainability/Testability Demonstration Test Report

Standards for Testability

- Mil HDBK 2165: Testability Design Handbook
- Mil HDBK 1814 Integrated Diagnostics

Standards for System Safety

- Mil Std 882E: System Safety
- Def Stan 00-056: Safety Management Requirements for Defence Systems
- SAE ARP 4761: Safety Assessment Process for Civil Airborne Systems
- IEC 61508: Functional Safety

- ISO 26262: Software Compliance in the Automotive Industry

5.3.3.5.2 Processes for RAMST

Planning...

- R&M Programme Plan (see 2.2.1.3, and Annex 1 Para 3.2)

Supportability Analysis and Maintenance Process

- Perform Supportability Functional Analysis for FMECA and Maintenance (see 2.2.2.3, 2.2.2.4)
- Perform a Reliability Prediction and report (see 2.2.2.3, 2.2.2.4)
- Perform a Maintainability Prediction and report (see 2.2.2.3, 2.2.2.4)
- Perform Testability Analysis to influence the design of diagnostic systems (see 2.2.2.3, 2.2.2.4)

Supply process

- Provide Reliability Prediction Report or Reliability Case (see 2.2.2.3, 2.2.1.7)
- Provide Maintainability Prediction Report (see 2.2.2.3, 2.2.1.7)
- Provide a Testability Report to show how Testability requirement is met. (see 2.2.2.3, 2.2.3.7 and 2.2.1.7)
- Provide a Safety Hazard Report (see 2.2.2.3)

5.3.3.5.3 Outputs from Design Interface – RAMST

The outputs from the RAMST ILS element, like some others, need to be kept up to date to the point of customer delivery reflect design change. This approach improves the supportability of the SOI to ensure that design changes are properly considered for supportability up to the point of delivery. In-Service modifications and upgrades must also use the same Supportability methods to ensure supportability is designed into the changes or improvements. SAE TA-HB-0007-1A contains 54 summary reports. The summary reports in SAE TA-HB-0007-1A are protected by copyright and are based on the integrated data and functional areas of SAE GEIA-STD-0007C. Those below from MIL-STD-1388-2B are provided for example purposes. Below is a list of the minimum deliverable items/datasets expected for RAMST:

- **Reliability Prediction Report** – to help quantify System availability performance and quantify resources needed to support the System of Interest. Specification for Reliability Prediction Report to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure rate, FRT MB, MTBF, Derating and quality factors used, Item quantity fitted, Parent Assembly Item Name, Parent Reference Number, Parent NCAGE and Parent quantity fitted.
 - Reliability Block Diagrams
 - Standards and methods used.
 - Assumptions made and data sources, identifying data sources as either primary raw data or secondary pre-processed/aggregated data.
- **Maintainability Prediction Report** – to help quantify System availability performance and quantify analysis focus on reducing long duration maintenance task to improve

support the System of Interest. Specification for Maintainability Prediction Report to include:

- LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Maintenance task Identity, Task Code, quantity fitted, Task Frequency Parent Assembly Item Name, Reference Number NCAGE and quantity fitted, Task Elapsed Time, MTTR, MaxTTR and Percentile
- Reliability Block Diagrams
- Standards and methods used
- Assumptions made and data sources, identifying data sources as either primary raw data or secondary pre-processed/aggregated data
- **Safety Hazard Analysis Report** of operator and maintenance tasks – to help certification. Specification for Task Inventory to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Hazard Description, Failure Mode, Failure Mode Cause, Safety Hazard Severity Code, Task LCN, Task Code, Task Identification, Hazardous Maintenance Procedure Code, Hazardous Code for Transportation
- **Testability Report** – to help monitor progress towards compliance with Testability requirements. Specification for SA Report to manage Testability to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure Mode Identity, Failure Mode Ratio, Failure Cause, Method of Detection, Failure Consequence,
- **SA Report to Manage R&M** – Standard SA Report options (Mil Std 1388-2B) include: LSA-027, LSA-058. Specification for SA Report to manage R&M to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure rate, FRT MB, MTBF, MTBF MB, MTTR to replace, Parent Assembly LCN, Parent Item Name, Ref Number, NCAGE
- **SA Report to Manage FMECA and Corrective Maintenance** – Standard SA Report options (Mil Std 1388-2B) include: LSA-056. Specification for SA Report to manage FMECA and Corrective Maintenance to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Failure Mode Identity, Failure Mode Ratio, Failure Model Cause, Method of Detection, Compensating Design Features, Failure Mode Criticality, Corrective Maintenance Task Identity, Task Code, Task Frequency

5.3.3.6 Maintenance

The Maintenance function takes inputs from Design Interface (SA and RAMST) to rationalise the preventative elements of the Task Inventory into a series of higher-level Master Tasks. System downtime can be reduced, with shorter maintenance times, when some tasks can take advantage of improved access in a deeper level maintenance situation than the front line. Key activities are:

- Use the Candidate Items List and Task Inventory to plan and manage planned Maintenance until FMECA and RCM validate the Task inventory.

- Use the RCM outputs for maintenance planning to group low level scheduled maintenance into higher level master Task at common intervals.
- Use the RCM processes to derive the component overhaul life where required to create the Component Replacement List.
- Use Level of Repair Analysis (LORA) to develop the repair or maintenance policy for each LRU and SRU.

LORA can be processed for large System populations by a full LORA Programme using AS 1390 or for very small fleet sizes using a more pragmatic way that must account for the operational population of the SOI. If the Candidate Items List has 3000 LRUs not all will require a full LORA model. Some may only require a decision to Repair or Discard, rather than at what level to repair as the System population may guide the level/location. An initial LORA based on a decision algorithm like the one below can quickly decide on the draft repair policy.

For some items the decision may be more difficult, and LORA modelling is advised in these situations:

- Can the item be repaired? Y/N
- What skills, test equipment and facilities are necessary for repair?
- At what maintenance level/location do those resources exist or could be purchased?
- Are there reasons not to send the item to this level/location?

Medium sized populations (>20 <40) often need LORA to help repair policy decisions, as the economics are more balanced and dependent upon demand rate and quantity fitted. For small fleets <20 the cost of buying test equipment, SRU and component spares, repair facility, and training staff is often far greater than contractor repair. Organic repair is hard to justify economically for small System populations. For large fleets (>100) Organic repair is usually the economic solution, as the cost of resources is far less than Contractor repair over the System life cycle and this will be evident from any LORA modelling.

The data associated with resources used in preventative maintenance is an output required by the Supply Support function for inclusion in Provisioning process. This should also feed across to plan the illustrated parts catalogue within the Technical Information data modules.

5.3.3.6.1 *Standards recommended for Maintenance:*

- SAE JA1011 and SAE JA1012 Standard for Reliability Centered Maintenance, and A Guide to the Reliability Centered Maintenance Standard
- IEC 60300 3-10:2001 Dependability Management – Application Guide for Maintainability
- IEC 60300 3-11:2011 Dependability Management – Application Guide for Reliability Centred Maintenance
- Mil Std 3034A: Reliability Centred Maintenance
- ASD S4000P: A Specification for developing and continuously improving preventive maintenance
- Def Stan 00-045: Using Reliability Centred Maintenance to Manage Engineering Failures
- SAE AS1390 Level of Repair Analysis
- MIL-HDBK-1390: Level of Repair Analysis

- Compliance with regulatory requirements, like MSG-3 or others may be necessary

5.3.3.6.2 *Processes for Maintenance*

Planning...

- Prepare a Maintenance Concept and a planned Maintenance Programme Plan (see 2.2.3.2 and 2.2.3.3)

Supportability Analysis and Maintenance Process

- Perform Supportability Functional Analysis for FMECA and RCM (see 2.2.2.3 and 2.2.3.6)
- Perform Maintenance Task Analysis (MTA) (see 2.2.3.5)
- Develop Maintenance Plan (see 2.2.3.3)
- Perform Level Of Repair Analysis (LORA) (see 2.2.3.4)

Supply process

- Provide an RCM Report, showing analysis of Failure Modes and preventive maintenance decisions and any redesign action required (see 2.2.2.3, 2.2.2.4, 2.2.3.6, and 2.2.3.7)
- Provide a LORA Report (see 2.2.2.3, 2.2.2.4, 2.2.3.4)
- Provide a Maintenance Report, to include: LRU Repair Policies, Preventive Maintenance Schedule of Tasks and Intervals, Overhaul Life for Component Replacement, Maintenance Task Inventory with resources for each task identified. (see 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.3.4, 2.2.3.9, 2.2.3.3)

5.3.3.6.3 *Outputs from Maintenance*

- **Task Inventory** of maintenance tasks is validated by the FMECA and RCM – this helps planning for Maintenance, Technical Information, and Training. Shared with all elements within ILS and Systems Engineering Team. Specification for Task Inventory to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Code, Task Frequency (per year). Both corrective and preventative maintenance tasks should be included. Operator tasks can be included also if helpful for integration across ILS elements (Tech Docs, Training, Human Factors, etc)
 - Standard report LSA-018 from Mil Std 1388-2B provides a Task Inventory, but this uses a Job Duty definition for the USA not commonly used by other countries. An Ad hoc report is often better able to meet the need to manage the Task Inventory than using LSA-018
 - Standard Report LSA-019 provides Task Inventory and procedural step information and can be used by Maintenance planners, technical authors and training development staff.
- **SA Report to Manage planned Maintenance** – Standard SA Report options (Mil Std 1388-2B) include: LSA-016 or LSA-033. LSA-016 is good for overall summary, and LSA-033 focusses on Crew and Organisational level preventive maintenance. Specification for SA Report to manage planned Maintenance to include:
 - LSA Control Number (LCN), ALC, UOC, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), SMR Code, Quantity Per Assembly, Item Category Code, Preventative Task Codes, Task Identification, Task Interval, Man Hours.

- **SA Report to Manage Maintenance Repair Policy** – Standard SA Report options (Mil Std 1388-2B) include: LSA-023 or LSA-024. LSA-023 and LSA-024 focus more on maintenance concept and repair policy. LSA-023 includes: A Table R&M requirements, B Table R&M Data, Task/Subtask timing from Tables CA/CB, Unit of Issue Price, as items missing from LSA-024. LSA-024 includes: functional description, Table EF SERD, Table HG Maintenance Task Distribution data as items missing from LSA-023. Specification for SA Report to manage Maintenance Repair Policy to include:
 - LSA Control Number (LCN), ALC, UOC, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), SMR Code, Quantity Per Assembly, Item Category Code, Maintenance Concept, Maintenance Plan Rationale, Task Codes, Task Identification, Task Frequency, Preventative Task Interval, Man Hours, Facility Required Y/N, Support Equipment Required: Item Category Code, Item Name, Reference Number, NCAGE, Quantity per Task, Unit of Measure

5.3.3.7 Supply Support

The Candidate Items List is often used to aid development of the Supply Support programme plan to achieve the Logistics Support Date (LSD) for delivery. Purchase Lead Time data must be available to compile Long Lead Time Item Lists to help planning and ordering of longest lead items. It is important to schedule the System breakdown across a number of provisioning lists, with accompanying breakdown illustrations. These must be presented over a time scale that allows: Initial Provisioning List (IPL) preparation, IPL Review, Spares and S&TE modelling, Spares and new special to type S&TE order administration, Production and delivery in time for Logistics Support Data (LSD).

The standards used are complex and flexible to allow tailoring for project needs. Like Supportability, a Guidance Conference is usually planned shortly after SA Guidance Conference with suppliers and customer invited to agree and document agreements for data and process interpretations. The Guidance Conference should be used to motivate teams to set achievable timescales and adopt workable processes that help data sharing across ILS elements and between Customer and prime contractor. Configuration management of the data and IPLs is a significant workload and processes must be understood by all. An outcome of the IP Guidance Conference should be an integrated process to prepare and present data on spares concurrently with illustrated parts breakdown diagrams. This will enable the Customer ILS team to understand the SOI and the importance of any LRU/SRU and the related attaching or union parts.

The provisioning process should include reviews, accommodate Customer observations, be integrated with NATO Codification and permit the Customer to quantify and commercially cost the: spare parts, special to contents containers (STC), special to type S&TE and Training Equipment. This requires indicative or Firm Item Price data to be included with the IPLs after the initial Draft IPL (Formal IPL in S2000M). The inclusion of commercially valid Item Price data early enough in the provisioning process allows spare and resource modelling to assess cost drivers and budget needs to guide commercial purchase decision. It is also helpful to focus the benefits of supportability analysis on Cost drivers, based upon data, and not intuition.

Parts data from the Logistics Database identifies parts to be replaced and reason for selection. Attaching and Union parts often need to be identified and included in illustrative breakdown graphics, and these are usually identified after the part needed for maintenance.

The presentation of provisioning data with breakdown illustrations is more helpful for spares assessment than a simple list of Part Names and Reference Numbers. The results should be a System that has better spares support, provided items are bought in good quantities to account for usage, item reliability and variation in supply chain using Safety Stock

5.3.3.7.1 *Standards recommended for Supply Support*

The standard(s) to be used are those that fit best with national inventory management processes. Continued use of historic standard may not provide the best solution going forwards. A move to the ASD/AIA S2000M standard would help with data integration between Supportability Analysis, Supply Support, and the Technical Information ILS elements. The provisioning data is often jointly identified by Supportability analysts and Provisioning analysts, so the sharing of supportability data between these staffs of engineering drawings, equipment breakdown structures, and detailed characteristics data is very important. The standards below identify options to join provisioning data with illustrated parts data for technical publications:

- IEC 62550 Spare Parts Provisioning
- RM-5078-PR A multi echelon technique for recoverable item control (METRIC)
- Mil HDBK 502A + Mil Std 1388-2B standard report LSA-036 + ASDAIA/A4A S1000D
- Mil HDBK 502A + SAE GEIA-STD-0007C + ASD/AIA/A4A S1000D
- DI-ILSS-81285 USA DID for Provisioning Technical Data
- DI-ILSS-80727 USA DID for Government Furnished Material (GFM)
- ASD S4000P, ASD/AIA S3000L, ASD/AIA S2000M, ASD/AIA S6000T, ASD/AIA S5000F and ASD/AIA/A4A S1000D
- Integrated Product Support (IPS) Elements Guidebook
- UK JSP 886 Vol 7 Pt 8.10 Supportability Engineering – Supply Support
- STANAG 4597 / ISO 62402 Obsolescence Management
- UK JSP 886 Vol 7 Pt 8.13 Supportability Engineering – Obsolescence Management
- UK JSP 886, Vol7 Pt2 ILS Management
- UK JSP 886 Vol 7 Pt 8.15 Supportability Engineering – Gatekeeper Role In Utilisation Of Common Defence Materiel

Standards for NATO Codification are:

- ACodP-1
- ACodP-1 + DEFCON117
- ACodP-1 + National contractual requirements for Codification
- FEDLOG, database of Federal Stock Numbers
- NATO Master Catalogue of Reference for Logistics (NMCRL), database of NATO Stock Numbers
- Electronic NATO Ammunition Database (Enabd)

5.3.3.7.2 *Processes for Supply Support*

Planning...

- Supply Support Programme Plan (see 2.2.1.3, 2.2.4.2)

- Plan the Initial Provisioning Guidance Conference and plan the Guidance Document (see 2.2.1.4)

Supportability Analysis and Maintenance Process

- Perform Supportability Task Analysis to identify spares and special to type Support and Test Equipment and attaching and/or union parts for Initial Provisioning (see 2.2.2.3, 2.2.3.5, 2.2.2.4, 2.2.3.9, and 2.2.4.3)
- Perform Parts Screening and NATO Codification (see 2.2.4.3)
- Prepare Initial Provisioning Lists and Illustrated Breakdown Graphics or Data Modules (see 2.2.4.3)
- Manage Configuration of Initial Provisioning Lists, associated data and illustrations (see 2.2.1.6, 2.2.4.3)
- Manage IPL Reviews and Observations (see 2.2.4.3)
- Perform modelling to recommend Spares and special to type S&TE quantities for purchase (see 2.2.2.2, 2.2.2.3, 2.2.2.4, and 2.2.4.3)

Supply process

- Deliver Initial Provisioning Guidance Document (see 2.2.1.4)
- Deliver Initial Provisioning Data for review (2.2.4.3)
- Deliver Provisioning data to apply for NATO Codification (see 2.2.4.3)
- Deliver Spares and S&TE Report Quantity Recommended for Purchase recommending the quantity of spare parts and S&TE for purchase (see 2.2.2.3, 2.2.2.4, 2.2.5.2 and 2.2.2.2)
- Purchase the required material and manage delivery to meet System delivery profile (see 2.2.4.4, and 2.2.5.3)

5.3.3.7.3 *Outputs from Supply Support*

Supply Support Programme plan to manage the provisioning and order administration of spare parts and material for the SOI. This includes process for NATO Codification screening and application for Codification. For a plan outline, see 2.2.4.2 and Annex 1 Para 3.4

- Initial Provisioning Guidance Document to record the agreement of implementing ASD/AIA S2000M or other provisioning standard, between Customer, Contractor and suppliers. A document reference below, used by the UK MoD from Def Stan 00-60, Issue 1, Part 0, Annex D, lists UK DID 4001 was used to propose the specification below:
 - Explanation of Contractors approach to Initial Provisioning (IP)
 - Outline of IP programme and timescales
 - Level of Presentation of IP required
 - Requirements for CSN or Part Numbered IP List (IPLs)
 - Requirements for Long Lead Time Items List
 - How Government Furnished Equipment (parts and S&TE) and new special to type S&TE will be incorporated into the IP process and Illustrated parts Catalogue via IP Data Modules
 - Customer parameters for spares recommendations
 - Parts Data Commonality how used and addressed

- Concurrent ordering of spares with production
- Deviations from standard S2000M processes
- NATO Codification requirements
- **NATO Codification Report** to identify items from screening to apply for Codification. Specification for Codification Report to manage codification application data and workload to include:
 - LSA Control Number (LCN), Part Item Name, Item Name Code, Part Reference Number, Manufacturers Code (NCAGE), Functional Description of item, Colloquial Name, Reference Number Justification Code (RNJC), Reference Number Category Code (RNCC) Reference Number Variation Code (RNVC), NATO Supply Classification Group, Nation Code, National Item Identification Number (NIIN) Type of Items Identification Code, Manufacturers Drawing Number, Characteristics data including dimensions and weight
- **Initial Provisioning Lists** of spare parts and their parent assemblies– this helps to: gain customer understanding of spares through reviews, quantify parts for spares for ordering, process NATO Codification, and design Packaging. Data is often shared with most elements within ILS and Systems Engineering Team. Specification for Initial Provisioning Lists to include:
 - Parts Identity: LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE)
 - Position in System Structure: Indenture level, Quantity Per Next Higher Assembly
 - Why spare is needed: Reason For Selection, Spare Parts Category, :
 - Reliability & Repair Date: Repair Policy (SMR Code), Repair Turn Round Time or Repair Cycle Time, Scrap rate, Repair Cost.
 - Commercial data: Item Price, Purchase Lead Time, Minimum Order Quantity, and recommended quantity for purchase
 - Unpackaged data: Unpackaged Weight, Unpackaged Dimensions: L, W, H, and Measurement Base
 - Packaging Data: Packaged Weight, Packaged Dimensions: L, W, H, level of Package Protection, Packaging Type, Packaged Quantity, Package Labelling Data: Hazards, precautions, etc
 - Identity of Category 1 or Special To contents Containers (STC), by Part Name, Part Reference Number, Manufacturers Code (NCAGE), and recommended quantity
 - Illustrations with multiple items presented in disassembly sequence with attaching and union parts with whole System context graphic
- **Provisioning Report** to identify Spares and Special to Type S&TE for procurement. Specification for Provisioning Report to manage spares and new special to type S&TE to include:
 - LSA Control Number (LCN), Part Name, Part Reference Number, Manufacturers Code (NCAGE),
 - Reliability and Repair data: MTBF, Item Price, PLT, Repair Policy or SMR Code, Repair cycle Time, Scrap Rate, Repair Price, Quantity Per Next Higher Assembly, Quantity Per End Items, Reason part selected,
 - Packaging Data: Unpacked Dimensions at Weight; L x W x H, Wt, Packaged Dimensions and Weight; L x W x H; Wt, and Measurement Base

- **Spares and S&TE Report Quantity Recommended for Purchase** to identify Spares and Special to Type S&TE quantity for procurement. Specification for Spares Quantity Report to manage purchase of spares and new special to type S&TE to include:
 - Parts Identity: LSA Control Number (LCN), Part Name, Part Reference Number, Manufacturers Code (NCAGE),
 - Type of item: Spare, Attaching part, Union part, S&TE, GFE Spares, GFE S&TE, GFE Attaching part or Union part
 - System Position data: Quantity Per Next Higher Assembly, Quantity Per End Items, Reason part selected,

5.3.3.8 Support and Test Equipment

The Candidate Items List and Task Inventory is the starting point for planning in S&TE. These documents provide visibility of the items to be supported, through replacement, testing, repairing, handling, or training. The primary aim in this ILS element is to use whatever items of S&TE are already on Customer inventory. Only when the S&TE requirement cannot be met from existing inventory should new items be developed. If the built in test requirements are stringent enough, and the LRU mass requirement is low enough, the need for new S&TE can be mostly minimised by these supportability requirements.

Identify the need for off equipment S&TE, where Built in Test and Testability design do not cover the failure modes to enable diagnosis, or where lifting or other types of S&TE are required. Alternatively, MTA may have identified the need for S&TE, and the effective test solution must be sought/developed.

Undertake Make or Buy analysis, and plan to implement the decision best for the System supportability. Assess whether an item of Government Furnished Equipment S&TE is available with the correct parameters and specification to save new design entering the inventory.

Design S&TE including Supportability design influence, Build and Test S&TE prototypes, Record engineering and commercial data for Supportability and Supply Support, Manufacture S&TE, Test and Certify S&TE where required. Assess the calibration or inspection intervals and agree interval with Maintenance team undertaking the RCM Analysis.

Ensure each item of Test and Measurement S&TE has the associated Unit Under Test (UUT) recorded, along with UUT parameters. This will help identify replacement S&TE should items become obsolescent/obsolete and lifetime buy options are not available.

Ensure S&TE specification includes adequate packaging protection, or a case where required for transportation or everyday use, to ensure it meets an appropriate design life. Seek help from Technical Information to create a User Guide Data Module for the S&TE if its operation or support is complex enough to require explanation for users.

Assess the Quantity for production or purchase to meet the forecast usage rates and S&TE repair policy, likely repair loop delays, purchase lead time, and product life duration. Include the number of user Units to develop an equipment S&TE scale appropriate for the end user.

Ensure S&TE data is recorded in Logistics database and available with S&TE Candidate Items List. Share S&TE data across ILS elements to ensure items can be selected for use with maintenance tasks and identified for procurement by Supply Support team through IPLs and Illustrations.

5.3.3.8.1 *Standards recommended for Support and Test Equipment*

The standard(s) to be used are those that fit best with national inventory management processes. Continued use of historic standard may not provide the best solution going forwards. A move to the ASD S4000P and ASD/AIA S3000L for Supportability/Preventive Maintenance planning and S2000M for Supply Support would help with data integration between S&TE Design, Supportability Analysis, Supply Support, and the Technical Information ILS elements.

The USA has a standard/process for S&TE management the Support Equipment Recommendation Data (SERD), defined by data item, DI-ILSS-80118C and Mil HDBK 2097A. Europe does not have an equivalent. The UK has Gatekeeper roles to encourage standardisation for Automatic Test System, Deployable workshops, General and Special Purpose Test and Measurement Equipment, Aircraft Ground Support Equipment, Hand tools, Training Equipment and Simulators, and Workshop tools and Equipment. Projects and Contractors should seek advice from their military ILS Manager.

The provisioning data is often jointly identified by Supportability/S&TE analysts and Provisioning analysts, so the sharing of supportability data between these staffs of engineering data/models, and detailed characteristics data is very important. The provisioning of new items is processed via initial provisioning methods and common items already in-Service are usually identified as Government Furnished. Once quantified by the Contractor their supply is arranged by the Customer. The standards below identify options for Testability and S&TE:

- Mil HDBK 2165: Testability Handbook
- DI-ILSS-80118C USA Data Item Description – Support Equipment Requirements Data
- DI-ILSS-80868 Special Equipment Tools and Test Equipment List
- Mil HDBK 2097A: Acquisition of Support Equipment and Associated ILS
- Integrated Product Support Elements Guidebook, 2021
- UK JSP 886 Vol 7 Pt 8.06 Supportability Engineering – Test Equipment
- UK JSP 886 Vol 7 Pt 8.07 Supportability Engineering – Support Equipment
- UK JSP 886 Vol 7 Pt 8.15 Supportability Engineering – Gatekeeper Role in Utilisation of Common Defence materiel
- UK JSP 886 Vol 7 Pt 8.17 Calibration Policy
- Def Stan 05-055 Measurement and Calibration System Requirements
- Def Stan 66-031 Basic Requirements and Tests for Electrical and Electronic Test and Measurement

5.3.3.8.2 *Processes for Support and Test Equipment*

Planning...

- Prepare a Support and Test Equipment Element Programme Plan (see 2.2.1.3, 2.2.5.2, and Annex 1 Para 3.5)

Supportability Analysis and Maintenance Process

- Identify the S&TE needs and issue S&TE Candidate Items List (see 2.2.2.3, 2.2.2.4, 2.2.5.2)

- Review S&TE Candidates to determine if Government Furnished or new S&TE is required (see 2.2.2.3, 2.2.2.4, 2.2.5.2)
- Perform make/buy analysis for new S&TE to determine procurement strategy (see 2.2.2.3, 2.2.2.2, 2.2.2.4 and 2.2.5.2)
- Design, build, test, qualify/certify new S&TE (see 2.2.5.3)
- Perform Supportability Post-Production Support or DMSMS Analysis for S&TE to set up for obsolescence management during Utilisation and Support Stages (see 2.2.1.11, 2.2.2.3 and 2.2.2.4)
- Perform Supportability Analysis to quantify the S&TE needed at each Maintenance level for each Unit, including operating and maintenance units. (see 2.2.2.3, 2.2.2.2 and 2.2.2.4)

Supply process

- Provide S&TE Candidate Items List data (see 2.2.2.3, 2.2.2.4, 2.2.3.5, and 2.2.5.2)
- Provide S&TE Design requirements data for new S&TE items (see 2.2.2.4)
- Provide S&TE (see 2.2.5.3)

5.3.3.8.3 *Outputs from Support and Test Equipment*

SAE TA-HB-0007-1A contains 54 summary reports. The summary reports in SAE TA-HB-0007-1A are protected by copyright and are based on the integrated data and functional areas of SAE GEIA-STD-0007C. Those below from MIL-STD-1388-2B are provided for example purposes.

- **S&TE Candidate Items List** of all S&TE items. New special to type S&TE is to be included with Customer or Government Furnished Equipment S&TE to provide visibility of the full S&TE range of items to support the SOI. Specification for S&TE CIL to include:
 - S&TE Item Name, S&TE Reference Number, Manufacturers Code (NCAGE), Item Category Code (Mil Std 1388-2B DED 177): Tool, Test Equip, Lifting Equip, Common or Peculiar.
 - Commercial Data: S&TE Indicative Item Price, S&TE Purchase Lead Time
 - Reason(s) for S&TE Need: Task LCN(s), Task Identification(s), Task Code(s)
 - Specification: Brief functional description of main feature: e.g. to lift LRU 26 with mass 75kg, or Test power of LRU 42.
- **SA Report to Manage S&TE Candidate Items** – Standard SA Report options (Mil Std 1388-2B) include: LSA-071, LSA-008, LSA-037 (sections C and D), and LSA -074. Specification for SA Report to manage S&TE Candidate Items to include:
 - S&TE Reference Number, Manufacturers Code (NCAGE), S&TE Item Name, S&TE NSN, Maintenance Level used, Item Category Code
 - S&TE Item Price, PLT, S&TE MTBF, Quantity Required in Task
 - Support Equipment functional description
 - Supported LCN
- **SA Report to Manage S&TE Design Data** – Standard SA Report options (Mil Std 1388-2B) include: LSA-007, LSA-070, LSA-072, LSA-076. Specification for SA Report to manage S&TE Design Data to include:
 - LCN, LCN Nomenclature, UOC, Task Code, Task Identification

- S&TE Reference Number, Manufacturers Code (NCAGE), S&TE Item Name, S&TE NSN, Maintenance Level used, Item Category Code
- Dimensions, Test Parameters, Calibration Interval
- Item Price, PLT
- **SA Report to Manage S&TE Procurement** – Standard SA Report options (Mil Std 1388-2B) include: LSA-008, LSA-013, LSA-011, LSA-074, LSA-076. Specification for SA Report to manage S&TE Design Data to include:
 - S&TE Reference Number, Manufacturers Code (NCAGE), S&TE Item Name, S&TE NSN, Maintenance Level used, Item Category Code, Task LCN, Task Code, Task Identification, Quantity required per task, S&TE SMR Code, Item Price, Purchase Lead Time
 - Calibration Interval
 - Test Parameters
 - Unit Under Test (UUT) LCN, UUT LCN Nomenclature, UUT Reference Number, UUT NCAGE, UUT SMR Code

5.3.3.9 Training and Training Support

Many countries have national standards for training. The key aspect here is maximise the available data and analysis from SA to benefit Training Needs Analysis or Training Course or Training Equipment design.

Training development analysts need to work closely and share data with Supportability and many element groups within ILS. The Training Needs Analysis is guided by the Candidate Items List and Task Inventory for operator and maintenance personnel. The Task inventory identifies the range of activity and the outline training requirement. Training or Learning Objectives are an essential element of Training Analysis as they determine what must be taught and to what standard. Enabling Objectives should be identified to support the Training/Learning Objectives.

A Training Gap analysis will compare existing and the required skill levels to determine the training content and method of delivery. This may require Training Equipment that will require cooperation with the S&TE ILS element for introduction and support.

Development of Training material will share as far as possible the data modules created by the Technical Information team for the technical publications to minimise duplication of effort or configuration control errors. Cooperation with the Workforce and Personnel manager will be essential to plan the schedule of the number of staff to be trained to meet Logistics Support Date and the delivery rate of the System of Interest.

5.3.3.9.1 Standards recommended for Training and Training Support

The standard(s) to be used are those that fit best with national personnel management processes. A move to the ASD/AIA S6000T for Training Needs Analysis and Training Design will integrate well with Supportability Analysis using ASD/AIA S3000L, and ASD/AIA/A4A S1000D for Technical Information.

The standards below identify options for Training and Training Support:

- Mil HDBK 29612-1A: Guidance for Acquisition of Training Data

- Mil HDBK 29612-2A: Instructional Systems Development Approach to Training Design
- DI-ILSS-80570 USA DID for Training Needs Analysis
- DI-ILSS-80872 USA DID for Training Equipment
- DI-ILSS 81070 USA DID for Training Development
- Integrated Product Support Elements Guidebook, 2021
- ASD/AIA S6000T: International Specification for training analysis and design
- UK JSP 822 (parts 1 to 10) Direction and Guidance for Training and Education, including Defence Systems Approach to Training (DSAT)
- UK JSP 886 Vol 7, Part 8.01 Supportability Engineering – Training and Training Equipment

5.3.3.9.2 *Processes for Training and Training Support*

Planning...

- Training Management Programme Plan (see 2.2.1.3 and Annex A Para 3.6)

Supportability Analysis and Maintenance Process

- Perform Supportability Analysis (Maintenance Task Analysis) to identify training requirements (see 2.2.2.3, 2.2.2.4 and 2.2.3.5)
- Perform Training Needs Analysis (see 2.2.6.2)
- Perform Training Support requirements analysis (see 2.2.6.3)
- Perform Training Gap Analysis (see 2.2.6.2, 2.2.6.4)
- Perform Training Design (see 2.2.6.5)

Supply process

- Provide Training Equipment to facilitate training delivery to meet LSD or another agreed timescale (see 2.2.6.6)
- Provide Training for personnel to meet LSD (see 2.2.6.7)

5.3.3.9.3 *Outputs from Training and Training Support*

- **Training Needs Analysis** identifies the training objectives for each aspect of operator and maintenance tasks. Specification for Task Inventory to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Code, Task Frequency (per year). Both corrective and preventative maintenance tasks should be included. Operator tasks can be included also if helpful for integration across ILS elements (Tech Docs, Training, Human Factors, etc)
- **SA Report to manage Training Equipment** – Standard SA Report options (Mil Std 1388-2B) include: LSA-011. Specification for SA Report to manage Training Equipment to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Code, Task Identification, Task Frequency, Task Elapsed Time, Skill Code, and Task Man hours
- **SA Report to manage Training Needs Analysis** – Standard SA Report options (Mil Std 1388-2B) include: LSA-014. Specification for SA Report to manage TNA to include:

- Skill Code, LSA Control Number (LCN), LCN Nomenclature, Task Frequency, Task Code, Task Identification, Training Type Recommendation, Task Conditions, Performance Standards, Rationale for Training Recommendation, Rational for Training Location
- **SA Report to Manage Workforce and Personnel** – Standard SA Report options (Mil Std 1388-2B) include: LSA-075. Specification for SA Report to manage Personnel and Training to include:
 - LCN, ALC, LCN Nomenclature, UOC
 - Skill Code, Maintenance Level, Available Man Hours per Year, Actual man hours per Year, Available Quantity, Actual Quantity.

5.3.3.10 Technical Information

The planning for Technical Information benefits from the Candidate Items List and Task Inventory of Operator and Maintenance tasks. The first stage is to scope the requirement for data modules and created the draft Data Module Requirements List (DMRL).

Working closely with Human Factors and Training specialists for operator tasks, and Supportability analysts for maintenance and support resources information, technical authors use the Logistics database as a primary source of data and are recipients to collate and present the data in the deliverable Technical Manual. The technical authors can contribute to Task Analysis with the SA team to record:

1. Procedural steps
2. Resources Required
3. Resource Qty
4. Training Requirement
5. Facility Requirements
6. Training Equipment Requirement
7. S&TE Requirement
8. Redesign proposals where the key supportability goals are exceeded, for example: maintenance task has access difficulties or MTTR or much greater than the 95% Max TTR.

Technical Information also benefits from Human Factors Operator Task Analysis and Training Analysis as input to the compilation of Operator Manuals

Supply Support data for Initial Provisioning is used to plan and manage the graphics required for illustrated parts catalogue data modules. The ASD/AIA S2000M provisioning process presents Initial Provisioning List (IPL) data and illustrations in a review process to inform discussions on spares selection and new S&TE. These combined data and illustrations form the IP Data modules for the Technical Information delivery.

5.3.3.10.1 *Standards recommended for Technical Information*

The standard(s) to be used are those that fit best with national documentation management processes. A move to the ASDAIA/A4A S1000D for electronic documentation will integrate well with Supportability Analysis using ASD/AIA S3000L, and S2000M for Supply Support.

The standards below identify options for Technical Information:

- Mil DTL 87268D: Specification for Interactive Electronic Technical Manuals
- Mil DTL 87269: Database Revisable Interactive Electronic Technical Manuals
- Mil HDBK 523: Guide to general style and format of S1000D Technical Manual Data Modules
- Mil Std 38784B: General Style and Format for Technical Manuals
- Mil Std 3031A: Army Business Rules for S1000D
- Mil Std 3048B Air Force Business Rules for S1000D
- DI-TMSS-81952: USA DID for S1000D Project Business Rules Exchange (BREX)
- Integrated Product Support Elements Guidebook, 2021
- ASD/AIA/A4A S1000D: Specification for Technical Documentation
- UK JSP 886 Vol 7, Part 8.05 Supportability Engineering – Technical Documentation
- Def Stan 00-600 Pt 03: ILS requirements for MOD Projects: Logistic Information Requirements
- Def Stan 00-601 : MOD Business Rules – Contracting for Technical Documentation:
 - PT 01 AIR S1000D Business Rules
 - PT 02 MARITIME S1000D Business Rules
 - PT 03 LAND S1000D Business Rules
 - PT 04 Non S1000D Business Rules

5.3.3.10.2 *Processes for Technical Information*

Planning...

- Technical Information Programme Plan (see 2.2.7.2)
- Plan the Technical Information Guidance Conference and Guidance Document to record the conference agreements on interpretation of standards and processes. (see 2.2.7.2)

Supportability Analysis and Maintenance Process

- Use initial Task Inventory to generate an early DMRL (see 2.2.7.2, 2.2.2.4)
- Perform Task Analysis of operator and maintenance activities to record process steps and procedures to create data modules (see 2.2.2.32.2.3.5, 2.2.2.4, and 2.2.7.2)

Supply process

- Provide Technical Information Guidance Conference Document (see 2.2.1.4)
- Provide the Data Module /Management Requirements List (DMRL) for review and acceptance (see 2.2.1.7, 2.2.7.3)
- Provide Data Modules for the Review process (See 2.2.7.3)

- Provide Technical Publication to support the System for LSD (see 2.2.7.3, 2.2.1.7)
- Provide Technical Publication Common Source Database to support the System for LSD (see 2.2.7.3, 2.2.1.7)
- Provide Technical Information to support a Maintainability Demonstration to validate the Logistics Database content (see: 2.2.7.3, 2.2.1.7 and 2.2.2.3)

5.3.3.10.3 *Outputs from Technical Information*

- **Technical Information Management Plan.** A document reference below, used by the UK MoD from Def Stan 00-60, Issue 1, Part 0, Annex D, lists UK DID 3006 was used to propose the specification below.
 - Description of publication development method
 - Explanation of how SA data, operational data, engineering data, operator data and test data will be used in the publication
 - Methods for achieving consistent and common use of data
 - Standards and specifications to be used
 - How the integration and associated activity, and subcontractors' efforts, are related and controlled
 - Documentation development plan and approval procedures
 - Preliminary documentation development and distribution methods
 - First, and second verification procedures
 - Preparation and In-Process Review procedures, controls and schedules
 - System for storage and retrieval of data and method to prevent duplication of data already developed
 - DM preparation and control
 - Method of handling routine and priority changes and supplements
 - Method of handling routine and priority changes and supplements
 - Controls over classified information
 - Methods of incorporating engineering changes, and instructions/information furnished by the MOD, for inclusion in documentation
 - Explain how the use of existing customer documentation and existing commercial documentation will be integrated with the final publication
 - The plan shall include a brief description of the contents of each deliverable or groups of deliverables
 - The Plan should detail the timescales for all Technical Information deliveries
- **Technical Information Guidance Document.** This Document should contain the guidance relating to implementing S1000D business rules and processes agreed between the Customer, Contractor and supplier for the SOI.
- **Data Module Requirement List/Data Management Requirements List (DMRL)** to plan and manage the technical author workload. This requirement is often derived from a combination of Candidate Items List and Task Inventory and includes Operator and Maintenance Tasks. A document reference below, used by the UK MoD from Def Stan 00-60, Issue 1, Part 0, Annex D, lists UK DID 3001 was used to propose the specification below:
 - DMRL Status
 - Data Module Code, Data Module Title, Issue Number, Issue Date, DM QA status, DM Classification, LCN, LCN Nomenclature.

- **Delivery of Data Modules** – The actual delivery of data modules and publication data modules. Specification for to manage Data Module delivery:
 - Publication Modules
 - BREX data modules
 - Data Modules
- **Common Source Database (CSDB) delivery** – The actual delivery of data modules, publication data modules complete with links.
- **SA Report to Manage Technical Information** – Standard SA Report options (Mil Std 1388-2B) include: LSA-019. Specification for SA Report to provide data module source data for maintenance includes:
 - LSA Control Number (LCN), ALC, UOC, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Item Category Code, Task Identity, Task Code, Sub Task Number, Task procedure steps narrative, Task elapsed time, Task resource skill code, Task Resource Parts Identify (Item Name, Reference Number, NCAGE), and Quantity, Task Resource S&TE Identify (Item Name, Reference Number, NCAGE) and Quantity, Task Resource Facility Identify and Quantity, Hazardous Maintenance Procedure Code

5.3.3.11 Workforce and Personnel

The Candidate Items List and Task Inventory provide the personnel manager with an early view of the potential requirements for the range of personnel skills. The operator and maintenance Task Inventory is of concern to Human Factors specialists, who through the design influence aspect look at the human interface, the look and feel of equipment to operator and maintenance personnel for consistency of symbology and presentation style. The workload analysis identifies critical operator tasks, and their design influence interacts with systems engineering to ensure operators are not overloaded during a mission.

For maintenance staff, the Customer usually mandates standards that include requirements for maintenance space to ensure hand tools can be used by a range of staff, usually a 5 to 95% range of personnel to account for size and strength. These ensure the safety and health of staff whilst supporting the SOI. Hazardous maintenance procedures should be identified, revised to remove the hazard, and record in the logistics database for visibility by technical authors and Training development team.

Later, once the task frequencies are understood, the number of personnel required for each skill becomes more apparent. This requires close understanding and working with the maintenance, training and supportability analysts for data sharing and understanding of changes to configuration and requirements.

Once the number of personnel for each skill has been quantified, the number and rate that need to be trained is the next concern. The source of personnel is a customer concern, and the military ILS Manager will want to be kept informed of the early fielding analysis and plans to know the rate of deployment for trained operator and maintenance staff to operating and supporting Units.

5.3.3.11.1 *Standards recommended for Workforce and Personnel*

Nations have their own preferences for standard and requirements for human factors analysis. The standards and guides listed below may help nations that have no standards of their own. The standards below identify options for Human Factors Engineering:

- Mil Std 1472H: Human Engineering Design Criteria
- Mil Std 740-2: Structure borne vibratory Acceleration Measurement
- Mil Std 1474E: Design Criteria Standard Noise Limits
- Mil Std 1787D Aircraft Display Symbolology
- Mil Std 46855A Human Engineering Requirements for Military Systems, Equipment and Facilities
- Mil HDBK 759C: Human Engineering Design Guidelines
- Mil HDBK 1280: Keyboard Arrangements
- MIL-HDBK-1473A: Color Marking of Army Materiel
- USA JSSG-2010 Joint Service Guide Crew Systems
- DOD HBK 743A: Anthropometry Data
- UK JSP 912 Human Factors (Pt1: Directive. Pt2: Guidance)
- Def Stan 00-025 Human Factors Engineering

5.3.3.11.2 *Processes for Workforce and Personnel*

Planning...

- Prepare a Workforce and Personnel Element Programme Plan (see 2.2.1.3 and Annex 1 Para 3.8)

Supportability Analysis and Maintenance Process

- Identify the sources of personnel to support the SOI, Operations and Maintenance (see 2.2.8.2)
- Perform Supportability Analysis for Personnel to quantify the personnel by Skill Code or Trade annotation (see 2.2.2.3, 2.2.2.4, and 2.2.2.2)

Supply process

- Provide Personnel (see 2.2.8.3)

5.3.3.11.3 *Outputs from Workforce and Personnel*

SAE TA-HB-0007-1A contains 54 summary reports. The summary reports in SAE TA-HB-0007-1A are protected by copyright and are based on the integrated data and functional areas of SAE GEIA-STD-0007C. Those below from MIL-STD-1388-2B are provided for example purposes.

- **Personnel Utilisation** by Skill Code and maintenance level to review the Man hours per year. This helps to quantify the number of personnel required before shift and holiday allowances are made. Specification for Task Inventory to include:
 - Skill Code, Maintenance level, Man Hours Per Year

- **SA Report to Manage Workforce and Personnel** – Standard SA Report options (Mil Std 1388-2B) include: LSA-001. Specification for SA Report to manage Personnel Utilisation to include:
 - Skill Code, Maintenance Level, Man Hours per Year
 - Skill Code, LCN Nomenclature, Task Code, Task Identification, Task Frequency, Training Equipment Required Y/N, Man Hours per Person ID.
- **SA Report to Manage Workforce and Personnel** – Standard SA Report options (Mil Std 1388-2B) include: LSA-065. Specification for Report to manage Personnel Requirements to include:
 - Skill Code, Person ID, Maintenance Tasks grouped (by Unscheduled/ Scheduled, On/Off Equipment), Man Hours per Person ID, Task Code, Task Identification, Task Frequency, MTBMA, Task Criticality.
- **SA Report to Manage Workforce and Personnel** – Standard SA Report options (Mil Std 1388-2B) include: LSA-075. Specification for SA Report to manage Personnel and Training to include:
 - LCN, ALC, LCN Nomenclature, UOC
 - Skill Code, Maintenance Level, Available Man Hours per Year, Actual man hours per Year, Available Quantity, Actual Quantity.

5.3.3.12 Packaging Handling Storage & Transportation

Packaging design activity is driven by the Candidate Items List and analysis of the Task Inventory. The resources used, that need to be transported, handled and stored will need protection, and packaging designs and labelling will be necessary to meet these requirements. Some reparable items will probably require have reusable packaging in the form of Special to Contents or Category 1 Containers. Larger items often require handling equipment to lower an item into the packaging case.

Handling requirements come from a review of the Task Inventory accounting for the dimensions and weight of LRUs and other replace items, with guidance from human factors team. In addition, the need to handle items into and out of packaging and on a 'repair bench' may create new handling requirements that lead to the design of lifting equipment to support the maintenance personnel. The new handling equipment will then be managed as Candidate Items for a selection, make or buy decision and be managed by the S&TE ILS Element. The Handling requirements may also be generated from the review of Safety Hazard Data sheets for materials that require special handling procedures. These will be passed to the Technical Publications team.

Storage requirements have an input from Safety Hazard Data sheets, where special handling and storage requirements require notices in the related Technical Publication data module.

Transportability analysis will use customer requirements from ConOps and ConUse to understand the mobility requirements on a system of interest. The System may need to be disassembled into sections for transportation via aircraft, road, rail or sea. The Systems engineers should have included this within the basic concept and transportability analysis will set about validated the design with trials to ensure that safe loading is normal procedure. This may also involve human factors engineers.

5.3.3.12.1 *Standards recommended for Packaging Handling Storage & Transportation*

The standard(s) to be used are those that fit best with national inventory management processes. There is no ASD/AIA S-Series specification guiding **Packaging Handling Storage & Transportation** (PHS&T) analysis. The USA and UK have standards/processes for Packaging Protection and Design solutions. Other related standards can be found below.

- Mil Std 2073-1E: Military Packaging
- DI-PACK-80120C: US DID for Preservation and Packing Data
- DI-PACK-80121C: US DID for Special Packaging Instructions
- Mil Std 129: Marking for Shipment and Storage
- Mil Std 834: Packaging Data Forms
- Mil Std 1366E: Transportability Criteria
- UK JSP 886 Vol 7 Pt 8.02, Packaging Handling Storage and Transportation
- UK Def Stan 81-41 Pt2: Packaging Design
- UK DefCon 129: Packaging Requirements
- UK Def Std 81-41 Pt4: SPIS, Services Packaging Instruction Sheet

5.3.3.12.2 *Processes for Packaging Handling Storage & Transportation*

Planning...

- PHS&T Element Plan (see 2.2.1.3, 2.2.9.2 and Annex 1 Para 3.9)

Supportability Analysis and Maintenance Process

- Perform Supportability Analysis (Packaging Requirements) to identify items needed for maintenance and related packaging design activity (see 2.2.2.3, 2.2.2.4, and 2.2.9.2)
- Perform Packaging Design (see 2.2.9.2)
 - Packaging Design and Labelling is influenced by Sustainability Engineering and Environmental Conditions and Recoverability (see 2.2.9.2, 2.2.2.3, 2.2.2.4, 2.2.12.2, and 2.2.13.2)
- Review Task Inventory to identify hazardous activities with help from Human Factors to record maintenance data and training material (see 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.7.2, 2.2.6.2 and 2.2.8.2)

Review Task Inventory to identify hazardous materials with help from Environmental Conditions and Recoverability team to record provisioning data and training material (see 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.4.3, 2.2.6.2 and 2.2.13.2) Supply process

- Provide Packaging for all spares delivered for LSD (see 2.2.9.3)
- Provide Special to Contents Containers, or Cat 1 Containers for items delivered in reusable packaging (see 2.2.9.3, 2.2.4.3)
- Provide a Handling Report of hazardous tasks and material (see 2.2.3.5, 2.2.2.3, 2.2.9.2, and 2.2.8.2)
- Provide a Storage report for general storage requirements of spares etc, and special storage for hazardous materials with assistance from Environmental Conditions and Recoverability (see 2.2.4.3, 2.2.2.2, 2.2.5.2, 2.2.9.2, and 2.2.13.2)

- Provide a Transportability analysis report recording issues for transportability of the System, sections of the system or any hazardous materials used to support the System with assistance from Supportability Analysis and Sustainment Engineering (see 2.2.2.3, 2.2.2.4, 2.2.4.3, 2.2.5.2, 2.2.9.2 and 2.2.12.2)

5.3.3.12.3 *Outputs from Packaging Handling Storage & Transportation*

- **Packaging Requirements Report** of items identified as required for maintenance to identify and manage the packaging design workload. Identification of reusable packaging and use of special Support Equipment is helpful for planning of Maintenance, Technical Information, and Training. Specification for Packaging Report should include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), NSN, Task Code, Task Identity, Task Frequency, Item Category Code, Unit Dimensions (L, W, H), Size Measurement Base, Weight, Weight Measurement Base, Packaging Drawing Number, Hazardous Code, SPI Number
- **SA Report to Manage Packaging** – Standard SA Report options (Mil Std 1388-2B) include: LSA-025 and LSA-026. Specification for SA Report to manage Packaging to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), NSN, Unit Dimensions (L, W, H), Size Measurement Base, Weight, Weight Measurement Base, Packaged Unit Dimensions (L, W, H), Size Measurement Base, Packaged Weight, Weight Measurement Base, Quantity per Package, Degree of Protection, Unit Container Code, Unit Container Level, Packaging Code, Packaging Category Code, Method of Preservation, Cleaning and Drying Procedures, Preservation Material code, Wrapping Material, Cushioning and Dunnage Material type, Cushioning Material Thickness, Hazardous Code, Special Marking Code, Container NSN, Supplemental Packaging Data, SPI Number, Packaging Data Preparer NCAGE
- **Handling Requirements Report** of items identified as requiring special handling equipment. Identification of reusable packaging and use of special Support Equipment is helpful for planning of Maintenance, Supply Support, Technical Information, and Training. Specification for Handling Report should include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Dimensions L W H, Weight, Support Equipment Name, SE Reference Number, SE NCAGE, SE NSN, Special to Contents Container/CAT 1 data: (Name, Reference Number, NCAGE, NSN, Dimensions, L, W, H, Weight). Environmental Handling and Transportation Indicator, Environmental/Hazardous Material Considerations
- **SA Report to Manage Handling** – Standard SA Report options (Mil Std 1388-2B) include: LSA-078. Specification for SA Report to manage Hazardous material to include:
 - Item Name, Part Reference Number, Manufacturers Code (NCAGE), NSN, Proper Shipping Name, Environmental/Hazardous material considerations, Hazard Code for packaging (Mil Std 2073-1E)
 - Where used: Task LCN, Task Code, Task Identification
 - How much is used: Task Frequency (per year), Quantity per task and unit of measure

- Annual Cost data: Hazardous Materials Storage Cost, Hazardous Materials Waste Storage Cost, and Hazardous Materials Waste Disposal Cost
- **Storage Requirements Report** of items identified that required special storage conditions and the overall storage requirements. This can be helpful for planning of Maintenance, Supply Support, Technical Information, and Training. Shared with all elements within ILS and Systems Engineering Team. Specification for Storage Report should include:
 - Item Name, Part Reference Number, Manufacturers Code (NCAGE), Unit Packaged Dimensions (L, W, H), Dimension Measurement Base, Packaged Weight, Weight Measurement Base, Shelf Life, Shelf Life Action Code, Hazardous Code, Hazardous Material Annual Storage Cost, Hazardous Waste Annual Storage Cost, Environmental Handling and Transportation Indicator, Environmental/Hazardous Material Considerations
- **SA Report to Manage Storage** of hazardous materials – Standard SA Report options (Mil Std 1388-2B) include: LSA-078. Specification for SA Report to manage Hazardous material to include:
 - Item Name, Part Reference Number, Manufacturers Code (NCAGE), NSN, Proper Shipping Name, Environmental/Hazardous material considerations, Hazard Code for packaging (Mil Std 2073), Shelf Life, Shelf Life Action Code
 - Where used: Task LCN, Task Code, Task Identification
 - How much is used: Task Frequency (per year), Quantity per task and unit of measure
 - Annual Cost data: Hazardous Materials Storage Cost, Hazardous Materials Waste Storage Cost, and Hazardous Materials Waste Disposal Cost
- **Transportability Requirements Report** of the SOI of SOI sections and of items identified as required for maintenance. Report should also include special precautions for items (Spares, S&TE, or other support resources, etc.) being transported by road, sea or air. Specification for Transportability Report should include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Mode of Transportation, Task Identification to prepare for SOI or sections of SOI Transportation, Task Code, Task Frequency
 - Support Resources required identities: Parts, S&TE, Personnel, etc, Reference Number, Item Name, NCAGE Code, Skill Code, Quantity, Unit of Measure.
 - Special Transport Requirement: Environmental Handling and Transportation Indicator, Environmental/Hazardous Material Considerations
- **SA Report to Manage SOI and Component Transportability** – Standard SA Report options (Mil Std 1388-2B) include: LSA-085. Specification for SA Report to manage Transportability/Transportation to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE),
 - Shipping Configuration, Shipping Mode, Road Shipping Constraints, Rail Shipping Constraints, Aircraft Shipping Constraints by aircraft type, Shipping Weight, Shipping Dimensions: L, W, H.
 - Lifting and Tiedown Narrative, Shipping Shock and Vibration Remarks, Transportation Remarks

- Special Transport Requirement: Environmental Handling and Transportation Indicator, Environmental/Hazardous Material Considerations

5.3.3.13 Facilities and Infrastructure

The broader Facility requirements come from either the need to operate at a new location or the need to modify existing facilities at a location already in use. Facilities may be required for: operational planning, training of operators or maintenance staffs, repair facilities for components or facilities to house the System and act as a base for front line operational staff. Change of use can be a complex task with long lead times for installation and commissioning, but these may be better for life cycle cost than building new facilities every time, and this must be taken into account.

Like many ILS elements, for Facilities the Candidate Items list and Task Inventory will provide first sight of operational or maintenance requirements for facilities with the initial LORA allocation repair policies to be later validated.

5.3.3.13.1 Standards recommended for Facilities and Infrastructure

The standard(s) to be used are those that fit best with national Facility construction and management processes. New Facilities may require planning permission and have long construction and development lead times. There is no ASD/AIA standard for Facilities, and the following handbooks and guidance may be helpful to NATO nations:

- Mil HDBK 1012: Electronic Facility Engineering
- Mil HDBK 1013: Design Guidelines for Physical Security of Facilities
- Mil HDBK 1190: Facility Planning and Design Guide
- Integrated Product Support (IPS) Element Guidebook
- UK JSP 886 Vol 7 Pt 8.08 Supportability Engineering – Facilities and Infrastructure
- Def Stan 00-056 System Safety
- UK JSP 886, Vol7 Pt2 ILS Management
- ISO 29481: Building Information Models
- ISO 16739: Industry Foundation Classes

5.3.3.13.2 Processes for Facilities and Infrastructure

Planning...

- Facilities Element Plan (see 2.2.1.3 and Annex 1 Para 3.10)

Supportability Analysis and Maintenance Process

- Perform Supportability Analysis (Facilities and Infrastructure Requirements) to identify Facilities needed for to support maintenance and related repair activity from MTA and LORA (see 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.3.4, 2.2.3.6, 2.2.3.9, 2.2.4.3, 2.2.5.2, 2.2.6.5, 2.2.8.2, 2.2.9.2, 2.2.10.2, 2.2.11.2, 2.2.12.2, and 2.2.13.2)

Supply process

- Provide Facilities Report detailing the potential activities for each facility (see 2.2.2.3, 2.2.2.2, 2.2.2.4 and 2.2.10.2)
- Perform Facility Design (see 2.2.10.2)

- Provide Facilities to meet support requirements for LSD (see 2.2.10.3)

5.3.3.13.3 *Outputs from Facilities and Infrastructure*

- **Facility Report** of tasks undertaken within each facility – this helps planning for Facility development as well as the Maintenance Concept and Maintenance Planning. Shared with all elements within ILS and Systems Engineering Team. Specification for Task Inventory to include:
 - Facility Name, Facility Location, Task LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Code, Task Identification, Task Frequency (per year).
- **SA Report to Manage Facilities and Infrastructure** – Standard SA Report options (Mil Std 1388-2B) include: LSA-012. Specification for SA Report to manage Facilities to include:
 - LSA Control Number (LCN), LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Task Identification, Task Code, Task Frequency, Elapsed time, Facility Name, Facility Capability, Facility Maintenance Requirements, Facility Operations Requirements – Utilities, Supply Storage Requirements, Facility Design Criteria, Facility Construction/Installation Lead Time, Facility Task Areas Requirement, Facility Justification, Facility Task Utilisation.

5.3.3.14 *IT System Support*

IT System Support needs to be planned to adopt the standards used for data interchange between Customer and Contractor, and between Contractor and their suppliers as well as internally between Supportability teams, Engineering, Commercial, Procurement and others. At one level, there will be computing resources to which many people need access, and others, perhaps modelling tools that will be used by a single person or small team.

A coherent plan needs to be created to ensure that the software solution implemented to cover all of the standards can exchange and provide data access in the way expected. The Product Support Analysis Activity 15 (Mil HDBK 502A, and the equivalent in SAE TD-STD-0017) for field feedback assesses the Support stage requirements for data exchange to achieve continuous improvement in supportability plans to introduce the required framework and agreements. The ASD/AIA S5000F specification aims to achieve a similar feedback framework.

Chapter 5.4 of ALP-10 describes the data exchange issues.

5.3.3.14.1 *Standards recommended for IT System Support*

The standard(s) to be used are those that fit best with national System introduction and management processes. The data interfaces for new Systems will already be in place for historical standards and adoption of new standards will require these to be updated. There are standards from USA, UK and Europe, and the following handbooks and guidance should be helpful to NATO nations:

- Product Support Data
 - Mil Std 1388-2B: Logistics Support Analysis Record
 - SAE GEIA STD-0007C: Product Support Data

- ASD/AIA S3000L: International procedure specification for Logistics Support Analysis (LSA)
- Def Stan 00-60 Pt 1: Logistics Support Analysis (LSA) and Logistics Support Analysis Record (LSAR)
- Def Stan 00-600: ILS requirements for MOD Projects, Pt 03: Logistic Information Requirements
- Supply Support
 - ASD/AIA S2000M: International Specification for Materiel Management
- Technical Publications
 - ASD/AIA/A4A S1000D: International Specification for Technical Publications using a common source database
- In Service Feedback
 - ASD/AIA S5000F: International Specification for in-service data feedback

5.3.3.14.2 Processes for IT System Support

Planning

- IT System Support Plan (see 2.2.1.3, 2.2.11.2, and Annex 1 Para 3.11)
- Plan and agree interfaces between Customer and Contractor IT System for data exchange, for example: S1000D, S2000M, S3000L, S4000P, S5000F, and S6000T as applicable (see 2.2.1.4, 2.2.1.3, 2.2.2.3, 2.2.11.2 and 2.2.10.2)
- Planning for in-Service phase with data feedback and analysis processes (see 2.2.12.2, 2.2.12.4 and 2.2.11.2)
- Planning for Failure Reporting and Corrective Action Systems (FRACAS). (see 2.2.2.3, 2.2.2.4, 2.2.3.7, 2.2.12.2, 2.2.12.4 and 2.2.11.2)
- Planning for Maintenance Management System to manage scheduled maintenance (see 2.2.3.3, 2.2.3.9, 2.2.10.2, 2.2.11.2)
- Planning for in-service Reliability analysis (see 2.2.12.2, 2.2.12.4, 2.2.3.7 and 2.2.11.2)
- Planning for in-service Logistics Support Analysis (see 2.2.2.3, 2.2.2.4, 2.2.2.2, 2.2.12.4 and 2.2.11.2)
- Planning for in-service Supply Support Analysis of inventory and repair transactions (see 2.2.4.3, 2.2.4.5, 2.2.4.6, 2.2.5.4, 2.2.12.5, 2.2.9.3 and 2.2.11.2)
- Planning for in-service LCC and resource modelling of operational usage, inventory, repair and maintenance actions (see 2.2.2.2, 2.2.2.4 and 2.2.11.2)

Supportability Analysis and Maintenance Process

- Maintain configuration of data in Logistics database. (see 2.2.1.6, 2.2.2.3, and 2.2.4.3)
- Validate data in logistics database with maintenance demonstrations (see 2.2.3.5, 2.2.2.3, 2.2.4.3, 2.2.5.2, 2.2.6.5, 2.2.6.6, 2.2.7.3, 2.2.10.2, 2.2.11.2, and 2.2.1.7)

Supply process

- Provide IT System Support Requirements Report to aid Development stage project planning and resourcing (see 2.2.11.3)

- Provide IT System Support Requirements Report to aid transition planning from a Development project into the Utilisation and Support stages with feedback loops for data (operational usage hours, Maintenance Work Orders, and R&M Analysis, Inventory transactions) to aid support improvement, planning and resourcing (see 2.2.11.3, 2.2.2.4, 2.2.4.3, 2.2.4.5, 2.2.4.6, 2.2.5.4, 2.2.3.7, 2.2.3.4, 2.2.12.4 and 2.2.3.10)
- Deliver IT System Support to internal and external users (see 2.2.11.3)

Operation process

- Manage IT System Support to ILS team (see 2.2.11.3)

5.3.3.14.3 *Outputs from IT System Support*

- **IT System Support Requirements Report: Development Stage** – to help manage customer requirements regarding standards and practical needs for project solution. Shared with all elements within ILS and Systems Engineering Team. Specification for IT System Support Report to include:
 - For each supportability Standard or Specification identity an ILS element user and Point of Contact
 - For each Standard or Specification identity the data exchange requirements internal and external, Customer and supplier
 - Identify the interface requirements for each data exchange
 - For each Standard or Specification identify the software and hardware requirements and solutions
 - For each Standard or Specification propose a software and hardware solution, with options if available
- **IT System Support Requirements Report: Utilisation and Support Stages** – to help plan and manage the transition from Development into Utilisation and Support with feedback loops for data and analysis from external customer to internal department and external suppliers. Shared with all elements within ILS and Systems Engineering Team. Specification for IT System Support Report to include:
 - Feedback data purpose, ILS element using/analysing the feedback data
 - Utilisation & Support data exchange requirements internal and external, interface requirements for data exchange,
 - Proposed software and hardware requirements
 - Proposed processes for improving sustainability

5.3.3.15 *Sustaining Engineering*

Review design material through Candidate Items list, Task Inventory, logistics dataset and other engineering data sources to evaluate operational suitability. Use the planning and results from Test Evaluation and Verification Planning to assess whether System is sustainable, and that key supportability requirements are achievable in-Service.

Use progress made during STEV Plan activities to recommend design improvements to enhance sustainment in the schedule of major design reviews: SRR, PDR, CDR, TRR, PRR, etc. This will continue during the Support stage from in-service data feedback.

The Sustaining Engineering team will contribute to the transition planning for IT System Support to ensure data feedback loops and analytical processes result in a continuously improving support system for the SOI.

The other activities of Sustainment Engineering occur during the Support and Retirement stages.

5.3.3.15.1 *Standards recommended for Sustaining Engineering*

Standards for Sustainment Engineering are:

- S4000P: ISMO process
- S3000L: ISSO process

5.3.3.15.2 *Processes for Sustaining Engineering*

Planning...

- Prepare a Sustainment Engineering Element Plan (see 2.2.1.3 and Annex 1 Para 3.12)

Supportability Analysis and Maintenance Process

- Evaluate Operations Suitability (see 2.2.12.2)
- Develop Sustainment Improvements (see 2.2.12.3)

Supply process

- Deliver Sustainment Improvements (see 2.2.1.7, 2.2.1.8, 2.2.1.10, and 2.2.1.11)

5.3.3.15.3 *Outputs from Sustaining Engineering*

Sustainment Improvements Report for System operational suitability. Specification to include:

- Identify the sustainment area of low performance
- Propose the improvement to correct the sustainment deficiency
- Forecast the sustainment performance with the improvement
- Identify the sustainment benefits in terms of life cycle cost and impact on other ILS elements and resource requirements

Sustainment Engineering Report for System operational suitability. Specification to include:

- Key supportability requirements, for example: MTBF, MTTR, Operational Availability

5.3.3.16 *Environmental Conditions and Recoverability*

This new ILS element becomes the focus for environmental issues that were previously within the design influence of SA, and PHS&T. The key activities include:

- Analyse EC&R requirements to contribute to design solutions and develop supportability requirements before System Requirements Review (SRR).
- Assess risks and hazards for environmental requirements not being achieved and mitigate or eliminate the risks.
- Review supportability data to ensure warnings, cautions and directives are included in Technical Information and Training Material.

- Identify the hazardous materials, wastes and pollutants to ensure necessary planning and management is in place to cater for these during the Support stage. These should be recorded in the logistics database and a report to share with engineering and the ILS team.
- Ensure plans created for reuse of components, recycling of materials and environmentally friendly facilities and methods/ procedures are in place.
- Work with PHS&T and Safety teams to evaluate goods for safe transport in accordance with laws and regulations (example Transportation of Dangerous Goods). Hazardous materials storage conditions are also included.

5.3.3.16.1 *Standards recommended for Environmental Conditions and Recoverability*

Recommended standards for EC &R are:

- REACH, UN ST/SG/AC.10/1 (Vol.1) Transportation of Dangerous Goods
- DSA-2-DLSR: UK Defence Codes of Practice: Movement and Transport Safety Regulator, Defence Land Safety Regulator

5.3.3.16.2 *Processes for Environmental Conditions and Recoverability*

Planning...

- Prepare an EC&R Element Plan that includes materials reuse and recycling (see 2.2.1.3 and Annex a Para 3.13)

Supportability Analysis and Maintenance Process

- Identify EC&R Issues during development phase for design reviews (see 2.2.2.3, 2.2.2.4, 2.2.4.3 and 2.2.13.2)
- Contribute to review of Operator and Maintenance tasks to identify hazardous tasks based upon environmental requirements and hazardous materials (see 2.2.6.2, 2.2.3.5 and 2.2.9.2) and refer to Design Interface Supportability Analysis outputs
- Review Hazardous materials and evaluate their storage costs and the Hazardous Waste Storage cost and Waste Disposal costs (see 2.2.2.3, 2.2.2.4, 2.2.2.2, 2.2.4.3, 2.2.9.2 and 2.2.13.2)
- Review hazardous materials and identify the transportation requirements (see 2.2.2.3, 2.2.2.4, 2.2.4.3, 2.2.9.2 and 2.2.13.2)
- Review Supportability data to ensure Warnings, Cautions and Directives are include in Training material and Technical Information (see 2.2.13.2, 2.2.6.5 and 2.2.7.2)

Supply process

- Provide a report on Hazardous materials identifying the material, and hazards, along with costs for storage, waste storage and waste disposal (see 2.2.13.2, 2.2.2.4 2.2.4.3, 2.2.9.2)

5.3.3.16.3 *Outputs from Environmental Conditions and Recoverability*

- **Hazardous Materials Report** of materials used within or to support the SOI. This will be of interest to the engineering design, PHS&T, Supply Support, Technical Information, and Training teams. Specification for Task Inventory to include:
 - Item Name, Part Reference Number, Manufacturers Code (NCAGE), NSN, Proper Shipping Name, Environmental/Hazardous material considerations, Hazard Code for packaging (Mil Std 2073)

- Where used: Task LCN, Task Code, Task Identification
- How much is used: Task Frequency (per year), Quantity per task and unit of measure
- Annual Cost data: Hazardous Materials Storage Cost, Hazardous Materials Waste Storage Cost, and Hazardous Materials Waste Disposal Cost.
- **SA Report to Manage EC&R** – Standard SA Report options (Mil Std 1388-2B) include: LSA-078. Specification for SA Report to manage Hazardous material to include:
 - Item Name, Part Reference Number, Manufacturers Code (NCAGE), NSN, Proper Shipping Name, Environmental/Hazardous material considerations, Hazard Code for packaging (Mil Std 2073)
 - Where used: Task LCN, Task Code, Task Identification
 - How much is used: Task Frequency (per year), Quantity per task and unit of measure
 - Annual Cost data: Hazardous Materials Storage Cost, Hazardous Materials Waste Storage Cost, and Hazardous Materials Waste Disposal Cost
- **SA Report to Manage EC&R** – Standard SA Report options (Mil Std 1388-2B) include: LSA-085. Specification for SA Report to manage Transport of hazardous items to include:
 - LSA Control Number (LCN) of Transported End Item or Section, LCN Nomenclature, Part Reference Number, Manufacturers Code (NCAGE), Contractors Name and Address, Proper Shipping Name, Mode of Transportation, Country of Transportation, Transported To and From, Hazardous Material/Environmental Considerations, Protective Clothing Requirements, Disaster Response Force Requirements,

5.3.4 Production stage

The purpose of the Production Stage is the manufacture and ensure the required functionality and quality of the SOI. In addition, the necessary support and enabling systems need to be produced.

The Production Stage requires the output of the Development Stage and delivers the accepted SOI and related support and enabling systems into the Utilisation and Support Stages.

5.3.4.1 Design Reviews

The design review stages for Systems Engineering started in the Development Stage with Requirements and Functional reviews, before proceeding to Preliminary and Critical Design reviews. The Functional Configuration Audit and System Verification Review will signify the end of Development and the transition into Production. The review and audits in the production stage are described below.

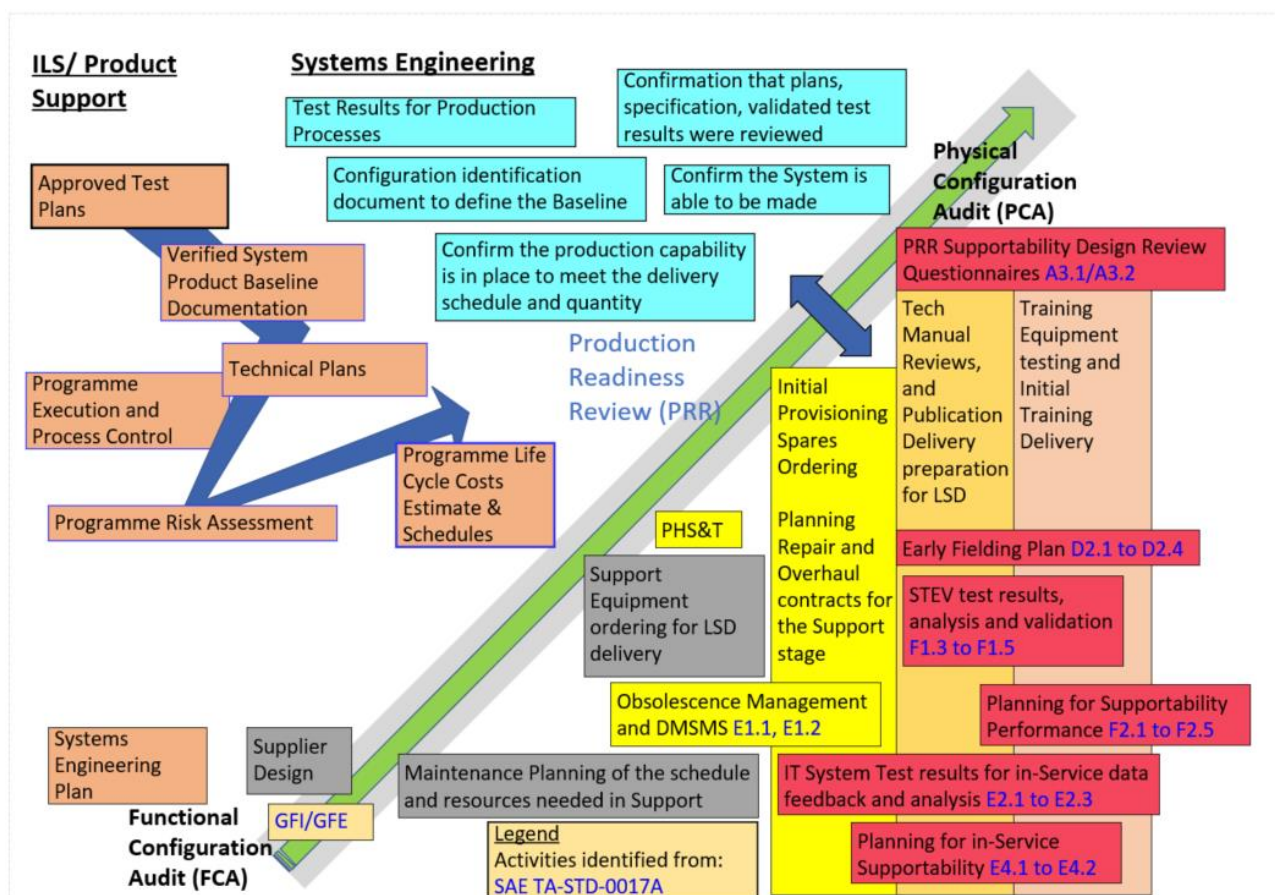
5.3.4.1.1 Production Readiness Review

The purpose of the Production Readiness Review (PRR) is to ascertain the system design is ready for production and adequate production planning is in place to meet the initial delivery schedule and quantities, whether at low or high production rates. Refer to Figure 48. The timing of the PRR is to support the operational need to deploy the system at the agreed delivery rate and schedule.

The Systems Engineering PRR inputs are:

- Approved Test Plans
- Verified System Product Baseline documentation
- Technical Plans: validated manufacturing planning, processes and assembly
- Programme Execution and Control
- Programme Risk Assessment
- Programme Life Cycle Cost estimate and schedule

Figure 48: Production Readiness Review



The ILS inputs to the PRR are:

- The final version of the Early Fielding Plan should be used to guide the production resource quantity and distribution. This will assist with finalising orders for resources to be delivered by LSD. This includes: Spares, Support equipment, Technical Information, and Training.
- Early planning for repair and overhaul resources, facilities and training to ensure repair facilities can be deployed in the Support stage.
- Early planning for System scheduled Maintenance planning activity.

It is important that design changes made in or for production processes are reflected in the design to be supported and that product supportability is not undermined by changes to

configuration. These changes shall be agreed between: Production, Systems Engineering and the ILS Teams.

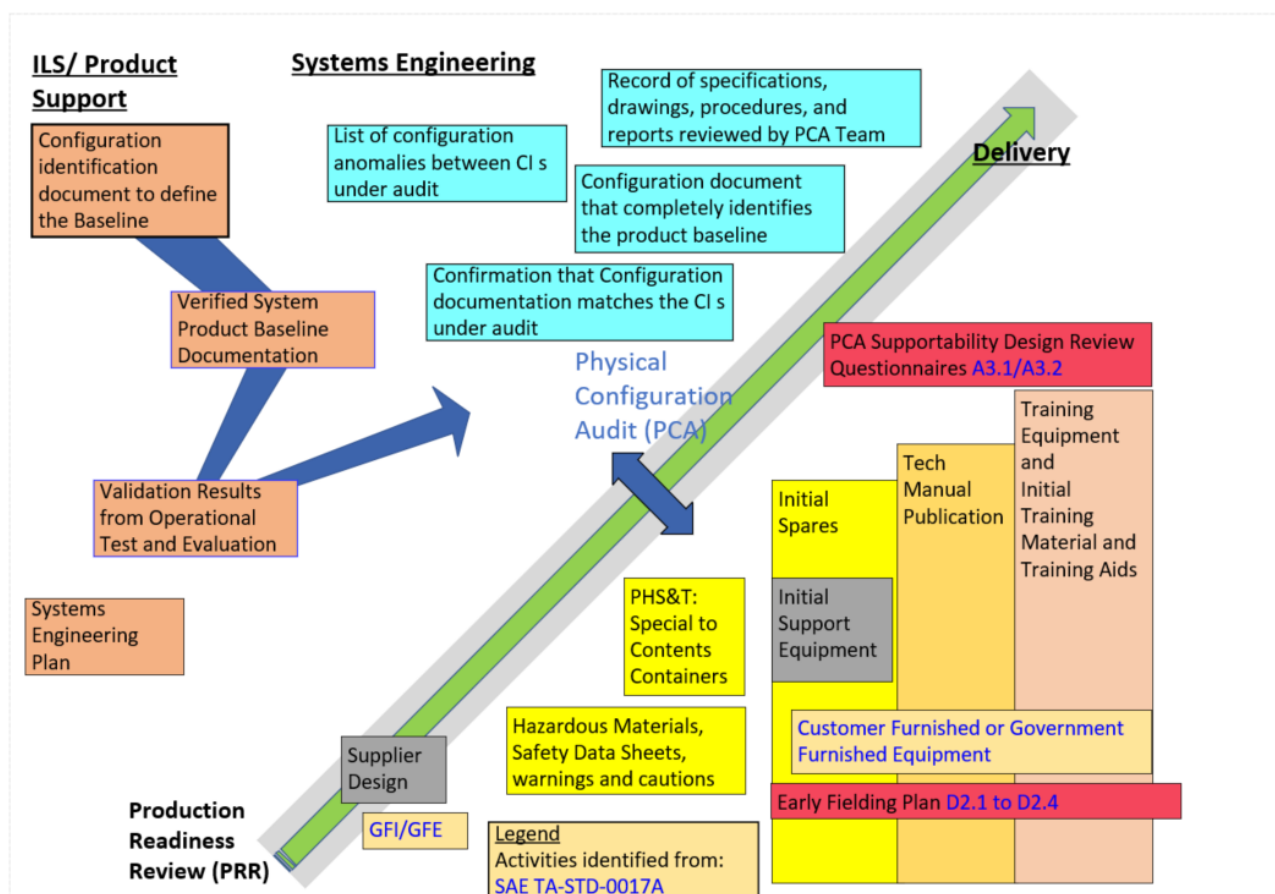
The Systems Engineering PRR outputs, shade in turquoise in the PRR graphic are:

- Test results for Production processes
- Configuration identification document to define the Baseline
- Confirm that the SOI is able to be manufactured
- Confirmation that plans, specifications and validated test results were reviewed
- Confirm that the production capability is in place to meet the delivery schedule and quantity

5.3.4.1.2 Physical Configuration Audit

The purpose of the Physical Configuration Audit (PCA) is to determine conformance to the as-built configuration of validated Configuration Items with design documentation and verify the product baseline. This ensures that the As Designed is the same as the As Built and the same as the configuration recorded in the support documentation, the As Supported.

Figure 49: Physical Configuration Audit



The Systems Engineering PCA inputs are:

- Configuration Identification document to define the SOI Baseline
- Verified System Product Baseline

- Validated Results from operational Test and Evaluation

Supportability activity leading to this Audit will continue to with ordering support resources to meet the LSD requirements. There is keen interest to ensure that the As Built SOI matches the data captured in the As Supported SOI, and any anomalies are resolved to eliminate any gap between design, support and production. Refer to Figure 49

The PCA systems engineering outputs, shade in turquoise in the PCA graphic, are:

- Record of specifications, drawings, procedures and reports reviewed by the PCA team
- List of Configuration anomalies between Configuration Items (Cis) under audit
- Configuration document that completely identifies the product Baseline
- Confirmation that the Configuration document matches the CIs under audit.

5.3.4.2 Design Interface

Validation of SA dataset shall take place in agreement with the customer. Ideally a validation of maintenance tasks should take place on a real SOI rather than using a pre-production prototype. This should validate the data recorded in the Logistics dataset reflects the skills gained by trained maintenance personnel, the spares, support and test equipment, technical manual and any other resources identified for the task. Where the logistics dataset is deficient that dataset shall be revised to ensure it matches the delivered design. Using at least the top 50 or 100 life cycle cost driver LRUs should ensure a cost effective way of validating the data with limited sample of the maintenance task inventory. The LCC modelling should be used to identify these items for the validation review.

The following ILS elements are active in the production stage of the life cycle:

5.3.4.3 Maintenance

5.3.4.3.1 Processes for Maintenance

The following processes apply to planned maintenance in the Production stage.

Supply process

- Provide Planned Maintenance System to meet LSD (see 2.2.3.3)

5.3.4.3.2 Outputs for Maintenance

The following outputs apply to Maintenance in the Production stage.

- Deliver Planned Maintenance System for LSD

5.3.4.4 Supply Support

The production of spares should be matched to the orders and delivery requirements identified in the early fielding analysis and report. The Supply Support team are often involved to ensure spares delivery by quantity and location is achieved in time for the Logistics Support Date (LSD). This delivery schedule for spare parts should be following the Early Fielding Plan developed by supportability analysis during the Development stage.

5.3.4.4.1 Standards for Supply Support

The following standards apply to Supply Support in the Production stage.

- S2000M: International Specification for Materiel Management
- ACodP-1: NATO Manual on Codification
- IEC 62550: Spares Parts Provisioning
- The contracted Supply Support Data Items Description

5.3.4.4.2 *Processes for Supply Support*

The following processes apply to Supply Support in the Production stage.

Planning

- Prepare Purchase Orders for spare and S&TE (including agreements to supply GFE) to meet the Early Fielding Plan and LSD delivery date. If using ASD/AIA S2000M these shall use data from the Master Initial Provisioning Lists (see 2.2.4.3)

Supply process

- Provide Spares and Special to type or Peculiar S&TE and Training Equipment (including any GFE) to meet LSD (see 2.2.4.4)

5.3.4.4.3 *Outputs for Supply Support*

The following outputs apply to Supply Support in the Production stage.

- Deliver support resources to meet the Early Fielding Plan for LSD

5.3.4.5 **Technical Information**

The creation of publications from the data modules within the CSDB is a function of the Production stage of a project. This follows the review processes any logistics data validations or demonstrations to ensure the publication is validated and fit for purpose.

5.3.4.5.1 *Standards for Technical Information*

The following standards apply to Technical Information in the Production stage.

- S1000D: International Specification for Technical Publications using a common source database
- Def Stan 00-601: MOD Business Rules – Contracting for Technical Documentation
- MIL-STD 3031A: US Army Business Rules for S1000D
- MIL-STD 3048B: US Air Force Business Rules for S1000D
- The contracted Technical Information Data Items Description

5.3.4.5.2 *Processes for Technical Information*

The following processes apply to Technical Information in the Production stage.

Supply process

- Review and provide Technical Manuals and Common Source Database to meet LSD (see 2.2.7.3)

5.3.4.5.3 *Outputs for Technical Information*

The following outputs apply to Technical Information in the Production stage.

- Deliver Technical Manuals to meet the Early Fielding Plan for LSD

5.3.4.6 Support and Test Equipment

Monitoring the production of new S&TE, and coordination with the customer for provision of common items already on inventory, is necessary to ensure that S&TE needs match the delivery requirements of the early fielding analysis and report. The Supply Support and S&TE teams are often involved to ensure the delivery by quantity and location is achieved in time for the Logistics Support Date. This delivery schedule for support and test equipment should be following the Early Fielding Plan developed by supportability analysis during the Development stage.

5.3.4.6.1 Standards for S&TE

The following standards apply to S&TE in the Production stage.

- The contracted S&TE Data Items Description

5.3.4.6.2 Processes for S&TE

The following processes apply to S&TE in the Production stage.

Supply process

- Provide Special to type or Peculiar S&TE (including any GFE) to meet LSD (see 2.2.5.3)

5.3.4.6.3 Outputs for S&TE

The following outputs apply to S&TE in the Production stage.

- Deliver support resources to meet the Early Fielding Plan for LSD

5.3.4.7 Training and Training Support

The training of operators and maintenance staff will most likely start before the production stage as the courses, durations, and personnel numbers influence the preparations prior to LSD. Delivery of training courses does occur during the Production stage, up to and beyond LSD. The delivery schedule for training courses and training equipment should be following the Early Fielding Plan developed by supportability analysis during the Development stage. There is often a conflict of time to provide training on an SOI but the ship, for example, is not yet finished enough. This can lead to a lag between the design used for training and the design finally delivered. The Training material and Training Equipment should be revised to ensure this knowledge gap is eliminated. The requirement to train on an incomplete SOI should be considered during planning.

5.3.4.7.1 Standards for Training

The following standards apply to Training and Training Support in the Production stage.

- ASD/AIA S6000T: International Specification for training analysis and design
- The contracted Training Data Items Description

5.3.4.7.2 Processes for Training

The following processes apply to Training in the Production stage.

Planning

- Prepare for the training induction by planning the training course delivery schedule to provide the required complement of operator and maintenance trained personnel by LSD. (see 2.2.8.2 and 2.2.8.3)

Supply process

- Provide Training Courses and Training Equipment to meet the training need by LSD (see 2.2.6.6 and 2.2.6.7)

5.3.4.7.3 *Outputs for Training and Training Support*

The following outputs apply to Training and Training Support in the Production stage.

- Deliver training equipment and training courses to meet the Early Fielding Plan for LSD

5.3.4.8 *IT System Support*

Activity during the Production stage will be focussed on the transition to in-Service support. The testing of data exchange interfaces for inventory transactions, maintenance work orders and operating hours to feed the analysis of field data and start the cycle of continuous improvement during the life cycle.

5.3.4.8.1 *Standards for IT System Support*

The following standards could apply to IT System Support in the Production stage.

- ASD/AIA S3000L: International procedure specification for Logistics Support Analysis (LSA)
- Mil Std 1388-2B: DOD Requirements for a Logistics Support Analysis Record
- Mil HDBK 502A: Product Support Analysis
- SAE TD-STD-0017A: Product Support Analysis
- SAE GEIA-STD-0007C: Logistics Product Data
- ASD/AIA/A4A S1000D: International Specification for Technical Publications using a common source database
- ASD STE 100: Simplified Technical English
- ASD/AIA S2000M: International Specification for Materiel Management
- ASD/AIA S5000F: International Specification for in-service data feedback
- The contracted IT System Support Data Items Description

5.3.4.8.2 *Processes for IT System Support*

The following processes apply to IT System Support in the Production stage.

Planning

- Plan data exchange framework for usage, maintenance and inventory transaction data (see 2.2.11.3)

Supply process

- Provide hardware and software to implement the data exchange framework for feedback of usage, maintenance and inventory transaction data by LSD (see 2.2.11.3)

Operation process

- Test the data exchange framework to ensure fit for purpose by LSD (see 2.2.11.2 and 2.2.11.3)

5.3.4.8.3 *Outputs for IT System Support*

The following outputs apply to IT System Support in the Production stage.

- Provide the hardware and software for the data exchange framework before LSD.
- Deliver Data Exchange test report on range of data exchanged and data exchange performance before LSD.

5.3.4.9 *Design Interface*

The strategy for supportability improvement should be developed with the aim to track reliability and maintainability, and to monitor availability and performance against the service delivery level. Monitoring the maintenance work order duration or down time should help to track the first line MTTR and build a picture for LRU reliability when the customer operating hours for the population are included. These analyses can help to build confidence rather than validate the prediction reports for reliability and maintainability and provide a trigger for modification development if performance is unacceptable.

5.3.4.9.1 *Standards for Design Interface*

The following standards apply to Supportability Analysis in the Production stage.

- ASD/AIA S3000L: International procedure specification for Logistics Support Analysis (LSA)
- Mil Std 1388: Logistics Support Analysis and Logistics Support Analysis Record
- SAE TD-STD-0017/Mil HDBK 502A: Product Support Analysis
- SAE GEIA-STD-0007C: Logistics Product Data
- Def Stan 00-60/00-600: Integrated Logistics Support
- ASD/AIA/A4A S1000D: International Specification for Technical Publications using a common source database
- ASD/AIA S2000M: International Specification for Materiel Management
- ASD/AIA S5000F: International Specification for in-service data feedback
- The contracted Supportability Analysis Data Items Description

5.3.4.9.2 *Processes for Design Interface*

The following processes apply to Supportability Analysis in the Production stage.

Supply process

- Monitor delivery and receipt of resources to ensure the resources are delivered to meet the Early Fielding Plan requirement and any updates (see 2.2.4.4, 2.2.5.3, 2.2.6.6, 2.2.6.7, 2.2.7.3, 2.2.8.3, 2.2.9.3, 2.2.10.3, 2.2.11.3 and 2.2.1.7)

5.3.4.9.3 *Outputs for Design Interface*

The following outputs apply to Supportability Analysis in the Production stage.

- Ensure delivery of support resources is made on schedule for LSD

5.3.4.10 *Facilities and Infrastructure*

This team will be aiming to deliver the operational and repair facilities to meet the Early Fielding Plan and Level of Repair Analysis in time for LSD.

5.3.4.10.1 *Standards for Facilities and Infrastructure*

The following standards apply to **Facilities and Infrastructure** in the Production stage.

- The contracted Facilities and Infrastructure Data Items Description

5.3.4.10.2 *Processes for Facilities and Infrastructure*

The following processes apply to Facilities and Infrastructure in the Production stage.

Supply process

- Provide the facilities for operations and maintenance required by the Early Fielding Plan before LSD (see 2.2.10.3)

Operation process

- Undertake any testing or Facility certification before LSD (see 2.2.10.3 and 2.2.10.4)

5.3.4.10.3 *Outputs for Facilities and Infrastructure*

The following outputs apply to Facilities and Infrastructure in the Production stage:

- Delivery of operational facilities
- Delivery of maintenance facilities
- Delivery of training facilities

5.3.5 **Utilisation Stage**

The purpose of the Utilisation Stage as described in paragraph 3.5.5, is to operate the SOI at the intended operational sites and to deliver the required services with continued operational and cost effectiveness. The Utilisation stage will end when the SOI is taken out of service and the Retirement Stage starts.

While the Utilisation Stage largely occurs at the same time as the Support Stage, the focus during the Utilisation Stage is the activities summarised by Figure 32: Operation Process, and the text of Para 0. Some of the activities of this Stage are purely in the operator domain and outside of ILS. These will be described below at a high level to enable awareness amongst ILS Managers and staff that need to interact with the user community. The activities within ILS will be described in more detail under the specific ILS element headings.

When the SOI is activated during the Utilisation Stage it is entirely under the responsibility of the user. The SOI and its enabling systems will provide the required capability in its intended operational environment, utilising the resources that have been prepared for it.

Many of the Utilisation Stage activities are closely related and overlap with activities of the Support Stage, which focusses on the provision of the support services. Those remaining activities are within the operator domain, and have a far lesser overlap with the Support Stage. These are identified below from the AAP-48 Operation Process of Figure 32:

- Prepare for Operations
- Identifying Operational constraints
- Monitoring Operational Mission Effectiveness and System technical performance
 - This excludes the ILS related aspects of operational availability relating to reliability, maintainability, spare parts, S&TE, training, etc.
- Compare current operations with the ConOps used in the SOI development

- Activating the Enabling Systems for operations

In addition to these operator-oriented activities the ILS activities and processes that occur in this Stage are summarised below. While these activities may have an ILS focus, they are still relevant to the Operator personnel as there is a direct connection between ILS activities and operational effectiveness. For example, if the Training or Training Equipment provided a poor learning system the mission effectiveness is likely to be underwhelming, even if the SOI design is good.

A major activity within this life cycle stage is the monitoring of the performance of the SOI, and verification that the operational performance requirements are being achieved. To complete this verification it is necessary to monitor the mission and operability aspects regarding:

- System Safety for Operator personnel
- Human Factors for Operator Workload
- Operator Training Effectiveness of training design, training material, and training equipment
- Operator Technical Information provided in operator publications including Standard Operating Procedures

From an ILS perspective the above activities fall within the Design Interface, Training and Technical Information ILS Elements, which are described in more detail below.

5.3.5.1 Design Interface

Monitoring and verifying achievement of the operator aspects of the System is part of the Utilisation Stage for ILS. The System Safety and Human Factors workload assessments during the Development Stage need to be verified and that the current mode of SOI operation falls within the bounds of crew capability for the design. The analysis and verification within the Design Interface ILS element will repeat to some extent the original design work, but using field data to replace the original assumptions/guidance of the ConOps and the designers view on what should happen.

5.3.5.1.1 Standards for Design Interface

The standards for Design Interface during Utilisation stage are:

- | | |
|-------------------------|--|
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • ASD/AIA SX000i | Integrated Product Support |
| • MIL-STD-1388 | Logistics Support Analysis |
| • SAE TD-STD 0017A | Product Support Analysis |
| • Mil HDBK 502A | Guidance on Product Support Analysis |
| • SAE GEIA-STD/HB 0007 | Product Support Data |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |
| • MIL-STD-1472 | Design Criteria for Human Engineering |
| • DOD-HDBK-743A | Military Handbook Anthropometry of U.S. Military Personnel |

5.3.5.1.2 *Processes for Design Interface*

Planning

- Plan a System Safety Hazard review for Operator personnel during missions (see 2.2.2.3 and 2.2.2.4)
- Plan a Human Factors review for Operator personnel during missions (see 2.2.2.3 and 2.2.2.4)

Analysis process

- Analyse System Safety for Operators for all mission phases (see 2.2.2.3 and 2.2.2.4)
- Analyse Human Factors and Operator workload during missions for all mission phases

Supply process (see 2.2.2.3 and 2.2.2.4)

- Mission System Safety for Operators Report
- Human Factors and Operator workload Report

5.3.5.1.3 *Outputs for Design Interface*

- System Safety for Operators during missions Report
- Human Factors and Operator mission workload Report

5.3.5.2 **Training and Training Support**

The focus for Training and Training Support during the Utilisation Stage is validating and verifying the effectiveness of the delivered Operator training to complete the mission and hence verify the SOI operational performance. The activities below describe what is to be done.

5.3.5.2.1 *Standards for Training and Training Support*

The standards below identify options for Training and Training Support:

- Mil HDBK 29612-1A: Guidance for Acquisition of Training Data
- Mil HDBK 29612-2A: Instructional Systems Development Approach to Training Design
- DI-ILSS-80570 USA DID for Training Needs Analysis
- DI-ILSS-80872 USA DID for Training Equipment
- DI-ILSS 81070 USA DID for Training Development
- Integrated Product Support Elements Guidebook, 2021
- ASD/AIA S6000T: International Specification for training analysis and design
- UK JSP 822 (parts 1 to 10) Direction and Guidance for Training and Education, including Defence Systems Approach to Training (DSAT)
- UK JSP 886 Vol 7, Part 8.01 Supportability Engineering – Training and Training Equipment

5.3.5.2.2 *Processes for Training and Training Support*

Planning

- Plan a review of Training course material and Training equipment to measure effectiveness for Operator personnel during missions (see 2.2.6.2, 2.2.6.4, 2.2.6.5 and 2.2.6.6)

Analysis process

- Analyse Effectiveness of Operator Training design and Training Course material (see 2.2.6.4 and 2.2.6.5)
- Analyse Effectiveness of Operator Training Equipment (see 2.2.6.3)

Supply process

- Training Course and Training Equipment Effectiveness Report

5.3.5.2.3 *Outputs for Training and Training Support*

- Training Course and Training Equipment Effectiveness Report

5.3.5.3 **Technical Information**

The focus for Technical Information during the Utilisation Stage is the effectiveness of the Operator information to complete the mission and hence verify the SOI operational performance. The activities below describe what is to be done.

5.3.5.3.1 *Standards for Technical Information*

The standards below identify options for Technical Information:

- Mil DTL 87268D: Specification for Interactive Electronic Technical Manuals
- Mil DTL 87269: Database Revisable Interactive Electronic Technical Manuals
- Mil HDBK 523: Guide to general style and format of S1000D Technical Manual Data Modules
- Mil Std 38784B: General Style and Format for Technical Manuals
- Mil Std 3031A: Army Business Rules for S1000D
- Mil Std 3048B Air Force Business Rules for S1000D
- DI-TMSS-81952: USA DID for S1000D Project Business Rules Exchange (BREX)
- Integrated Product Support Elements Guidebook, 2021
- ASD/AIA/A4A S1000D: Specification for Technical Documentation
- UK JSP 886 Vol 7, Part 8.05 Supportability Engineering – Technical Documentation
- Def Stan 00-600 Pt 03: ILS requirements for MOD Projects: Logistic Information Requirements
- Def Stan 00-601: MOD Business Rules – Contracting for Technical Documentation:
 - PT 01 AIR S1000D Business Rules
 - PT 02 MARITIME S1000D Business Rules
 - PT 03 LAND S1000D Business Rules
 - PT 04 Non S1000D Business Rules

5.3.5.3.2 *Processes for Technical Information*

Planning

- Plan a Review of Operator Technical Information to verify Effectiveness (see 2.2.7.2)

Analysis process

- Analyse the effectiveness of Operator Technical Information (see 2.2.7.2)

Supply process

- Technical Information Effectiveness Report (see 2.2.7.2)

5.3.5.3.3 *Outputs for Technical Information*

- Technical Information Effectiveness Report

5.3.6 **Support Stage**

5.3.6.1 *Introduction*

The purpose of the Support Stage is to provide the identified logistics, maintenance, and support services that enable continued SOI operation and sustainable service (see Para 3.5.6). The Support Stage will end when the SOI is taken out of service and the Retirement Stage starts.

During the Support Stage all activities of support services for the users of the SOI are provided. A major activity within the Support Stage is the monitoring of the performance of the SOI, and to verify if the dependability requirements are achieved.

This verification is performed through the monitoring the of the following aspects:

- Availability
- Reliability
- Maintainability
- Testability
- System Safety
- Personal/Human Resources
- Spares/Consumables
- Support and Test Equipment
- Training Courses and Training Equipment
- Technical Information

It is important to establish the coverage of in-service-feedback provided to all applicable stakeholders to ensure that the dependability performance can be monitored correctly. The feedback data, to be used for RMT, Supportability and resource modelling analyses, must encompass as a minimum:

- Operating Hours, without classified location data
- Inventory demands for replacement parts
- Maintenance Work Order data describing what was replaced, when and how long it took

Where shortfalls in the distribution of in-service feedback data exist, the data distribution shall be revised to connect those omitted to ensure dependability monitoring and performance is achieved.

Once the SOI performance in its intended environment and future requirements are understood, consideration for a mid-life-update, functional upgrade or evolution may be necessary due to obsolescence or modifications required to enhance capability. The changes in such an upgrade can distort the dependability performance as more functionality is added. It is important to establish a new baseline for dependability to include changes resulting from the update or modification. Some modifications are undertaken specifically to improve reliability or maintainability, and these can improve dependability in a positive way.

An analysis of the operational use to consider if all operational and mission profiles are fully supported and realizable may also be required.

For example, if the mission has changed over time and the planned Concept of Operations (ConOps) does not reflect current usage, a fresh look to re-establish the operational and mission profile baseline must be carried out. Such an amendment will be important for monitoring ongoing supportability during the Utilisation and Support stages of the life cycle. As such, a mid-life upgrade is likely to require a new ConOps.

The following sections detail the processes, activities and responsibilities required for each ILS Element during the Support Stage.

5.3.6.2 Design Reviews

If modification programmes are implemented, they should invoke the fullest ILS process applicable to the level of design freedom. This will ensure that the new designs and equipment will be supported with the same level of analysis, data and decision making as the original SOI. This should encompass all the ILS elements, and a Systems Engineering design review process tailored to the modification and potentially repeating the processes of the Development stage for each modification. The original Design Review Questionnaires may need to be reviewed/revised to ensure they are valid for the modification design review.

Data in the Logistics database should also be updated to capture analysis results and provide the source data for Initial Provisioning and Technical Information using ASD/AIA S2000M and ASD/AIA/A4A S1000D for example. The sharing of functional description and maintenance procedure data modules with the Training team will maximise reuse of good data and minimise rework when developing in-service support for design change and modifications.

The strategy to track design variation in the logistics database should be considered ahead of the modification process. Standardisation methods should be used to minimise LCC and reduce design variation proliferation and the development of fleets within a fleet. The greater the number of variants, the greater the life cycle cost and a lower interoperability for NATO will result. Variant designs using Usable on Codes (UOC) and Model Identifiers (MOI) should be used sparingly to maximise integration and ease of support. The strategy should aim to minimise the cost of joining data and datasets every time a whole platform solution is required: Spare optimisation, support and Test Equipment, FMECA and RCM Review, LORA, and Technical Information and Training for new customers.

5.3.6.3 *Standards for Design Reviews*

The primary standard for design reviews is ISO 15288.

5.3.6.4 *Maintenance*

The Maintenance Process during the Support Stage ensures that the required maintenance activities are conducted, managed and optimized. The maintenance requirements have been raised, assessed and defined in the earlier stages, are executed in this stage.

5.3.6.4.1 *Standards for Maintenance*

The primary standards for Maintenance are shown the list below:

- Mil Std 1388 1A + Mil Std 1388-2B
- Mil HDBK 502A + GEIA STD-0007C
- SAE-TA-STD-0017A + SAE GEIA STD-0007C and SAE TA HB-0007-1A
- ASD/AIA S3000L and ASD S4000P + ASD/AIA S3000L

The secondary and related standards are shown here:

- IEC 60300-1 Dependability Management
- IEC 60300-2 Guide to Dependability Management
- IEC 60300-3-12: 2011 Dependability Management – Application guide – Integrated Logistics support
- IEC 60300-3-3: 2017 Dependability Management – Application guide – Life Cycle Costing
- ASD/AIA SX000i Specification for Integrated Product Support (IPS)
- Def Stan 00-60 Pt1 (SA Tasks) + Def Stan 00-60 Pt0 and Pt2 (LSAR) (Cancelled)
- Def Stan 00-60 Pt3 Software Supportability Analysis (Cancelled)
- Def Stan 00-600: ILS requirements for MOD Projects.
- Integrated Product Support (IPS) Elements Guidebook
- UK JSP 886 Vol 7 Part 3 Supportability Analysis

5.3.6.4.2 *Processes for Maintenance Analysis*

The following maintenance planning processes are likely to occur during the Support Stage:

Planning Processes

- FMECA and RCM Review (see 2.2.2.3 and 2.2.2.4)
- Scheduled Maintenance Review (see 2.2.2.3 and 2.2.2.4)
- Level of Repair Analysis Review (see 2.2.3.4 and 2.2.2.4)

Supportability Analysis and Maintenance Process

- Execute Maintenance Tasks (see 2.2.3.8)
- Perform Maintenance Task Analysis (MTA) (see 2.2.3.5)
- Perform in-service maintenance optimization (ISMO) (see 2.2.3.10)
- Develop Maintenance Plan (see 2.2.3.3)

Supply Process

- Master Maintenance Schedule updates
- Component Replacement List updates for life limited and overhaul components
- Level of Repair Analysis reports

5.3.6.4.3 *Outputs for Maintenance*

The outputs from the Support Stage are not numerous. Deliverable items are usually controlled by a Contract Data Requirements List (CDRL) and each deliverable item or dataset will be defined by a Data Item Description (DID). Below is a list of the minimum deliverable items/datasets expected:

- Review of Critical Maintenance Tasks relating to the anchor points for the scheduled maintenance intervals
- Master Maintenance Schedule
- Component Replacement List for Life and Overhaul Components
- Level of Repair Analysis Report to justify new or existing repair levels/organisations.
- Updated maintenance Plan

5.3.6.5 *Supply Support*

The Supply Support Process during Support Stage ensures that the required supply items are managed, available, and properly located when required to support other activities, such as maintenance.

5.3.6.5.1 *Standards for Supply Support*

The following primary standards relate to Supply Support during this life cycle stage:

- | | |
|---------------------------|---|
| • ASD/AIA S2000M | Specification for Materiel Management |
| • A-CodP-1 | NATO Manual for Codification |
| • ASD/AIA/A4A S1000D | Specification for Technical Publications using a common source database |
| • STANAG 4597 / ISO 62402 | Obsolescence Management |
| • ASD/AIA S5000F | Specification for in-service data feedback |

The following secondary standards relate to Supply Support during this life cycle stage:

- | | |
|---------------------|--|
| • ASD/AIA S3000L | Procedure Specification Logistics Support Analysis |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S6000T | Specification for Training Analysis and Design |
| • ASD/AIA SX000i | Specification for Integrated Product Support |
| • MIL-STD-1388 | Logistics Support Analysis and LSAR |
| • SAE TD STD-0017A | Product Support Analysis |
| • SAE TA-HB-0007-1A | Companion handbook for SAE-TA-STD-0017 |
| • SAE GEIA-0007 | Product Support Analysis Data |
| • SAE GEIA-HB-0007B | Companion handbook for SAE-TA-STD-0017 |

- DEF-STAN 00-60/00-600 Integrated Logistics Support
- PLCS (ISO 10303-239.3) Product Life Cycle Support
- ISO/IEC/IEEE 15288 Systems and Software Engineering – System Life Cycle Processes

5.3.6.5.2 *Processes for Supply Support*

The Supply Process is started in the earlier stages of the lifecycle where agreements for the supply of a SOI/Product, spares, services, and support are made. Within the Support Stage these agreements are used to keep the SOI/Product operational and maintainable.

As explained in 3.6.1.2 the purpose of the process is to introduce a new system, sub system or enabling system into its operational environment or to change the operational environment of an existing system including the transfer of accountability and responsibility from one organisational entity to another.

Planning

- Plan the transition or modification, (see 2.2.1.8, 2.2.1.9, 2.2.4.2, 2.2.4.5 and 2.2.4.6)

Supportability Analysis and Maintenance Process

- Provide Provisioning Data and illustrations (see 2.2.4.3)

Supply Processes

- Perform the transition or modification, (see 2.2.1.10)
- Perform Material Supply (see 2.2.4.4)

Operational Processes

- Manage the results of transition or modification, (see 2.2.4.5, 2.2.4.6).
- Manage Stocks (see 2.2.4.5)
- Manage Repair and Overhaul (see 2.2.4.6)

Roles/Responsibilities involved in this process:

- ILS Manager
- ILS Element team leaders
- Purchasing department
- Facilities/Stores/Infrastructure Manager

5.3.6.5.3 *Outputs for Supply Support*

The outputs of Supply during the Support Stage are:

- Draft/Formal/Master IPLs with Illustrations aligned with the spare parts.
- NATO Codification Data updates
- IP Data Modules to update the Technical Information
- Spares modelling report to recommend purchase of new items.
- Purchase orders for new spares
- Delivery of spares to locations and withdrawal of obsolete items

5.3.6.6 Facilities and Infrastructure

The Infrastructure Management Process ensures that infrastructure and services are available during Support Stage. In the earlier stages the requirements have been raised, assessed and activities have been started to implement any missing infrastructure or services requirements.

5.3.6.6.1 Standards for Facilities and Infrastructure

The following primary standards relate to Facilities during this life cycle stage:

- Mil HDBK 1190 Facility Planning and Design Guide
- Mil HDBK 1012 Electronic Facility Engineering
- Mil HDBK 1013 Design Guidelines for Physical Security of Facilities

These secondary standards can be helpful for Facilities analyses:

- ASD/AIA S2000M Specification for Materiel Management
- ASD/AIA S3000L Procedure Specification for Logistics Support Analysis (LSA)
- ASD S4000P Specification for developing and continuously improving preventive maintenance
- ASD/AIA S5000F Specification for in-service data feedback
- ASD/AIA S6000T Specification for Training Analysis and Design
- ASD/AIA SX000i Integrated Product Support
- MIL-STD-1388 Logistics Support Analysis and Data
- SAE-TD-STD 0017 Product Support Analysis
- SAE GEIA-STD-0007 Product Support Data
- DEF-STAN 00-60/00-600 Integrated Logistics Support
- PLCS (ISO 10303-239.3) Product Life Cycle Support
- ISO/IEC/IEEE 15288 Systems and Software Engineering – System Life Cycle Processes

5.3.6.6.2 Processes for Facilities and Infrastructure

The following processes for Facilities are likely to occur during this life cycle stage:

Planning

- Plan the Facility transition or modification, (see 2.2.10.2)

Supply Processes

- Perform the Facility transition or modification, (see 2.2.10.3)

Operational Processes

- Manage the Facility after transition or modification, (see 2.2.10.4).

Roles/Responsibilities involved in this process:

- ILS Manager
- ILS Element team leaders

- Facilities/Stores/Infrastructure Manager

5.3.6.6.3 *Outputs for Facilities and Infrastructure*

The outputs for Facilities will relate to design change in the SOI or from feedback in the supportability data where a need for continuous improvement identifies an aspect of the facility design or functioning that could be better to improve capability or capacity.

5.3.6.7 *Workforce & Personnel*

The Workforce and Personnel process ensures that suitably qualified and experienced personnel are available to satisfy the resource needs of all programmes. Normally the activities for this process start in earlier stages, but might not be completed and therefore are done during Support Stage.

5.3.6.7.1 *Standards for Workforce & Personnel*

The following primary standards relate to Workforce and Personnel during the Utilisation and Support stages:

- | | |
|-------------------------|--|
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • MIL-STD-1388 | Logistics Support Analysis and Logistics Support Analysis Record |
| • SAE TD-STD-0017 | Product Support Analysis |
| • SAE GEIA-STD 0007 | Product Support Data |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |

5.3.6.7.2 *Processes for Workforce & Personnel*

The following processes for the Workforce and Personnel element are likely to occur during the Support Stage:

Knowledge management process

- The Information Management Process ...” aims to generate, obtain, confirm, transform, retain, retrieve, disseminate and dispose of information, to designated stakeholders” (ISO/IEC/IEEE 15288: 2023 [6.3.6.1 Purpose]). Information includes technical, project, organisational, agreement, and user information. This process is strongly interconnected to the Knowledge Management process.

Planning

- Perform Workforce & Personnel Analysis (see 2.2.8.2)

Operational Processes

- Manage Workforce & Personnel (see 2.2.8.3)

Roles and Responsibilities:

- ILS Manager
- HR Manager

- Project manager
- Stakeholders

5.3.6.7.3 *Outputs for Workforce & Personnel*

The outputs for Workforce and Personnel will relate to design change in the SOI or from feedback in the supportability data where a need for continuous improvement identifies an aspect of the number or skill level of personnel that could be better to improve capability or capacity. It may be that the SOI is operated differently from the original CONOPS and a revision to improve the Human engineering aspect of the design is relevant.

5.3.6.8 *Support & Test Equipment (S&TE)*

The activities associated with support and test equipment during the Support Stage relate mainly to:

- Sustaining the support and test equipment capability to overcome obsolescence.
- Introducing new S&TE to meet the requirements of modifications or mid-life update.

Both options involve assessing requirements, identifying candidate S&TE solutions, checking for 'better' alternatives. The concept of 'Better' could be interpreted as '*is more supportable and with lower Life Cycle Costs*'- but a *better reliability*, or a *better test capability with simpler man machine interface to simplify Training and User Guide*. Reviews of test parameters, and design data are part of these activities. The S&TE process can be summarised as a full range mini-ILS process of its own, with as many ILS elements interacting as at the SOI level.

5.3.6.8.1 *Standards for Support & Test Equipment*

The primary standards for Support Equipment are shown below:

- | | |
|-------------------------|---|
| • DI-ILSS-80118C SERD | Support Equipment Requirement Data |
| • Mil HDBK 2097A | Acquisition of Support Equipment and Associated ILS |
| • MIL-STD-1388 | Logistics Support Analysis and Data |
| • SAE TD-STD-0017 | Product Support Analysis |
| • SAE GEIA-STD 0007 | Product Support Data |
| • Def Stan 00-60/00-600 | Integrated Logistics Support |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ACodP-1 | NATO Codification |

5.3.6.8.2 *Processes for Support & Test Equipment*

Supply Process

- Purchase new S&TE for obsolete items. (see: 2.2.1.11, 2.2.5.2, 2.2.4.3 and 2.2.4.4)
- Provide Support & Test Equipment (see 2.2.4.4, 2.2.5.3)

Operational Processes

- Manage the pool of S&TE amongst user Units to meet priority needs for items returned for repair or calibration, (see 2.2.5.4)
- Report lessons learned for S&TE. (see: 2.2.1.5)

Supportability Analysis and Maintenance Process

- Prepare data for new S&TE to meet analysis and introduction requirements, (see: 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.3.4, 2.2.3.9 and 2.2.4.3)
- Monitor effectiveness of new S&TE introduced with SOI for contract compliance, (see: 2.2.2.3, 2.2.2.4, 2.2.12.2, 2.2.4.6)
- Recommend new or common S&TE as design changes, (see 2.2.5.2, 2.2.2.3, 2.2.2.4 and 2.2.12.3)
- Recommend improvements to new S&TE where required, (see: 2.2.2.3, 2.2.2.4, 2.2.5.2, 2.2.12.3)
- As S&TE becomes obsolete, recommend replacement S&TE to maintain the SOI availability, (see 2.2.1.11, 2.2.2.3, 2.2.2.4 and above 2.2.5.2).
- Evaluate the LCC trade-off for S&TE candidates and alternative designs, (see 2.2.2.2).
- The above changes for S&TE should be shared with the Supply Support, Training and Technical Information teams

5.3.6.8.3 *Outputs for Support & Test Equipment*

The outputs for S&TE during the Support Stage are:

- S&TE Maintenance Contracts for calibration, repair, test, inspection and certification, etc.
- S&TE NATO Codification Data updates for replacement items
- IP Data Modules for new special to type S&TE to update the Technical Information
- Purchase quantity recommendation report for S&TE new items
- Purchase orders for new S&TE Delivery of S&TE to locations and withdrawal of obsolete items

Roles and Responsibilities:

- ILS Manager
- ILS Element team leaders
- Supportability Analyst
- S&TE Engineer

5.3.6.9 *Design Interface*

Analysis of In-Service supportability performance is important to measure what has been achieved in the contract for the SOI. This will involve data feedback collection and analysis.

- Undertake SA for design changes to ensure new items are as well supported as original SOI LRUs
- Record Design change data in Logistics Database and ensure related ILS Elements are notified.

5.3.6.9.1 *Standards for Design Interface*

The standards for Design Interface during Support Stage are:

- ASD/AIA/A4A S1000D Specification for Technical Publications using a common source database

- | | |
|---------------------------------|--|
| • ASD STE 100 | Simplified Technical English |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • ASD/AIA SX000i | Integrated Product Support |
| • MIL-STD-1388 | Logistics Support Analysis |
| • Mil HDBK 502A/SAE TD-STD 0017 | Product Support Analysis |
| • SAE GEIA-STD/HB 0007 | Product Support Data |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |
| • ADMPs | Allied Dependability Publications |
| • STANAG 4597 / ISO 62402 | Obsolescence Management |

5.3.6.9.2 Processes for Design Interface

The Life Cycle Cost Management Process assists the programs in analysing system Life Cycle Cost. This process identifies, assesses and handles all costs during the entire life cycle of the system. The modelling should identify cost drivers at LRU level as well as at maintenance task level. These two views of costs drivers can guide system improvement and modification design. The processes for Design Interface during the Utilisation and Support stages reflects the level of design change from: obsolescence, functional upgrade, reliability upgrade, maintainability upgrade, etc.

Within the Support Stage the Life Cycle Costs (LCC) are continuously monitored, and estimations are improved. This process affects all ILS Elements.

Planning

- Plan the upgrade or modification, (see 2.2.1.2, 2.2.1.3, 2.2.1.11 and 2.2.1.10)

Supportability Analysis and Maintenance Process

- Perform Life Cycle Cost analysis (see 2.2.2.2)
- Perform Supportability Analysis (see 2.2.2.3)
- Develop SA Dataset (See 2.2.2.4)
- Review performance of Reliability using SOI field data (see 2.2.2.3, 2.2.2.4)
- Review performance of Maintainability using SOI field data (see 2.2.2.3, 2.2.2.4)
- Review performance of Testability using SOI field data (see 2.2.2.3, 2.2.2.4)
- Review Safety Hazards and effectiveness of technical information and training (see 2.2.2.3, 2.2.2.4)
- Review operator and maintainer performance for human factors workload, safety, hazards and effectiveness (see 2.2.2.3)

Supply Processes

- Deliver SA Data (see 2.2.2.4)

Roles:

- Analyst / Modeller
- Supportability Manager
- Supportability Analyst

5.3.6.9.3 *Outputs for Design Interface*

The outputs for Design Interface during the Support Stage reflect continuous improvement processes, design change due to obsolescence or functional enhancements are:

- LCC modelling outputs identifying costs, key performance metrics for downtime, man hours per year at maintenance levels, cost drivers by LRU NSN and cost drivers at maintenance task level.
- Supportability analysis results for design change:
 - Functional analyses (FMECA and RCM).
 - Candidate Items List.
 - Task Inventory.
 - Support Solution Options and trade-off.
 - Level of Repair Analysis
 - Transportability analysis (whole system, sectionalised system and components).
 - Maintenance Task Analysis.
 - Early Fielding Plan for modified SOI (for modifications or mid-life upgrade).
 - Post Production Support planning for obsolescence management of the modified SOI and DMSMS activities
 - Supportability Test Evaluation and Verification Report
- Reliability and Maintainability Prediction reports
- Testability Analysis Report
- System Safety Hazard Analysis Report
- Human Engineering report for design influence
- SA Data and reports detailing and summarising the supportability analysis results.

5.3.6.10 *Technical Information*

Technical Information during the Support Stage will focus on two aspects: the maintenance correction of Data Modules following in-service feedback, and updates and new data modules for design change coming from obsolescence and functional enhancement modifications. The latter is a reflection of the Development stage, whilst the former is a continuous improvement process as much as is allowed by budgets and incentives in a Performance Based Logistics sense.

5.3.6.10.1 *Standards for Technical Information*

The standards used for Technical Information during the Support Stage is the same as Development Stage, with the exception of ASD/AIA S5000F.

- | | |
|---------------------------|--|
| • ASD/AIA/A4A S1000D | Specification for Technical Publications using a common source database |
| • ASD STE 100 | Simplified Technical English |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • ASD/AIA SX000i | Specification for Integrated Product Support |
| • MIL-STD-1388 | Logistics Support Analysis and Data |
| • SAE TD STD-0017 | Product Support Analysis |
| • SAE GEIA-STD-0007 | Product Support Data |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |
| • ADMPs | Allied Dependability Publications |
| • STANAG 4597 / ISO 62402 | Obsolescence Management |

5.3.6.10.2 *Processes for Technical Information*

Planning

- Plan the Technical Information for the upgrade or modification, (see, 2.2.1.3, and Annex 1 Para 3.72.2.7.2)

Supportability Analysis and Maintenance Process

- Develop the Technical Data Package (see 2.2.7.2)

Supply Processes

- Deliver Technical Data Package (see 2.2.7.3)

Roles:

- Technical Information Manager
- Supportability Analyst
- Technical Author

5.3.6.10.3 *Outputs for Technical Information*

The outputs for Technical Information during the Support Stage are:

- Data Modules for new or modified design, software updates, obsolescence modifications or a larger mid-life upgrade
- Delivery of Revised or new Technical Publications

5.3.6.11 *Training & Training Support*

The Training and Training Support Process during Support Stage ensures that the identified training is provided, managed, and continually assessed for performance and relevancy.

5.3.6.11.1 *Standards for Training & Training Support*

The following primary standards relate to Training during this life cycle stage:

- ASD/AIA S6000T Specification for training analysis and design

5.3.6.11.2 *Processes for Training & Training Support*

Planning

- Develop Training Plan (see 2.2.6.4)

Supportability Analysis and Maintenance Process

- Revise training to keep track of design changes (see 2.2.6.5)
- Perform Training Need Analysis (TNA) (see 2.2.6.2)
- Develop Training Package (see 2.2.6.5)

Supply Processes

- Provide Training Equipment (see 2.2.6.6)
- Deploy Training/Training Implementation (see 2.2.6.7)

Operational Processes

- Monitor effectiveness of training and training equipment. Does feedback indicate a failure of training process or just individuals? (see 2.2.1.7, 2.2.1.10, and 2.2.2.3)

Roles/Responsibilities involved in this process:

- Training and Training Support Manager
- Training Analyst and Instructor
- Subject Matter Expert(s)
- Supportability Analyst

5.3.6.11.3 *Outputs for Training & Training Support*

The outputs from Training during the Utilisation and Support stages are:

- Revised Training Course materials to reflect the design changes
- Revised Training Equipment and Training Aids to reflect the changed design

5.3.6.12 **Packaging, Handling, Storage & Transport (PHS&T)**

The PHS&T Process during Support Stage ensures that the required services are performed and managed to always ensure the adequate protection and availability of materiel.

5.3.6.12.1 *Standards for Packaging, Handling, Storage & Transport*

The following primary standards relate to PHS&T during this life cycle stage:

- Mil Std 2073-1E Packaging Design
- Def Stan 81-41 Packaging Design
- Mil Std 1366E Transportability Analysis
- REACH, UN ST/SG/AC.10/1 (Vol. 1) Transportation of Dangerous Goods
- JSP 886 Vol 7 Pt8.02 Supportability Engineering – Packaging Handling Storage and Transportation

- DSA-2-DLSR UK Defence Codes of Practice: Movement and Transport Safety Regulator, Defence Land Safety Regulator

5.3.6.12.2 *Processes for Packaging, Handling, Storage & Transport*

Planning

- Develop PHS&T Plan (see 2.2.9.2 and Annex 1 Para 3.9)

Supportability Analysis and Maintenance Process

- Undertake Packaging Design activity (see 2.2.9.2)
- Perform Hazardous Materials Analysis (see 2.2.9.2, 2.2.2.3, 2.2.13.2, 2.2.2.4 and 2.2.4.3)
- Perform Storage analysis for hazardous materials and for spares packages etc. (See 2.2.2.3 and 2.2.9.2)
- Perform Transportability analysis of the SOI, revised by functional upgrades, enhancements, or obsolescence modifications (see 2.2.2.3, 2.2.2.2 and 2.2.9.2)

Supply Processes

- Provide Packaging Design Data (see 2.2.2.4, 2.2.4.3 and 2.2.9.3)

Operational Processes

- Monitor effectiveness of PHS&T solutions. Does feedback indicate a failure of analysis process or just individual solutions? (see 2.2.1.7, 2.2.1.10, 2.2.2.3, 2.2.2.4, 2.2.12.2, 2.2.9.2 and 2.2.12.3)

Roles/Responsibilities involved in this process:

- ILS Element team leaders
- PHS&T Designer
- PHS&T Analyst

5.3.6.12.3 *Outputs for Packaging, Handling, Storage & Transport*

The outputs for PHS&T during the Support Stage are:

- Produce packaging as required to meet demand
- Assess demand for hazardous material
- Prepare for disposal planning of hazardous and other stored material.
- Monitor the demand v Qty of STC or Category 1 Containers and reprovision if required

5.3.6.13 *IT System Support*

IT System Support activity during the Support Stage reflects a combination of feedback processes and data for the deployed SOI and Development stage activities relating to design analysis and development.

5.3.6.13.1 *Standards for IT System Support*

The following primary standards relate to IT System Support during this life cycle stage:

- Mil Std 1388-2B Logistics Support Analysis Record

- | | |
|-------------------------|--|
| • Mil HDBK 502A | Product Support Analysis |
| • SAE TD-STD-0017 | Product Support Analysis |
| • SAE GEIA STD 0007C | Product Support Data |
| • Def Stan 00-60/00-600 | Supportability Analysis |
| • ASD/AIA/A4A S1000D | Specification for Technical Publications using a common source database |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA S6000T | Specification for training analysis and design |

5.3.6.13.2 Processes for IT System Support

Planning

- Develop IT System Support Plan (see 2.2.11.2, 2.2.1.3 and Annex 1 Para 3.11)

Supply Processes

- Provide the environment for data exchange to enable data feedback from customer of usage hours per system serial number, inventory and maintenance transactions (see 2.2.11.3)

Operational Processes

- Monitor effectiveness of IT System Support solutions. Does feedback indicate a failure of analysis process or just individual solutions? (see 2.2.11.2, 2.2.12.2, 2.2.1.7 and 2.2.1.10)
- Validate the Logistics Database with the Logistics Demonstration of maintenance using resources and processes recorded in database (See 2.2.1.7, 2.2.2.3, 2.2.2.4, 2.2.3.5, 2.2.4.3, 2.2.5.2, 2.2.6.5, 2.2.6.6, 2.2.7.3, 2.2.8.2, 2.2.9.2, 2.2.10.2 and 2.2.12.2)
- Capture evidence of failures and analyse bugs to determine cause (see 2.2.12.4)

Roles/Responsibilities involved in this process:

- ILS Element team leaders
- IT Solution Architect
- Database administrator
- Data Analyst

5.3.6.13.3 Outputs for IT System Support

The outputs for IT System Support during the Support Stage are:

- Provide the environment for data exchange to enable data feedback from the Customer of: usage hours per system serial number, inventory and maintenance transactions

5.3.6.14 *Sustaining Engineering*

Sustaining Engineering takes on the analysis of field data fed back from operational usage hours, the maintenance work orders and inventory transactions for demands and repairs. The use of Failure Reporting and Corrective Action Systems (FRACAS) can be helpful to aid this analysis. This approach is useful to analyse field maintenance (how long the activity took, what the BITE detected/determined, which Skills did the maintenance, were the manuals correct in the procedure, etc).

Maintenance Management System tools for scheduled maintenance events are essential to the smooth organisation and management of a population of SOI. The word 'Population' is used as the word 'fleet' does not always translate well for some languages.

Continuing to manage the SA dataset and updates to track design changes and obsolescence issues is essential.

A tool to update the assessment of Operational Availability (Ao) and the spares modelling associated is often also required to maintain Ao at the required or a modified level. Modelling can be used to modify the range of spares to match design changes and assess life cycle cost drivers and R&M drivers.

5.3.6.14.1 *Standards for Sustaining Engineering*

The following primary standards relate to Sustaining Engineering during this life cycle stage:

- | | |
|--------------------------|--|
| • Mil Std 1388-2B | Logistics Support Analysis Record |
| • Mil HDBK 502A | Product Support Analysis |
| • SAE TD-STD-0017 | Product Support Analysis |
| • SAE GEIA STD 007C | Product Support Data |
| • Def Stan 00-60/00-600 | Supportability Analysis |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • PLCS (ISO 10303-239.3) | Product Life Cycle Support |
| • ISO/IEC/IEEE 15288 | Systems and Software Engineering – System Life Cycle Processes |
| • ADMPs | Allied Dependability Publications |

Secondary standards are:

- | | |
|----------------------|---|
| • ASD/AIA/A4A S1000D | Specification for Technical Publications using a common source database |
| • ASD STE 100 | Simplified Technical English |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ASD/AIA S6000T | Specification for training analysis and design |

5.3.6.14.2 *Processes for Sustaining Engineering*

Supportability Analysis and Maintenance Process

- Evaluate Operational Suitability (see 2.2.12.2)
- Develop Sustainment Improvements (see 2.2.12.3)

- Perform Engineering Technical Analysis (see 2.2.12.4)
- The planning to manage component and SOI Disposal (see 2.2.12.5)
- Support stage LCC modelling and outputs with updates of field data (see 2.2.2.2)

Roles/Responsibilities involved in this process:

- Project Manager
- ILS Manager
- ILS Element team leaders

5.3.6.14.3 *Outputs for Sustaining Engineering*

The outputs for Sustaining Engineering during the Support Stage are:

- Analysis Reports to monitor continuing operational suitability
- Proposals for supportability improvements to SOI design and support processes
- SOI and component Disposal Plan
- LCC models and reports to identify cost and R&M drivers to guide areas for improvement
- Root Cause Analysis reports from Engineering Technical Analysis

5.3.6.15 **Product Support Management**

Product Support Management encompasses the processes below:

- The Portfolio Management Process is used to establish, initiate, sustain and terminate the Programmes and projects necessary to satisfy the strategic aims and objectives of NATO. This management process is to retain strategic alignment to the ILS part of the programme or project.
- The Quality Management process is based on the principles of ISO 9000 and is an integrated systems approach to achieve quality in products and services throughout the life cycle. Within the Utilisation and Support Stages this process ensures that the quality policies and objectives of the ILS processes remain appropriate and relevant. This includes updates of Project, ILS, Risk Plan and measurement, monitoring and analysing ILS processes, and implement action necessary to achieve planned results and continual improvement.
- Quality Assurance (QA) is an integral part of Quality Management based on STANAG 4107 and its supporting Allied Quality Assurance Publications (AQAP). Within the Support Stage this process the main activity is support Risk Management and updating the QA Strategy to verify planned arrangements. The QA Plan should be reviewed to reflect programme acquisition intentions and supply chain performance and to update QA resource estimations.
- The Risk Management Process identifies, assesses, and handles all risks during the entire life cycle within the overall risk management plan. During the Support Stage continuously risk identification, assessment and mitigation is performed.
- Configuration Management (CM) is a management process for establishing and maintaining consistency of a product's performance that consists of activities that apply over the life cycle of a system, its configuration items, and related system configuration information. CM documents the system's configuration. It supports identification and

traceability, the status of achievement of its physical and functional requirements, and access to accurate configuration information in all phases of the life cycle by identify configuration, control the configuration, set up configuration status accounting and execute configuration audits.

During the Support Stage these activities are further performed including update of the Configuration Management Plan (CMP).

5.3.6.15.1 *Standards for Product Support Management*

Product Support Management should adopt the standards used by ILS during the Development, Production, Utilisation and Support stages. By doing this the planning of data exchange during the Support Stage can continue to maximise the benefits of the feedback and continuous improvement processes.

- | | |
|---------------------------|--|
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA SX000i | Specification for Integrated Product Support |
| • PLCS (ISO 10303-239) | Product Life Cycle Support |
| • ISO/IEC/IEEE 15288 | Systems and Software Engineering – System Life Cycle Processes |
| • STANAG 4597 / ISO 62402 | Obsolescence Management |
| • STANAG 4159, ISO 10007 | Quality Management – Guidelines for Configuration Management |
| • SAE TA-STD-0017 | Product Support Analysis |
| • SAE GEIA-STD-0007 | Product Support Data |
| • ASD/AIA/A4A S1000D | Specification for Technical Publications using a common source database |
| • ASD STE 100 | Simplified Technical English |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD S4000P | Specification for developing and continuously improving preventive maintenance |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • MIL-STD-1388 | Logistics Support Analysis |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |
| • MIL-STD 2073-1E | Packaging Design |
| • MIL HDBK 2097A | Acquisition of Support Equipment and Associated ILS |

5.3.6.15.2 *Processes for Product Support Management*

Supportability Analysis and Maintenance Process

- Analyse Alternatives (see 2.2.1.2, 2.2.2.3 and 2.2.2.4)
- Manage Fleet (see 2.2.1.8)
- Manage In-Service ILS activities (see 2.2.1.10)
- Perform Obsolescence Management (see 2.2.1.11)
- Document Lessons learned (see 2.2.1.5)
- Manage Configuration (see 2.2.1.6)
- Develop Integrated Lifecycle Support Plan (see (2.2.1.3 and Annex 1, in this stage maintaining the performance parameters)
- The Verification process provides objective evidence that the elements of a system fulfil specified requirements and characteristics through the lifecycle. The main effort on this process is done during the earlier stages up to Production Stage.
- The Activities within the Utilisation and Support stages are to perform verification and manage results of verification
- Validation is an independent assurance process that ensures a product, service or system satisfies the operational needs of the user in the intended environment. Together with the verification process these are important processes within the Quality Management Process.

Roles/Responsibilities involved in this process:

- ILS Manager
- ILS Element team leaders
- Supportability Analyst
- Quality Manager
- Quality Assurance team
- Project Manager
- Risk Manager
- Configuration Manager
- Configuration management team
- Obsolescence Manager
- Training Manager
- Purchasing department
- Facilities/Stores/Infrastructure Manager

5.3.6.15.3 *Outputs for Product Support Management*

The outputs for Product Support Management are indicated by the processes above.

5.3.6.16 *Environmental Conditions and Recoverability*

The Environmental Conditions and Recoverability Process during Support Stage ensures that the necessary environmental protections and considerations are observed and factored into the conduct of all activities.

5.3.6.16.1 *Standards for Environmental Conditions and Recoverability*

Related documents:

- | | |
|---------------------------|--|
| • STANAG 4597 / ISO 62402 | Obsolescence Management |
| • STANAG 4159, ISO 100073 | Configuration Management |
| • SAE TD-STD-0017 | Product Support Analysis |
| • SAE GEIA-STD-0007 | Product Support Data |
| • PLCS (ISO 10303-239.3) | Product Life Cycle Support |
| • ISO/IEC/IEEE 15288 | Systems and Software Engineering – System Life Cycle Processes |
| • ASD/AIA S2000M | Specification for Materiel Management |
| • ACodP-1 | NATO Manual on Codification |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD/AIA S5000F | Specification for in-service data feedback |
| • ASD/AIA S6000T | Specification for training analysis and design |
| • MIL-STD-1388 | Logistics Support Analysis and Data |
| • DEF-STAN 00-60/00-600 | Integrated Logistics Support |
| • ASD/AIA SX000i | Specification for Integrated Product Support |

5.3.6.16.2 *Processes for Environmental Conditions and Recoverability*

Planning

- Manage Environmental Conditions and Recoverability (see 2.2.13.3)

Supportability Analysis and Maintenance Process

- Analyse Alternatives (see 2.2.1.2)
- Develop Integrated Lifecycle Support Plan (see 2.2.1.3 and Annex 1)
- Manage In-Service ILS activities (see 2.2.1.10)
- Manage Configuration (see 2.2.1.6)
- Perform Obsolescence Management (see 2.2.1.11)
- Fleet management (see 2.2.1.8)
- Document Lessons learned (see 2.2.1.5)
- Manage Environmental Conditions and Recoverability (see 2.2.13.2 and 2.2.13.3)

Roles/Responsibilities involved in this process:

- ILS Manager

- ILS Element team leaders
- Supportability Analyst
- Purchasing department
- Facilities/Stores/Infrastructure Manager
- Configuration Manager
- Quality Manager
- Obsolescence Manager
- Risk Manager
- Training Manager
- Purchasing department
- Facilities/Stores/Infrastructure Manager

5.3.6.16.3 *Outputs for Environmental Conditions and Recoverability*

The following outputs are applicable to Environmental Conditions and Recoverability during the Support Stage:

- Identification of Environmental Conditions and Recoverability Issues (see 2.2.13.2)
- Manage Environmental Conditions and Recoverability (see 2.2.13.3 **Error! Reference source not found.**)

5.3.7 Retirement Stage

The purpose of the Retirement Stage is to dispose of the SOI and its supporting resources and infrastructure. This starts with a disposal strategy and plan produced by the Customer that conforms with national and international safety and environmental legislation and details the project disposal requirements. The Disposal process described by the graphic of Figure 34Figure 33: Logistics Support and Maintenance Process is a useful cross reference for the activities in the Retirement Stage.

The life cycle retirement stage starts as the end-of-life approaches for a system or sub-system. This can be a planned event, or it can occur as a result of the following factors:

- High cost of operations and or maintenance
- System capabilities are no longer needed or not cost effective
- High cost of upgrades and changes to make the SOI viable
- Technology obsolescence making the system/sub-system unsupportable.

Eventually, most system/sub-systems will face replacement no matter how well they were developed or maintained. To maximise the SOI useful life, it must be well designed, documented, and maintained. The following factors will shorten the useful life of an SOI:

- Lack of, or poor documentation
- No agreement on the CONOPS
- Inadequate operations & maintenance budget
- No configuration management process that synchronizes changes with system documentation

A strategy for replacement must be developed to migrate to the new system or sub-system. This strategy will become part of the Systems Engineering Management Plan. Chapter 3.8 of the Systems Engineering Guidebook for intelligent Transport Systems provides good guidance on retirement and replacement planning for Systems. It identifies Inputs, Outputs, and Systems Engineering V process diagram to show where retirement planning starts, and retirement takes place. The retirement planning should start with the development of both the SEMP and ConOps. Although this document is focused on traffic systems, the concepts within apply equally well to the military environment.

Disposal may involve the destruction of the System or the sale of the System to another nation. The disposal plan must have agreement with national departments who have an interest in these disposal routes. The management of disposal must conform with international standards and European regulations for the best outcome. The USA DoD standard 4160.21-M provides a good, structured approach for considering disposal. Also to be considered in the disposal process is ITAR. The International Traffic in Arms Regulations (ITAR) establishes controls regarding the export and import of Defense-related items and services that appear on the United States Munitions List (USML). ITAR is meant to limit access to specific technologies and their associated data resources. If items are being sold, approval from USA Authorities cannot be given until the new potential end user is identified. Items and SOI shall be demilitarised so that their capabilities cannot be used against NATO.

If the material to be disposed has a security classification above a threshold, it will need to be declassified before disposal.

Hazardous or special waste materials will need to comply with the environmental regulations.

5.3.7.1 Environmental Conditions and Recoverability

The new ILS element, Environmental Conditions and Recoverability, has a major role to play in disposal of Systems, and is the primary ILS element in this life cycle stage.

5.3.7.1.1 Standards recommended for Environmental Conditions and Recoverability

Standards for retirement:

- | | |
|---|--|
| • ISO/IEC TR 19760: 2003 | System life cycle processes |
| • ISO/IEC 15288 | Systems and Software Engineering – System Life Cycle Processes |
| • STANAG 4597 / ISO 62402 | Obsolescence Management |
| • Systems Engineering Guidebook for intelligent Transport Systems, 2009, Version 3.0, | Federal Highways Administration, California Division |
| • STANAG 4427 edn3, ISO 10007 | Configuration Management |
| • ISO 27001, 27002 | Information Security Management System |
| • ISO 22301 | Secure Disposal of Data and Equipment |
| • ASD/AIA S3000L | Procedure Specification for Logistics Support Analysis (LSA) |
| • ASD/AIA SX000i | Specification for Integrated Product Support |
| • DoD 4160.21-M, 1997 | Defense Materiel Disposition Manual |
| • WEEE Directive: 2012/19/EU | Waste from Electrical and Electronic Equipment |

- ISO 14001:2015 Environmental Management
- ISO 50001:2018 Energy management systems — Requirements with guidance for use
- ISO 21500:2021 Project, programme and portfolio management — Context and concepts
- ISO/IEC/IEEE 24748-5:2017 Systems and software engineering — Life cycle management
- ITAR International Traffic in Arms Regulations
- JSP 886, Vol 2, Part 404 Disposal of Inventory

5.3.7.1.2 *Processes for Environmental Conditions and Recoverability*

Planning

- Develop a Retirement and Disposal Strategy. (see 2.2.2.3, 2.2.2.2 and 2.2.1.11)
- Develop a Retirement and Disposal Plan. Reach agreement with national departments involved in disposal via export sales and disposal as scrap or salvage recovery (see 2.2.12.2 and 2.2.12.5)

Supportability Analysis and Maintenance Process

- Capture costs for disposal of Component and Systems (see 2.2.2.3, 2.2.1.11, 2.2.4.3)
- Update the Life Cycle Cost models and disposal analysis (see 2.2.2.2)
- Update Level of Repair Analysis model data sets to benefit future LORA (see 2.2.3.4)
- Document lessons learned (see 2.2.1.5, 2.2.1.11 and 2.2.2.3, 2.2.2.4)

Supply Processes

- Develop a Retirement and Disposal Report (see 2.2.13.2, 2.2.4.3, and 2.2.13.3)
- Update the Supportability Dataset with real disposal data values (see 2.2.2.4 and 2.2.4.3)

Operational Processes

- Manage the In-Service ILS Activity as SOI and components are retired and disposed (see 2.2.1.11, 2.2.1.8, 2.2.4.5, 2.2.4.6, 2.2.5.4, 2.2.13.3 and 2.2.12.5)

Roles and Responsibilities:

- EC&R Manager
- EC&R Analyst
- Analyst / Modeller
- Supportability Manager
- Supportability Analyst

5.3.7.1.3 *Outputs from Environmental Conditions and Recoverability*

The outputs from the disposal and retirement stage are:

- A reduction in System population by safe disposal of each System
- An income for the nation disposing of the System, either from export sale, salvage or scrap disposal
- Recycling and reuse shall be considered within Environmental Conditions and Recoverability

- Lessons learned
- Final recommendations
- Program management final report

5.4 Guidance and Advice

5.4.1 Purpose

The purpose of this paragraph is to provide guidance to create a coherent digital thread, coordinated from technical engineering, respecting config management, in and through the logistics elements. The aim is to reduce mapping between disciplines and standards-/specifications as much as possible – ideally to prevent any mapping. Instead of mapping, systems shall use a coordinated approach of tailoring the respective disciplines (and its standards and specifications) in a way, that the information can flow from one process to another, not interrupting processes - or information flow, while enabling in-service feedback.

Nevertheless, this approach shall be used for ongoing as well as new projects. If an ongoing project might not have been set up along the direction of this sub-chapter, the project management shall analyse the need for mapping and implement this at the earliest possible project opportunity, i.e., the interface between technical engineering and support engineering (LSA). This mapping must include the SOIs breakdown as well as config management from technical to support engineering. There must be no mapping within the logistics processes, but, as mentioned above and described below, coordinated tailoring.

This starts with the coordination of a functional-to-physical breakdown of the SOI to meet the needs of both engineering and the logistics support elements. This breakdown will enable information to be re-used across projects and ease the configuration management through the in-service phase. The functional breakdown of a system is realized by physical parts, in line with ISO/IEC 15288, STANAG 4457 and AEP-67.

5.4.2 Selection of Standards

The development of (complex) technical products (Systems of Interest, SOI) and their supporting and enabling systems is a joint effort between various stakeholders from various domains, typically including Engineering and ILS. An efficient and effective use of the SOI over the life cycle is achieved best when the coordination between the stakeholders is controlled and the mapping between the domains with their standards and specifications is kept to an absolute minimum.

The design, development, production, and sustainment of a (complex) technical product are different phases of the same System of Interest (SOI) using the ISO/IEC 15288 terminology. A major part of the sustainment life cycle costs, for both the customer and System Design Authority (SDA), are defined during the design and development stages, with the sustainment stage following the consequence of those design and support decisions. Effective configuration management can be used to minimize the costs and efforts for both the SDA and the customer and across departments of both stakeholders. It also enables the management of the SOI breakdown for different customers and enables re-use of previous work with an increase in quality.

The ILS scope mainly covers Support Analysis, Supply Support and Technical Publications, each of which supported by one or more standards or specifications.

Supply Support is supported by ASD/AIA S2000M, which has a prescribed method on how to implement configuration management. The same applies to Technical Publications and ASD/AIA

S1000D, including Training (SCORM). Support Analysis covers a set of analyses and is supported by several standards and specifications.

Support Analysis has: Mil-Std-1388, SAE GEIA-STD-0007C, SAE TA-STD-0017A, DEF-STAN 00-60 / 00-600 and its derivatives as possibilities and the ASD/AIA S-Series of IPS Specifications as another option. The ASD/AIA S-Series include S2000M and S1000D, whose breakdown structures shall be aligned with the breakdown of support analysis from S3000L, and S4000P. The breakdown structure of these specifications is based on breakdown in the Common Data Model (CDM) and is therefore referred to as the CDM-Variants.

Reliability calculations provides input to the system availability, but the reliability domain does not have a standard that can be used for the exchange of data, although the same identifiers must be used to align the reliability analysis with the LSA. It shall be assured that the reliability information is aligned with the respective production standard, as well as to be in line with the current system configuration. A significant part of the reliability calculations is part of the engineering activities, so this interface must also be controlled. The selection of one or more reliability standards should match the type of SOI.

The combination of the selected standards and specifications within engineering and support engineering determines and shall be aligned with configuration management. The purpose of the configuration management is to have an identical method to identify elements in a breakdown structure throughout the SOI and the ability to manage changes throughout the life cycle, within the limitations of the respective standards and specifications.

Carefully consider that ability to engage in Digital Thread opportunities when selecting standards/specifications. Assess each to see if they will enable this capability currently or in the near future.

5.4.3 Functional Modularization

In reality, non-trivial systems are systems of systems. On each system level, integrated systems shall be identified and handled autonomously, providing relevant, effective information to the next higher integrated level. Each of these systems (independent of the level) has its own, unique functional-to-physical breakdown and configuration management principles that have to be coordinated through all disciplines within the system's context, accordingly.

A functional breakdown aids the implementation of a modular system, providing the building blocks as an abstraction of the physical assemblies. The basis for these definitions can be derived from industry or company-specific standards, which are often already used by engineering teams.

According to ISO/IEC 15288, these building blocks build the logical architecture. Each building block includes: defined functions, interfaces, failure modes, tasks, special tools, effort estimation, etc. It is no longer the part that drives the analysis, but the functional group is the key element. The physical part is just an element of this. The logical architecture acts as a blueprint that can be reused for another project. The information shall be handled system-centric and not project specific. This means, that the information shall be as re-usable as possible. Therefore, it is critical to define base and delta configuration and implement this concept along all processes and specifications and information objects.

The functional architecture shall be set up at the beginning of a project and shall be the basis for the following design steps (e.g., 3D designs, EMC engineering, etc.) and software development. Subsequently, production and service processes are designed into the capability. The capability

consists of the System of Interest (SOI) and the supporting elements, which are also known as the ILS elements.

5.4.4 Implementation

The use of specific standards and specifications is not mandatory, but if standards and specifications are selected, the breakdown and config management approach must be consistent across all selected standards and specifications.

The basic spoken/written language to be used in a system must be defined across all selected standards and specifications. There shall be a defined strategy on how to handle additional languages for other customers. It is most helpful if the baseline and delta configurations are managed using a single language when a multi-national supplier community is involved.

As Supportability Analysis (SA) is not a one-off activity remember to require SA to be iteratively repeated. As new data surfaces (In-Service, Test, etc), all related SA must be reviewed and reconducted if impacted. If a Reliability prediction or FMECA report is issued, and the design changes the analysis shall be revised and the Report shall be updated.

5.4.5 System Identifier

An SOI is broken down into systems that can be used on their own or in other higher-level SOI. Each of these systems has an SOI, uniquely identified by its system identifier. This creates a modular and nested structure, in which each SOI has its own configuration, embedded in the system architecture (which is also a SOI with its own configuration). The alignment of the base version per standard and specification are shown in Table 3.

Table 3: System Unique Identifiers

Standard/Spec	Name	Abbreviation	Length limitation
Mil-GEIA-Std-Variants	End Item Acronym Code	EIAC	up to 10
CDM-Variants	productIdentifier	prodId	-
S2000M	Model Identifier	MOI	up to 14
S1000D	Model Identifier	MI	up to 14

The EIAC has a limitation on the length of the field of up to 10 positions. If a MIL/GEIA/DEF Standard based Support Analysis is used together with ASD/AIA S2000M/S1000D the MOI/MI shall adopt the limitation of EIAC, of up to 10 digits. If the Support Analysis uses ASD S3000L/S4000P, the MOI/MI can be defined up to 14 digits. The variants of the base version must be aligned as well, and the alignment is shown in Table 4 below.

Table 4: Alignment of Unique Identifiers

Standard/Spec	Name	Abbreviation	Length limitation
Mil-Std-Variants	Usable On Code	UOC	up to 3
CDM-Variants	productVariantIdentifier	prodVarId	-
S2000M	Model Version	MOV	up to 3
S1000D	System Difference Code	SDC	up to 4

The first up to 3 digits of UOC, MOV, SDC shall be the same.

A project must always define at least 1 variant, which is used as the base variant.

A project must define a strategy on how to handle delta variants to this base variant.

The base variant shall be valid as long as there will be no delta/variation. Variations are to be defined in the delta variants only.

5.4.6 Breakdown Element Identification

The alignment of the elements of a breakdown is shown in the table below.

Table 5: Breakdown Element Alignment

Standard/Spec	Name	Abbreviation	Length limitation
Mil-Std-Variants	Logistics Control Number	LCN	18
CDM-Variants	breakdownElementIdentifier	beld	-
S2000M	Catalogue Sequence Number	CSN	16
S1000D	Data Module Code	DMC	41

It is required to identify at least one Model version or Variant per EIAC/MOI/MI.

The Model version identifier is called Usable on Code (UOC, up to 3 characters long) in the LSA, it is called Model Version (MOV, up to 3 characters long) in S2000M and is called System Difference Code (SDC, up to 4 characters long) in S1000D. An ATA/ASD MoU in 2006 enabled the use of ATA iSpec 2200 with different versions for each customer in civil airways, similar to SDC, but not identical.

Within a project and through the specifications the variants should be used identical. This makes it necessary to initially agree on a common length (up to three digits) and a strategy on how to match this with the main configuration identifier in the configuration management. Using a length of up to 3 characters and a systematic setup of the coding brings the most benefit for the project and is necessary. Example of the setup of model version / usable on code / first-three-digits-of SDC:

- 1st Position: A – 9
- 2nd Position: 0 – Z
- 3rd Position: Language (1 digit)

The 1st and 2nd position allows for 1296 variants, or 1156 variants when characters “I” and “O” are omitted, to avoid confusion with “0” and “1”)

In the example above, A0 is the base variant of the system. All other variants are differences to the base variant.

To distinguish between variants, the first 2 positions of the UOC, in this example, are used as major and minor variant identifiers, and the last position is used for language (English, German, etc.) in accordance with ISO 639 – single character. The UOC sequence, in this example, A0-ZZ is reserved for variants. Table 6 below shows an example of how the UOC/MOV/SDC codes could be used for a programme.

Table 6: Unique Identifier Breakdown

UOC=MOV=SDC	Explanation
-------------	-------------

A0E	Base variant with English language (default)
A1E	First difference variant with English language
A2E	Second difference variant with English language

Where design change between variants is greater than 15-20% from the Baseline, the first character of UOC would change. For variants with a lesser design change from the Baseline, only the second position of the UOC would change.

The MIL-STD/GEIA-Variants use the Alternate LCN Code (ALC) in addition, which has a length of 2 positions and is a key field in the database definition. The base variant is defined by ALC of '00'. The ALC is used for both the UOC (model variant) and for a local alternative variant in the breakdown. It helps to keep the ALC code values consistent across a variant and to use steps in ALC between variants to identify alternative parts within a variant breakdown.

The UOC depends on the Alternate LCN Code (ALC) which is a data element that is used for the UOC (model variant) and for local alternative variants in a breakdown. To identify local variants (that do not affect the model variant) from model variants ALC with coding "00" to "99" shall be used for local variants while ALC coding's "A0" to "ZZ" shall be used for the definition of the UOC.

5.4.7 Breakdown Elements

Further structuring of an SOI is done by building a tree of the system indicating different locations as branches and leaves. These structures can be BOM, EBOM (from Engineering) or following the structure elements from the specifications/standards: LCN (LSA, Support Analysis), SNS (ASD/AIA/A4A S1000D, technical documentation), CSN (ASD/AIA S2000M, material management).

ASD/AIA/A4A S1000D uses a structure called Standard Numbering System (SNS) that divides the SOI in hierarchically blocks (chapter) that are further divided (subchapter and sub-subchapter) in subject/unit/assembly-level (subject). The specification ASD/AIA/A4A S1000D provides a breakdown for different types of systems (Air vehicle, Engines, General surface vehicle, General sea vehicle, etc.) that are identified by a leading code (Material item Category Code=MICC). The MICC will be selected for each block and will be used for all variants of that block. The MICC is described in S1000D¹ version 4.1 in Chapter 4.3.3, paragraph 2.2.2.

The MICC and the Chapter, Sub-Chapter describe the functional breakdown. The levels below describe the physical breakdown.

This SNS is also used by ASD/AIA S2000M in the Catalogue Sequence Number (CSN). Both specifications use the same breakdown for an individual SOI. This logic can be applied to define the LSA control number (LCN) that structures the SOI in the LSA dataset as well. The LCN is used as a variable length unique identifier for each breakdown element, and it also indicates the indenture level by the number of characters. The maximum length of the LCN is limited in the standard to 18 positions in total.

The alignment of the individual positions of each breakdown element are shown in Table 7 below as an example.

¹ <https://users.s1000d.org/ProductList.aspx>

Table 7: Breakdown Element Alignment

Mil-Std-Variants	S2000M	S1000D	Length
Material Item Category Code (MICC)	Material Item Category Code (MICC)	Material Item Category Code (MICC)	1
Chapter (Ch)	Chapter (Ch)	Chapter (Ch)	2 (1+1)
Section (SE) /Sub-Section (SSE)	Section (SE) /Sub-Section (SSE)	Section (SE) /Sub-Section (SSE)	2 (1+1)
Subject/Unit/Assembly (SJ)	Subject/Unit/Assembly (SJ)	Subject/Unit/Assembly (SJ)	4
Free within LCN structure	Figure Number (FN)	Disassembly Code (DC)	2
Free within LCN structure	Figure Number Variant (FNV)	Disassembly Code Variant (DCV)	1
Free within LCN structure	Item Number (IN)	n.a.	3
Free within LCN structure	Item Number (INV)	n.a.	1

The CDM-Variants have the generic possibility to assign multiple identifiers to each breakdown element, so the use of the CDM-Variants imposes no further restrictions. Another option in the CDM-Variants is the possibility to create multiple breakdowns for each Product Variant and interlink these breakdowns. The use of any of these possibilities must be tested for feasibility and effectiveness to ensure that this choice is supported in practise with working software for all stakeholders.

5.4.8 Effectivity for Serial Numbers

A change within a UOC/MOV/SDC can be handled by the effectivity or EFY-range within a model variant (MOV in S2000M) to distinguish the validity of the respective information. A 1:1 mapping from the effectivity code to the serial numbers of the SOI is possible as well as a mapping to an assigned range of numbers. The effectivity codes 0000 and ZZZZ are the sentinel for “for all”.

5.4.9 MOI registrations

Each OEM will register its own Model Identifier (MOI) for its systems to use in S-Series, if applicable, with the NSPA organisation in NATO and will be responsible to maintain the configuration in its PLM system, if appropriate. The same breakdown and configuration system will be used throughout the life of the respective product. The MOI will be used as MI in ASD/AIA/A4A S1000D as well as EIAC in LSA.

The arrangement of breakdown can be selected based on the type of product (set via the MICC), but it should remain consistent once selected.

5.4.10 Alignment of work packages

An ILS plan / concept shall be developed and implemented for each SOI. Further relevant plans, like Maintenance plan, LSA plan, Material management plan, Documentation plan, Guidance Documents and Business Rules etc. shall be derived from the ILS plan. As well as the supportability design requirements, the alignment of standards and numbering systems (as applied

to baseline and variant designs) shall be completed before System Requirement Review (SRR) design stage. This will help integration across engineering and supportability for the remainder of the SOI life cycle; refer to Figure 40 in Para 5.3.3.3. Relevant deliverables shall be produced before Preliminary Design Review (PDR), while the main ILS activities shall be finished before Critical Design Review (CDR). Change management planning shall be considered from the very beginning, as well as an obsolescence management strategy.

5.5 Data Exchange

The analyses and their results are documented in a dataset, for storage, evaluation, justification, and further processing. Data is generated during each design stage and life cycle phase. The standards and specifications that have been selected for a project have their own data exchange mechanisms, which typically requires further detailing to used effectively.

The selection and detailing must ensure that the data elements align throughout the various standards and specifications and align with the interfaces of data standards and specifications, which can be implemented in a (proprietary) software tool. This alignment is not limited to the ILS domain but can extend in any domain of any stakeholder in the project. Because these datasets can be (temporarily) disconnected, it must be possible to reconnect the datasets, so a versioning or baselining possibility must be designed in the data chain.

The dataset is exchanged between two or more parties for a particular purpose. All parties must agree to this, be able to process the data and to initiate appropriate action, such as review or initiate changes into the support system.

If the data exchange is based on XML and the exchange is done via individual files, the XML schema should be exchanged with each XML-file, to ensure traceability and the ability to validate the XML file directly against the schema.

It must be traceable which sources (documents, files, models) have been used to define the exchanged data set as well as the baseline for each analysis, if possible, in the file itself.

The detailing of the analysis and processes can be documented in a Policy and Procedures Handbook (PPH). The data exchange itself can be detailed in a Guidance Document (GD) or input instructions.

The ASD/AIA S-Series use an XML schema, which is generated from the UML models. The XML schema has separate (but linked) schemas for Valid Values. The Valid Values files should be tailored per Product, although a tailoring per exchange is possible.

The tailoring should be done early in the project, if not earlier, to ensure consistency.

The definition of the data exchange should contain the following:

- Which standard or specification is used
- The version of the standard or specification
- The selected data elements
- Any constraints on the value of each data element
- Full file or update file

If a selected data element is used in multiple locations in a data exchange dataset, it must specify which of the possibilities is used. A Data Element Definition (DED) can apply to several fields. The

data element selection must define the table and the field. The S-Series defines the data elements in the context of a Class in the UML model, which is then reflected in the XML schema.

A constraint on a data element can define the length of the data in the element, (non)capitalization, (non)use of characters, type of data (numerical, text, etc.), etc. It can also include the amount of allowed or required instances of a type of data element (e.g., minimal number of revisions or instances of a particular data element, such as Classification Types in ASD/AIA S3000L), number of subtasks, and any changes to the default Valid Values sets, etc.

A data exchange should serve a particular purpose. This purpose should be documented, so its effect can be verified. The results of the review should be documented as well as what the results will be used for. This can be feedback to other stakeholders as well as later reference, evidence and justification.

A review should be based on a clearly defined and documented configuration or baseline. Each review is performed to verify requirements. The results of the verification should be documented. All possible outcomes should be covered in a documented review process in a planning document.

The review of activities, such as Maintenance Task Analysis, requires an understanding of the actual system, so it requires a description of the functionality as well as the 3D representation. This information must be aligned with the provided baseline.

5.6 Analysis Method

To check the effectiveness of the System Sustainment processes (taken into account the elements of feed-back in the iterative process of the ILS, ...)

This means in addition the utilization of the techniques and methodologies of NIAG studies: SG: 204, 218, 241.

5.6.1 ILS elements

The primary objective of any NATO armament programme is to provide the optimum cost-effective military capability. For a supportable, sustainable and affordable military capability, SOI operational availability is one of the most significant metrics and it is composed of various support aspects named as ILS Elements. Table 2 of ALP-10 lists thirteen (13 ILS Elements).

5.6.2 Maturity assessment through the NATO SLCM

System Maturity is comprised of the maturity of the SOI and the enabling systems. This means that System Maturity is dependent on key tasks and activities within the enabling systems to achieve full system maturity. These enabling systems support a SOI and are directly linked to ILS Elements.

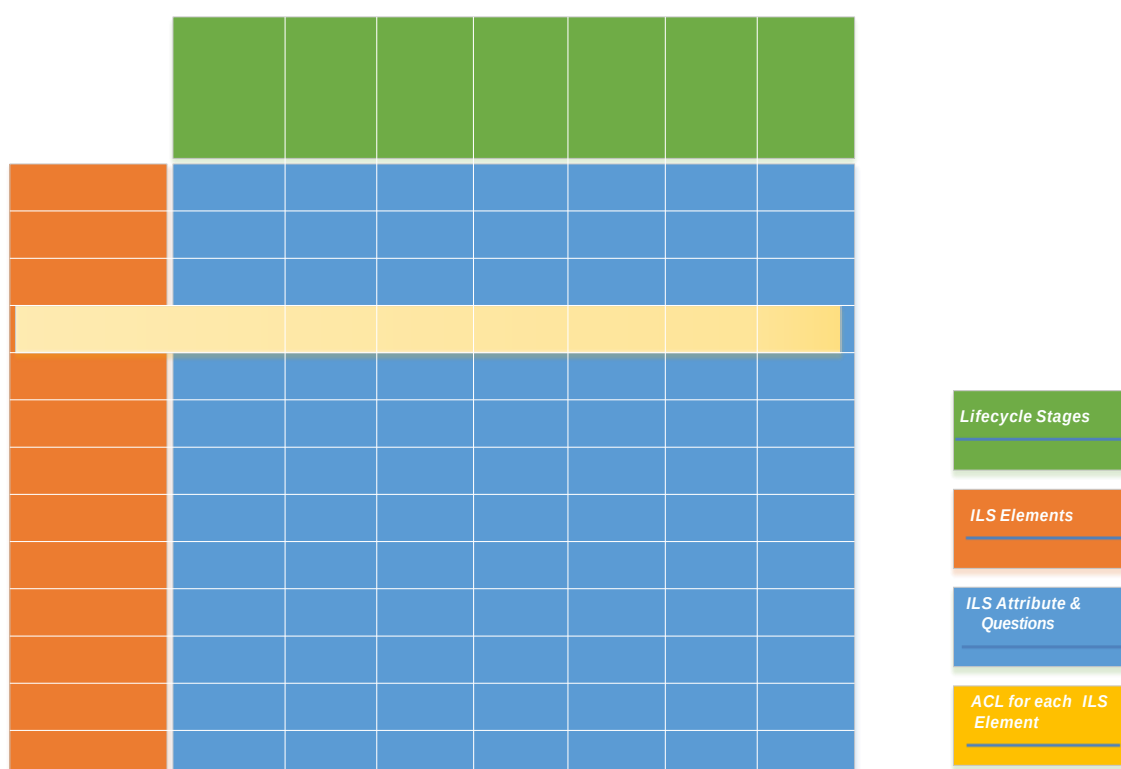
In accordance with Operational Maturity and System Maturity, ILS Elements maturity should be measured during the life cycle of the related system. Quantitative methodology defines the SOI Maturity Assessment regarding ILS Elements.

Quantitative "SOI Maturity Assessment" process and method are intended to evaluate the readiness level of the SOI as a whole regarding logistics in terms of supportability, sustainability and affordability at the related stage of the life cycle of SOI. Quantitative "SOI Maturity Assessment" provides a quantitative measure based on the 13 Integrated Life Cycle Support (ILS) elements.

The “Plan & organization” step is to ensure the required preparation takes place in sufficient time to properly initiate the SOI-MA. The programme manager ensures that a qualified and independent team leader for SOI-MA team is assigned and provides resources to establish the SOI-MA team.

“Conduct SOI-MA”, identifies the basic methodology for conducting a successful SOI-MA and provides Assessment Criteria Matrix (ACM) for use, see Figure 50. It is highly recommended that the ACM questions should be reviewed and tailored at this step-in accordance with the Programme characteristics and the related stage. The SOI-MA team should assign weights to ILS elements and questions with relevant justifications. After tailoring and weighting, each SOI-MA team member should score the questions.

Figure 50: Example Assessment Criteria Matrix



“Analysis of the Outputs” will be done by the SOI-MA team and a group of programme members to discuss the Quantitative Model results to identify risks and recommend corrective actions.

The ACM is composed of thirteen (13) ILS Elements in the matrix rows and the seven (7) Life Cycle Stages from “Pre-Concept” to “Retirement” in the columns. ACM contains questions for each ILS element and life cycle stages which are to be answered by the SMEs.

Due to the large size and complexity of the matrix composed of attributes and questions for each attribute for thirteen (13) elements and seven (7) stages, the matrix has been divided into thirteen (13) sub-matrixes, called as Assessment Criteria List (ACL), each pertaining the specific ILS element.

NATO, Nation and Agencies should follow these guides:

- Demonstrate the “SOI Maturity Assessment” process and method in multinational armament programmes in different life cycle stages in different programmes or Projects.
- Develop “Best Practice” and “Lessons Learned” documents based on demonstration.

- Prepare Guidance document to use “SOI Maturity Assessment” process and method.
- Review and align the relevant documents in order to include the “SOI Maturity Assessment” process and method.
- Develop “SOI Maturity Assessment” process and method training module for Subject Matter Experts (SMEs).

5.6.3 Quantitative Model

After completion of the “Conduct SOI-MA and Analysis of the Outputs” processes, a SOI maturity assessment report should be prepared. The content of this report should cover at least the following:

- SOI-MA Plan & Organization
- Tailoring & assumptions of ACM
- SOI-MA conduct methodology and implementation
- Analysis of the results
- Summary of each deficiency (risk areas) for each ILS element
- Any follow-up discussions on issues requiring action plans
- Lessons learned
- Final recommendations.

Well-structured and defined outcome-based or performance-based contracting method will reduce total costs, increase system availability for the war fighter, optimize industry performance (investments and costs) to deliver an improved outcome. Thus, NATO, Nation and Agencies should follow:

- Develop a high-level policy for contracting for systems and logistics services.
- Select the contracting method as early as possible in the life cycle of the system/subsystem, in consultation with industry starting with the Concept Stage of a programme.
- Select the convenient term to cover all contracting functions that provide outcome-based or performance-based results.
- Develop a policy in order to secure common understanding of the concept and of its underlying principles. Such policy and common understanding will facilitate decision-making in a multinational environment.
- Define responsibilities clearly for all parties involved.
- Industry should have the full responsibility for delivery of the service, to include set up and managing of the arrangements between supplier parties.
- In systems with multiple providers, designate a single integrator to avoid ambiguity in responsibilities.
- Specific authorities and responsibilities must be defined for changes in system configuration (e.g. modifications, upgrades, service bulletin incorporation, obsolescence management, etc.) prior to contract.

Use the decision support tool developed as part of the program. The use of an analytical toolset for contracting type selection at the highest-level NATO life-cycle policy and contracting regulations is required.

- Define desired outcomes from the perspective of the end-user. Proper planning and due diligence are required to understand the customer's desired outcomes, set the appropriate performance outcome metrics, and negotiate effective incentives.
- Conduct a follow-on study to determine the appropriate use of metrics in contracting. Define processes for Government Quality Assurance Organisations to evaluate outcome metrics and determine if adequate –based results are delivered.
- Develop the process, scope and capabilities of the decision support tool, to extend it to more contract types, and to enhance cross parameters interaction to better balance parameter ratings.
- Initiate and conduct training in contracting processes, including the use of a decision support tool.
- Review and update the NATO publications on contracting including all aspects of contracting -based ones.
- Improve the use of the tool through return of experience.

5.6.4 Metrics/Metrics data in contracting for Support Capability

The implementation of “outcome-based support (OBS)”/ “outcome-based contracting (OBC)” methodology to sustain/maintain NATO/Nations’ systems across the lifecycle is recommended. When properly employed, OBS/OBC will result in improved system readiness at the same, or lower cost. Broad application may also result in standardized performance requirements, and thus reduce complexities in already very complex systems. The “outcome-based logistics(OBL)/OBC methodology should be used in all new acquisition/support processes, and backfitted on legacy systems when appropriate.

Critical to successful implementation of OBS/OBC is the development and implementation of well defined, customer-focused metrics and metrics data. Many contracts include metrics, but in OBS the selection of a few critical outcome metrics (e. g. system availability, reliability, “time on wing”) ensures the benefits of a true outcome-based contract, rather than a transactional contract with scores of specifications and requirements which drive up the price to deliver. OBCs with minimal, but critical outcome metrics, provide the contractor the flexibility to determine actions required to deliver the level of support required by the end user. In other words, OBCs tell the contractor WHAT is needed, and but not HOW to do it. Metrics/metric data are key to successful OBC, and are as critical to a program's success as cost, schedule, and performance.

Regarding metrics/metric data, specific recommendations include:

- NATO develop a high-level policy requiring the consideration of OBS/OBC for Multinational Armaments Programmes. This policy and implementing guidance will include the requirement to work with the end-users to determine the appropriate metrics/metric data to ensure outcomes can be measured and achieved. Further, this policy should be aligned with the NATO Policy for Systems Life Cycle Management (SLCM) approved by the North Atlantic Council and signed by the Secretary General in 2006.
- NATO review and update existing NATO publications on contracting including all aspects of contracting to introduce OBC as a method for obtaining systems support, and identify appropriate points in the life cycle of the system where the responsible manager should evaluate the value of using OBC rather than traditional, transactional contracting
- NATO develop an Implementation Guidance for the Policy and Guidance Manuals (AC/327 STANAG, STANREC or Alliance Publication) for using metrics and metrics data in OBC and in traditional contracting.

- NATO develop an Allied Acquisition Practices (AAP) Guidance Manual for using the improved decision support tool in OBC and in traditional contracting. NATO should develop and implement a training package on NATO principles on outcome-based support arrangements. This training would also cover the use of metrics and the decision support tool in the development of OBC and traditional contracts for Multinational Armaments Programmes. This training package would also consider the requirements of NATO Policy for Systems Life Cycle Management (SLCM).
- This training should consist of two levels:
 - an executive overview to inform leadership across NATO, implemented through a high-level information campaign, and
 - a course for integration into the existing NATO Logistics Introductory Course at NATO School Oberammergau.

ANNEX 1: ILS CONCEPT / PLAN GUIDANCE

1 GENERAL

Provide general information on the project/program of the System and high-level supportability issues. This ILS Plan template is generic in layout and can be used by Government buyers to state ILS Requirements and by Contractors responding to explain their ILS approach to meet contractual requirements. As such the Plan content will change emphasis depending upon author and audience. It is recommended to have one single ILS Plan for the project.

1.1 INTRODUCTION

Introduce the purpose of the ILS Plan, provide background of ILS considerations, and describe the overall approach for developing the document. Define the scope of the ILSP.

1.2 ILS PLAN MANAGEMENT

Describe the procedures and responsibilities for ILS Plan preparation, update and approval mechanism. Explain in which cases the ILS should be updated and state that ILS plan is a living document, and it can be updated whenever necessary.

1.3 APPLICABLE DOCUMENTS

List the applicable documents, which can provide additional information and guidance with regard to the project/program. Detail how the ILSP relates to other project plans, such as the Project Management Plan (PMP) and identify any sub-plans or annexes to the ILSP.

1.4 PROGRAM MANAGEMENT

Provide general information on System, ILS Program management and ILS Schedule.

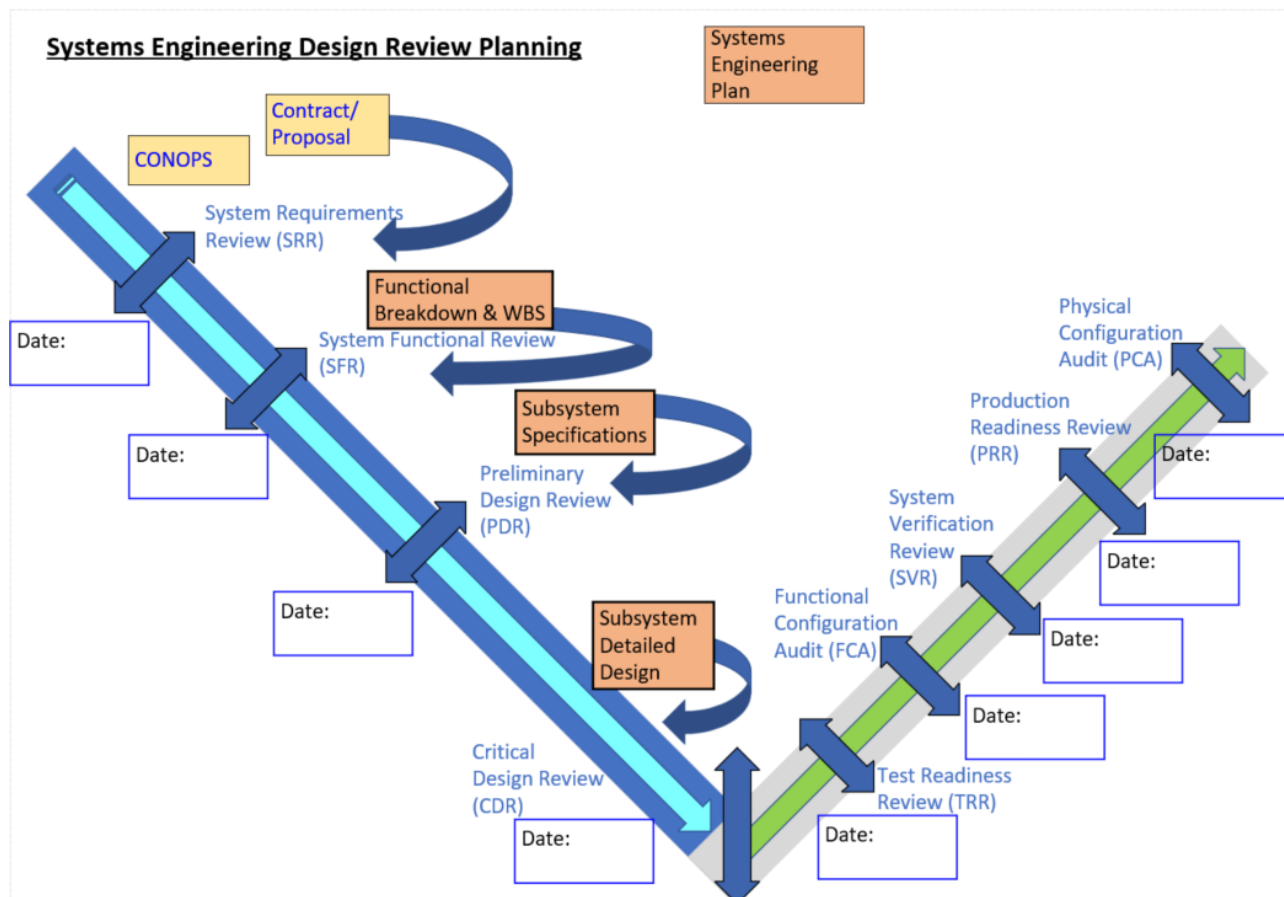
1.5 SYSTEM DESCRIPTION

Provide a high-level description of SOI and enabling systems, including the operational concept and objectives for the program, including physical configuration and functional requirements. Include a list of Government Furnished Equipment (GFE) used in System and explain the use of them in the SOI and enabling systems.

1.6 PROGRAM MILESTONES

Provide the major program milestones. Highlight the milestones which are affecting ILS solution like Systems Engineering Design Reviews (SRR, PDR, CDR, TRR, FCA, SVR, PRR, and PCA), SOI delivery schedule, etc. Contractors are encouraged to use the graphic of Figure 51 below to integrate their ILS planning with the system engineers, and derive the schedule of ILS activities that need to report prior to each design review.

Figure 51: Systems Engineering Design Reviews



1.7 ILS PROGRAM MANAGEMENT

State the main goals of the ILS Program. Define the interfaces within program/project management and describe the processes and responsibilities to share information and manage the ILS Program.

1.8 ILS ORGANIZATION

Provide information on ILS organization. Describe the team structure, roles, responsibilities and interactions; provide specific points of contacts.

1.9 INTERFACE

Define the interfaces with external functions like Customer(s), User Community, Manufacturers, Project managers, Contractors and sub-contractors, Systems Engineering team, Commercial and Procurement teams, etc. and describe the interrelations and responsibilities related to ILS Program management. The interface with providers of common in-Service GFE will be beneficial to overcome the common failing to provide sufficient support resources (parts and S&TE).

1.10 RISK AND OPPORTUNITY MANAGEMENT

Identify the risks and opportunities associated with ILS Program and System support alternatives. Create mitigation plans for the risks and define processes regarding risk management. Also state the opportunities and ways to exploit them.

1.11 ILS SCHEDULE

Provide the ILS Work Breakdown Structure and include the major Activities, Deliverable items and Milestones. Define the milestones for both the project/program (which are important for ILS activities) and ILS program management. Milestones must show a map of the project including where and when it started, when it will be finalized and when the ILS tasks and deliverables will be completed.

2 SUPPORTABILITY IN THE ACQUISITION PROGRAM

Describe ILS objectives within the context of the overall acquisition strategy. Provide essential information on the operational requirements, supportability objectives, acquisition and support strategy, supportability funding, Life Cycle Cost (LCC), supportability analysis strategy and Supportability Test, Evaluation and Verification (STEV).

2.1 OPERATIONAL AND SUPPORTABILITY REQUIREMENTS

Describe the mission scenarios and requirements, mission profile (annual usage rates, annual number of missions, mission durations, etc.), operational environment, security requirements, System level transportability requirements, employment, concepts, deployment plans, and combat service support force structure. Define the proposed system readiness objectives and supporting RAM thresholds for both peacetime needs and wartime requirements. Specify anticipated or fully mission capable (FMC) requirements.

2.2 ACQUISITION STRATEGY

Describe the anticipated acquisition approach. System requirements can be met by a system modification, a foreign materiel system, a new development, or commercial item. Define contractual approaches and incentives for risk management for support, personnel requirements, source selection, support elements and planned deployment & employment of the Systems. Explain how acquisition strategy affects ILS process.

2.3 LIFE CYCLE SUPPORT STRATEGY

Describe the life cycle support strategy. Explain how the System will be supported. The support might include organic governmental capabilities, Contractor Logistics Support (CLS), Interim Contractor Support (ICS), Public Private Partnership (PPP) or Performance Based Logistic (PBL). Define ILS/maintenance concept briefly.

2.4 LIFE CYCLE COST & SUPPORTABILITY FUNDING

Describe the methods, processes, assumptions and limitations to estimate life cycle cost. Identify the scope and depth of the studies and analysis to be conducted. Define the responsibilities, reporting schedules and update frequency. Use the appropriate LCC model to estimate the approximate cost of support for the System over its life cycle. The baseline LCC is recommended to be updated in each Design Review, to facilitate trade-off decisions, and track SOI and supportability solution changes. Provide point of contacts and coordination channels for supportability funding.

Ensure that the necessary operation and support requirements and lessons learned are considered in LCC Analysis and supportability funding.

2.5 SUPPORTABILITY ANALYSIS STRATEGY

Supportability Analysis (SA) is crucial for developing an efficient support strategy for military systems. Describe the SA to be conducted in the project/program. Identify the specific types of analyses required. Describe how they are selected and tailored for project needs and stages.

Explain source of data and methods/processes for data collection, data exchange and data verification (adequacy & accuracy). Identify the scope and depth of the analysis. Define responsibilities to conduct, report and review the analysis.

2.6 SUPPORTABILITY TEST, EVALUATION AND VERIFICATION (STEV)

Develop a Supportability Test, Evaluation and Verification Plan according to requirements. Describe the planned supportability STEV concept, scope, and objectives. Explain how they will be met during developmental and operational testing. Identify organizations and responsibilities. State the training, workforce and skill requirements to accomplish STEV. Provide a schedule, in line with project milestones, to start and finalize STEV. Define how the results will be reported and state the desired maturity level and key performance indicators (KPI) to assess the results. Use the STEV plan to reduce risk of delivering key supportability goals, e.g. MTBF, MTTR, etc. and also to plan and test the full range of in-service data feedback prior to the first mission.

3 ILS ELEMENTS

Provide details on plans for each ILS element. Each and every one of the ILS elements must be considered by the ILS Plan. Operational and supportability requirements and constraints must clearly be stated in ILS Plan.

3.1 ILS MANAGEMENT

Develop the ILS Plan for planning, implementing and coordinating all ILS elements and activities with the aim of achieving supportability throughout the life cycle. Delineate ILS Plan update schedule in-line with project/program schedule & milestones. Keep in mind that ILS Plan is a living document, and it must contain the most up to date information regarding all aspects of supportability anytime. Establish the Logistics Support Date early in the programme to allow for planning of resource deliveries, and to plan for trained personnel to be available to meet the System delivery.

Tailor the ILS Plan as required. It is essential to ensure that ILS Plan considers all of the relevant aspects and requirements of each ILS element. Prepare necessary sub-plans depending on the complexity of the ILS element or contractual requirements. If the ILS element is not applicable, explain the rationale clearly.

Provide information on the date, scope, content, agenda, and attendance etc. for planned guidance conferences. Plan and provide information on any other relevant conferences for other ILS elements, if required. Make sure that lessons learned from previous projects and utilization of similar systems are included in the conference content and documents produced.

Describe how ILS contract requirements will be passed to subcontractors (including performance metrics, incentives, etc.), how design and interface data will flow to those contractors. Describe the format requirements for data exchange, how supplier data will be received/processed and adopted in the System configuration. Describe how supplier supportability information will be

reviewed and adopted, and observations managed to ensure requirements are achieved. Explain how supplier data for the LSA data will be reviewed, managed and used.

Describe the selected support system. Provide information on analysis conducted for different support solution alternatives for different SOI alternatives. Use the initial capability document, design engineering data and LCC report to select a support system. Benefit from life cycle cost estimates throughout acquisition milestones to effectively plan, execute and manage budgeting and funding. Explain how cost data will be provided for LCC modelling and supportability analysis early in the programme for the Candidate Items List, and how updates to cost data will be managed.

Explain ILS outcomes and service level agreements to be satisfied for proper post warranty support. Define the process and responsibilities to structure and manage complete and balanced contracts to be able to provide cost-effective support solutions and operational availability. Develop and maintain support arrangements/agreements for sustainable ILS and manage support capacity to get in line with the operational needs.

Define how ILS package must be implemented to maintain readiness and operational capability after fielding. Specify the required process to ensure effective feedback during operational life. Describe the mechanisms, processes and responsibilities to manage fleet and support capacity by continuously monitoring and recording performance metrics in coordination with the owner/user during both warranty period and in-service stage of the life cycle. Identify which performance metrics will be evaluated and how data will be collected. Define how to monitor and evaluate support organization for further improvement. Describe how ILS package will provide input for repair, upgrade, disposal or retirement decision.

Outline the mechanism to monitor, evaluate, support, change, trace the System configuration. Provide the obsolescence management strategy to ensure operational readiness and define how to plan and implement obsolescence management to provide relevant feedback.

Describe the standards to be used across the ILS team to record data (LSA Dataset), publish Technical Manuals and introduce new items to inventory via the Supply Support processes. Define the interaction between these standards and enable compatible data exchange between Supplier and Sub-Contractor, Supplier and Customer, and across the ILS Team. For example, describe how Training analysis benefits from shared common data with Technical Publications and Supportability Analysis or describe how PHS&T assesses hazardous materials and the interface with the System Safety analysis.

3.2 DESIGN INTERFACE

Since decisions before the Utilization stage affect almost 90% of life cycle cost; influencing the design in the early stages of life cycle is very crucial for facilitating supportability to maximize the availability, effectiveness and capability of the system at the optimum life cycle cost. Life Cycle Cost Analysis (LCCA) and Supportability Analysis (SA) are the key to obtain necessary information to achieve this.

Explain the schedule of supportability analysis activities and how this integrates with the System Engineering Design Review schedule.

Explain how the Candidate Items List (CIL) and Task Inventory will be used to manage data exchanges with Systems Engineering and disseminate information across the ILS team, including subcontractors. The ILS Plan must contain a draft CIL from the Supplier's proposal/tender. The

provision of Unit Cost, with Reliability and Maintainability data (MTBF, MTTR) with the CIL early in a supportability analysis programme is essential to make rational decisions about the importance of items. Effort to influence design must be spent where the benefit is largest, and transparency in cost data is important across the Systems Engineering and ILS teams.

Provide information on the date, scope, content, agenda, and attendance etc. for LSA/Supportability Guidance Conference. The conference is important to agree on processes, standards to be used, data interpretation and data recording for conducting analysis properly. Consider inviting the relevant Subcontractors who have design influence. Describe the Supportability analysis activities to derive the Supportability and Related Design Requirements in time to adopted in the System Requirements Review (SRR). Governments should provide to bidders a Use Study Report to inform about the outgoing system, its operational profile, usage rates, operating locations, the operating and maintenance facilities, the skills of operator and maintainer, and the in-Service Support and Test Equipment. The Use Study must also include forward and return Order and shipping times between operating and repair facilities using routine priority demand levels. This will be used by LCC, LORA and Spares Optimisation modelling.

Explain the approach to standardisation and how this will minimise LCC. Can LRUs/modules be removed without hand tools? Are fastener types and sizes optimised to minimise hand tool requirements and keep MTTR as short as practically possible. Are anti-scoop connector types specified? Is in-Service general-purpose support and test equipment use maximized to limit the number of new items introduced?

Describe how the Baseline Comparison System (BCS) will be used to inform the design requirements by using data and knowledge from 'known' subsystems to define the 'unknown new SOI'. Describe how lessons learned will be identified for adoption by the new System as support requirements and objectives, and how the painful lessons identified from the BCS Candidates will be excluded from the new System. Identify any new technology being considered for the System design or processes and software for use in the support system. Identify the risks and benefits associated with these technology opportunities.

Describe the mechanism to conduct, report and disseminate the results of LCCA. Identify the LCC model / software to be used. Explain the methods, processes and inputs/outputs. Define how to use the results. LCCA refers to the total of the direct, indirect, recurring, non-recurring and other related costs incurred throughout the System life cycle. It helps analysing different support solution alternatives and quantifying the resources required for supportability. A Master Data and Assumptions Log (MDAL) must provide a high-level explanation of the LCC model and record the assumptions to enable a rapid understanding of the model and cost base.

Describe how Reliability modelling, Maintainability and Testability analyses influence design to maximise availability and minimise LCC. Describe the coverage of failure modes by any built-in test system. How does this minimise LCC and reduce the use of separate test equipment. Describe the percentage of failure modes that can be diagnosed to a single LRU using the Built in Test system.

Describe how Human Engineering (HE) shall be used to influence the design and the standards that will be used. The plan shall include an explanation of how the End Item design will minimise human factor risks in all areas in order to promote safe, efficient and reliable operation/maintenance. The explanation of HE processes shall include its impact on human factors engineering, manpower, personnel, training, safety and health hazard assessments, and the review process with design and customer agencies.

List the supportability requirements and analysis to be performed (RAMST, FMECA, FTA, RCM, LORA, MTA, Affordability, Human factors analysis, Transportability, etc.). Explain the processes and inputs/outputs. Define the mechanism to conduct, report, disseminate the analysis and corresponding results. Explain how they would influence the design and other ILS elements. Outline the processes and responsibilities to obtain field data related to support activities with the aim of influencing the design also in Utilization stage. All Supportability analyses must be reviewed and re-analysed throughout the life cycle of the system. These are never one-and-done analyses. As new data comes in from multiple sources (In-service, Test, extreme operations, etc) this data could create significant changes in previous results of each analysis. While there is not a recommended annual cycle for revisiting these analyses, every time new data becomes available, reviewing each analysis must be considered.

Outline how Level of Repair Analysis (LORA) and Maintenance Task Analysis (MTA) are conducted. Explain which items will use a LORA algorithm and which will most likely require economic LORA modelling. Explain the process to apply the LORA algorithm if one is planned to be used. Identify the modelling software, data requirements and processes as necessary. Provide the results of those analyses (as an annex to ILS Plan, if required) and explain how these should be incorporated to maintenance activities. LORA is used to determine the most economical & efficient maintenance level to perform maintenance whereas MTA is conducted to define maintenance task requirements such as spare parts, consumables, support equipment, personnel, facilities and task duration information. LORA must be conducted at multiple times throughout the lifecycle of a system. The Recommended cycle for fielded systems is every 5 years, as in-service data matures the LSA Dataset. This allows for increased efficiencies across all the ILS elements.

Introduce LSA Dataset (formerly known as LSA database or LSA Records (LSAR)) as the single entity to store all support and supportability data as the basis for both LCCA and SA. Explain the process, requirements and responsibilities to develop, maintain and use the LSA Dataset. Describe how to create and sustain the Task Inventory for corrective and preventative maintenance, which provides a focus for influencing design and identifying support resources.

3.3 MAINTENANCE

Describe the maintenance concept including all levels of maintenance and the number of echelons across which maintenance tasks will be allocated. Maintenance responsibilities must be defined. If the already existing maintenance organization/system will be used, it must clearly be stated along with the capability gaps. Repair versus discard criteria must also be defined.

An example of a System level Maintenance concept:

“There will be three levels of maintenance: organizational, intermediate and depot level. Organizational level maintenance tasks will be limited to replacement of some failed LRUs and scheduled maintenance that can be accomplished without the aid of special tools or support equipment. Intermediate level maintenance will have the capability of replacing deeper items, repairing electronic, electro-mechanical and hydraulic assemblies, including the replacement of failed components. For organizational and intermediate maintenance tasks, the existing maintenance system will be used. Therefore, the support equipment must be compatible with the existing maintenance facilities and equipment.

The System shall be compatible with existing operating and maintenance facilities: e.g. the size of hangars, hangar door opening access and storage facilities. LRU overhaul, refurbishment, and fabrication of structural parts will be accomplished at the military depot level. If the cost of the action exceeds 75% of the acquisition cost of the item, the item should be discarded.

There must be maintenance manuals at each echelon with adequate level of details for component repair, and the related support and test equipment User Guides. The facilities, support and test equipment required at each echelon must be provided before or with the system delivery. The OEM will train the customer instructors, and the instructors will provide training for operators and maintainers at the military training school. The operator and maintenance personnel must be trained in case of new assignments or in each two years or if any update occurs in the maintenance system."

The Contractor shall describe how the FMECA and RCM analysis reports and data will be used to develop a maintenance plan (as an annex, if required) to specify when, where, and which maintenance tasks will be performed on the SOI including both preventive and corrective maintenance to ensure the system is maintained effectively and economically at the desired level of readiness. Do not forget to include the issues/requirements for other ILS elements that are relevant to maintenance. Describe the process by which the FMECA and RCM outputs will be used to validate the initial Task Inventory. Preventative tasks shall be derived from RCM analysis in a repeatable process and supplier recommendation shall be supported by sound FMECA and RCM analysis. Outline how Software Support Analysis (SSA) are conducted. SSA is important to define the requirements to keep the software active and available.

Describe Preventive Maintenance Task Requirements (PMTR) in order to reduce the likelihood of certain failures or diminish the severity of the consequences. And list the preventive maintenance tasks. Make use of the MTA and DPHM report, if applicable. Describe the process of taking RCM results and the validated Task Inventory to group preventive maintenance tasks into master groups and explain how System downtime will be minimised.

It is very important to have feedback from the field regarding the maintenance and performance of the Systems. Most of the analysis done to provide the best possible support solution relies on engineering experience and lessons learned from previous occasions. Therefore, it is essential to develop a mechanism to convey current information on usage, failures and execution of maintenance tasks to enable an effective DPHM Analysis and In-Service Maintenance Optimization (ISMO). Define this mechanism, processes and responsibilities.

3.4 SUPPLY SUPPORT

Develop a supply support program to describe all management actions, procedures, and techniques necessary to determine requirements to acquire, catalogue, receive, implement, store, transfer, issue and dispose of spares, repair parts, updates and supplies along with the training, support & test equipment, PHS&T materials, facilities and Infrastructure.

Include the issues related with initial provisioning for stock of spare parts & support, along with acquisition, distribution, update and replenishment of inventories in the ILS Plan. The Plan shall describe the range of Purchase Lead Time (PLT) values and how the schedule of provisioning is planned to enable the Long Lead Time and other items to be ordered and delivered by the Logistics Support Date. Identify the forecast number of items to be presented, the number of Initial Provisioning Lists (IPL) and the maximum number of items per IPL.

Deliver Initial Provisioning List (IPL) and provisioning data with breakdown illustrations and necessary quantity information. Ensure the customer requirements are taken into consideration. Provisioning data helps the quantification of resources, the introduction of items into inventory and in-service management. Provide Unit Price data early enough to make relevant economic decisions for Spares optimisation. Identify the spares modelling software to be used or the algorithms if validated and verified software is not used.

Define mechanisms to evaluate and ensure supply chain resilience to have the right spares, repair parts and all classes of supplies (including new/peculiar S&TE and training aids, etc.) in the right quantities, desired quality, at the right place, at the right time with the lowest possible life cycle cost. Keep in mind that proper codification of the equipment, components, and parts of the supply system are essential for supply chain resilience, efficacy and efficiency.

Define mechanisms to manage stocks. Stock management is the practice of ordering, storing, tracking and controlling inventory. This activity includes initially ranging, scaling, and controlling a stock level, through provisioning data, whilst preventing overstocking and under stocking problems. Efficient stock control requires understanding the mix of different kinds of stock and the demands on that stock. Make sure the plan considers and includes the items required for maintenance, repair, overhaul activities throughout the in-service phase of the life cycle.

3.5 SUPPORT AND TEST EQUIPMENT (S&TE)

Analyse the requirements and develop a plan to provide and support the necessary S&TE to sustain the System during its life cycle. The requirements for S&TE are derived from both contract and design. Keep in mind that all equipment (mobile or fixed) required to sustain the operation and maintenance of the SOI is in the scope of this ILS element; however, it is essential to minimize or eliminate support equipment through Design Interface or technology refresh. In order to achieve this, consider making maximum use of existing Government or commercial equipment before considering new design in order to decrease the proliferation of support equipment into the inventory.

According to the S&TE Plan, provide information on how to develop, acquire, deliver and support the S&TE, including modified or upgraded equipment. The support of S&TE must include both the scheduled maintenance (calibration, inspection, test and certification, etc.) and unscheduled maintenance (repair and overhaul, software updates, etc.)

The S&TE Plan must define the design and supportability data required to introduce new items. (MIL HDBK 2097A can be used for further information for Data Items Description for Support Equipment Requirement Data (SERD))

The S&TE Plan must describe how S&TE candidate items will be identified to the customer, design data reviewed, and items selected to minimise the introduction of new items. This Plan must describe how the stand-alone S&TE and Built in Test Equipment will integrate with the Testability philosophy for the new System. The Plan shall describe how S&TE preventative maintenance is identified, including: calibration, tests, inspections, etc. The process to determine S&TE LORA shall be described as well as the identity of repair providers. These aspects shall be included in the LCC modelling.

3.6 TRAINING & TRAINING SUPPORT

There are mainly four categories of training: Operator, Maintainer, Supervisor and Instructor. Training is the main transfer of know-how through-out the organizations.

Identify the gap between the needed and the currently available Knowledge, Skills and Abilities (KSA) by performing Training Needs Analysis (TNA). Define key elements like target audiences, training gaps, training environment, type of the training and expected level of expertise after completing the training. Specify certification criteria.

Develop Training Plan and define qualitative and quantitative requirements for the training. The TNA must make clear what the student: should be able to do; should know, and what is background information. Create a training curriculum to identify the scope of the training, training methods, training materials, training support, etc. and develop the training package accordingly.

Perform Training Support Analysis to identify crucial assets for training like simulators, trainers, classrooms, computers, support equipment, training models, mock-ups, computer-based training software, dummy ammunition, wall-charts, audio-video equipment, projector, etc. Provide the plan for either developing or acquiring training equipment. Keep in mind that complete functional SOI/subsystems and/or prototypes can also be used as training equipment.

Explain the method by which Training equipment and training aids will be procured and the connection with the Supply Support activities. Describe how they will be integrated with the Technical Manuals, including the illustrated parts catalogue for spares breakdown, attaching parts and illustrations.

The training plan must make clear how the Candidate Items List and Task inventory will be used for planning and how data sharing across the ILS team will make maximum use of data module information created for the Technical Publications.

Monitor changes after deploying or implementing the training. Deliver refreshment training as necessary during the life cycle of the System.

3.7 TECHNICAL INFORMATION

Define Technical Data Package (TDP), which is a complete, clear and accurate technical description to enable the construction, manufacture or development of an item. It is also used to support the performance of maintenance, production and logistic processes.

Provide information on the date, scope, content, agenda, and attendance etc. for Technical Publications Guidance Conference to agree on processes, business rules, and data interpretation. According to the contract and agreements in the guidance conference, provide technical information necessary to operate, maintain, repair, support, train and dispose a system throughout its life cycle. State the media in which the Technical Information will be provided. The media can be paper, graphics, audio, video and any kind of digital form according to the contract.

The Technical Information element plan shall explain how data reuse is maximized from supportability analysis. It must make clear how the Candidate Items List and Task inventory will be used for planning and how the MTA and other analyses will be used to create data module information for the Technical Publications. This must include:

- FMECA information which provides functional descriptions
- Graphics for illustrated parts catalogue
- Maintenance procedural content with resources from maintenance task analysis and the Logistics Dataset.

If electronic publications are contracted, the plan shall explain how the technical authors will be integrated with supportability analysts for maintenance task analysis, and the process of exporting logistics data to form data modules. Explain which data modules will be shared with the Training analysis and how this will benefit supportability.

Provide the plan for the delivery dates and distribution of the Technical Publications. Keep in mind that Technical Publications are the only documentation that the ultimate user receives; therefore, ensure comprehensiveness, ease of use and understandability of those.

Describe the mechanism, processes and responsibilities to provide feedback on changes, mistakes, missing information & other failures in Technical Publications and to update Technical Publications as necessary.

3.8 WORKFORCE AND PERSONNEL

Describe the workforce and personnel requirements to perform all the operation, maintenance and support tasks for the System. Consider both peacetime and wartime requirements in the planning. Bear in mind that workforce represents the number of personnel or positions required to perform a specific task; whereas personnel indicate required capabilities, knowledge, skills, abilities, and experience levels to perform operation, maintenance and support tasks properly.

Government ILS Managers must determine the source of staff to fulfil the workforce requirements for the new System. The provision of personnel should integrate with the early fielding planning to match the need for trained people and the System delivery rate up to, and beyond, the Logistics Support Date.

Provide an assessment on existing personnel qualifications and skills and develop a workforce and personnel plan to enhance existing and new skills. This plan would help the decision to resource or acquire new personnel as well as assignments & deployments. It will also support Training and Training Support ILS element. The Plan shall describe how training effectiveness will be measured, and the process by which training course material and training equipment and aids will be updated as the design changes.

3.9 PACKAGING, HANDLING, STORAGE AND TRANSPORTATION (PHS&T)

Describe the resources, processes, procedures, design considerations and methods to ensure SOI and its enabling systems are packaged, handled, stored and transported in a cost-effective manner. Make sure the PHS&T solutions are in accordance with operational concept, usability, System life cycle, necessary standards, laws, regulations and any other special requirements and shall be compatible with supply and support structure of the customer.

Create a PHS&T plan to identify, plan, resource and acquire PHS&T requirements to influence the design of the SOI from early stages of its life cycle to increase supportability and maximize availability. Include all the constraints relevant to storage (such as humidity, heating, storage space etc.) and transportation (such as road, tunnel, transporter capacity etc.) in the plan and provide solutions or influence the design regarding these.

Explain how the packaging design activity (including packaging design data) will be managed to integrate the provision of packaged size and weight data with Supply Support Plan for initial provisioning lists. Explain how Special Packaging Instructions and design data on preservation, and packaging materials will be managed in the Logistics Dataset to benefit long term supportability and NATO interoperability.

Explain how the handling of hazardous materials and hazardous maintenance tasks will be analysed to minimise the risk for personnel, the interface with the System Safety analysis and the extent of data sharing to benefit supportability. Identify how protective clothing is assessed and identified via the Supply Support Plan and integrated with the Technical Publications team.

Describe the process to analyse the storage requirements for hazardous materials, the disposal of hazardous waste and how the costs of using, storing and disposing of hazardous materials will be minimised to benefit the System LCC.

The Plan shall describe how Transportability analysis of the System for land sea and air transport modes will be integrated with System design and Supportability Analysis. Describe how bulky packaged items will be assessed for transportation and the need to plan for transportation trials as part of a supportable solution. Explain how transportation of hazardous materials will be identified and the impact on package labelling.

The Plan shall explain any limitations or export control constraints including ITAR.

3.10 FACILITIES AND INFRASTRUCTURE (F&I)

Describe the process to identify, cost, develop, and justify all the facility requirements. Identify the constraints for the usage, storage, testing, training, maintenance and disposal of the System. Keep in mind that System definition includes both SOI and all enabling systems. F&I can be either permanent or temporary. Describe all management actions, procedures and techniques for F&I that are required to support and operate. Describe how the Use Study will be used to maximise reuse of existing facilities to minimise LCC.

Assess the existing facilities in terms of capabilities, location, space, environmental, safety and security requirements. Define the gap and deficiencies based on the assessment. Describe any improvements and modifications necessary for those. Justify the requirements for new facilities and infrastructure. Ensure that the associated building, maintenance and operation costs are considered in the LCC studies.

Explain how data for facilities will be integrated into the Logistics Dataset and shared with the ILS team. Explain the need for specialist facilities and how the use of purpose-built facilities is minimised. Explain the planning and delivery of facilities to ensure solutions are in place for Logistics Support Date.

Provide a plan/schedule to modify the existing or to build/acquire new F&I. If there are any site activation requirements and/or any reservations for disposal; incorporate them into the F&I plan. Update the plan/schedule in case new program/project requirements occur.

Prepare a plan to manage, support and maintain the F&I. Define the responsibilities and possible provisioning list regarding these actions in that plan.

3.11 IT SYSTEM SUPPORT

Describe the requirements for IT System Support (formerly known as computer resources) and create a plan to develop, produce, procure, install and maintain all necessary IT System Support including computer hardware, software and enablers (interfaces, networks, servers, etc.) for successful operation and support of SOI. Describe how the IT System Support will be identified for the Utilisation stage. The plan for IT System Support must also include a delivery schedule, which is in line with the project milestones. Identify the standards used to identify and manage the data feedback process, and the data requirements for the analysis requirements. Consider the issues related to obsolescence management and configuration management in the plan.

The maintenance activities for IT System Support are in scope of the Maintenance ILS element. Therefore, ensure that the necessary maintenance activities are considered in Maintenance ILS element and necessary budget is planned for the activities.

Describe how the data analysis will integrate with and benefit the Design Interface/Sustaining Engineering activities to improve design for life beyond the LSD through continuous improvement.

3.12 SUSTAINING ENGINEERING

This ILS element covers the evaluation of all ILS activities at the time of fielding and post deployment.

Describe the mechanism, processes and responsibilities for evaluation of the initial fielding activities and operational environment to ensure proper usage of SOI in intended operational environment and to detect any unforeseen deficiencies. Define the data requirements to capture: For example, Operating hours by system serial number, Failure data, Inventory transactions and maintenance work orders to benefit reliability and maintainability analysis, etc. Explain how this integrates with the IT System Support activities to implement and test a data exchange system to facilitate continuous improvement of supportability.

Define how to create, evaluate and manage change recommendations derived by feedback from the field, various investigations, measurements, change proposals, root-cause analyses, health monitoring etc. Change recommendations are important to tackle any deviations from the contract and ILS plan in order to assure desired level of performance parameters such as reliability, availability, maintainability, mean downtime, operation/support costs, etc.

Define Engineering Technical Analysis process and develop a mechanism for post deployment support activities such as responding and solving technical queries, initiation of service bulletins and deploying field service representatives (if required).

Prepare a new disposal plan or implement an existing one according to contract and ILS Plan to ensure efficient and safe disposal. Define the process and responsibilities to keep the necessary records during and after disposal activities.

3.13 ENVIRONMENTAL CONDITIONS AND RECOVERABILITY (EC&R)

Identify environmental health, recoverability and safety risks/hazards issues related to the System. Outline the ways to incorporate them into the system engineering process.

Describe the mechanism to influence the design and manage the identified environmental health and safety risks/hazards during the whole life cycle in order to cope with supportability problems to protect the environmental health and safety. Describe how the identification of hazardous materials is shared with PHS&T and the System Safety staffs to benefit supportability. Identify how the hazardous material data is stored in the Logistics Dataset.

List and consider EC&R related regulations and laws in the ILS plan and implement those to all relevant ILS elements. Define the process and responsibilities for monitoring risks/hazards, keeping records, delivering feedback and assessing environmental effects on the performance and sustainability of the Systems in order to eliminate or reduce environmental risks/hazards. Introduce the environmental procedures that must be included in operation and maintenance procedures.

Evaluate the environmental considerations and recovery options during disposal and recycling in conjunction with disposal plans and recovery options.

4 SUPPORTABILITY IN FIELDING AND OPERATIONAL LIFE

4.1 INITIAL FIELDING

Describe the planning for initial fielding, achieving initial operational capability and operational availability requirements. Summarize the procedure and schedule for preparation of all materiel fielding documentation. Provide information on how fielding will be implemented.

4.2 PROGRAM TRANSITION

Provide a description of how and when the program will be transitioned from the program management office to the support organization. Identify transition lessons learned applying to the current program. Show how repair parts usage, skills, training, procedures, technical data, and so forth will be obtained and used. Provide sufficient detail to assure that all necessary data is provided in time to adequately provision, train, and maintain the system after transition to Government support.

4.3 WARRANTY

Identify contractual warranty requirements. Describe warranty terms, procedures and responsibilities. Explain the processes to enable the user to make warranty claims and to evaluate and manage warranty activities. Describe the transition between the warranty and in-service support periods.

4.4 POST PRODUCTION SUPPORT

Depending on the support strategy, develop a post-production support (PPS) plan to ensure the sustainment of life cycle support after the Production stage is finalized. The plan can include the initial provisioning lists, the manufacturing tools that also can be used as an S&TE or to manufacture an S&TE (production fixtures, jigs, calibration devices, etc.). PPS Plan can be a legal requirement as well as a contractual one. It requires mutual agreement among project managers, users and manufacturers.

Provide the schedule to update PPS plan and identify the responsibilities.

4.5 IN-SERVICE SUPPORTABILITY AND FEEDBACK

It is important to ensure high readiness while minimizing support costs for a system throughout its operational life. A plan must be developed for monitoring support of the system after it is fielded. Describe the readiness and support data to be collected; data sources; methods of data analysis; and procedures for using the results to correct ILS problems or to enhance the supportability of the system in line with ILS Management, Maintenance and Sustaining Engineering ILS elements.

4.6 DISPOSAL

It is important to plan for disposal even though the system is expected to have a long service life. Although salvage is of little economic concern, the potential environmental impact of system components is the driver for the emphasis on disposal planning.

Develop a disposal plan in line with Environmental Conditions and Recoverability (EC&R) ILS elements.

5 ILS PLAN ANNEXES

Include a based on contractual requirements and as needed. Example Contract Data Requirements List and Data Item Descriptions can be found in Def Stan 00-60 Part 0 (ANNEX D).

Some example annexes can be found below:

- LSA Plan
- ILS Element Plans
- RAMST Programme Management Plan
- Safety Management Programme Plan
- Human Engineering Programme Plan
- Obsolescence Management Plan
- In-Service Data Exchange Feedback and Analysis Plan
- Supportability, Test, Evaluation and Verification Report
- S&TE List
- Provisioning Data
- Preventive Maintenance Part List
- NSN Codification Report

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ANNEX 2: MAPPING OF PROCESSES / STAGES

1 INTRODUCTION

This Annex maps the ILS activities of ALP-10 with the System Life Cycle Stages of AAP-20. The aim here is present data to help ILS managers plan a programme by understanding what activities take place and when. The tables below can be a check list for the less experienced to ensure they have considered each activity in the time frame applicable to their programme. These tables have been compiled from the perspective of an acquisition programme. If a programme was an in-service modification or mid-life-upgrade, some tailoring of the activities would be necessary.

Table 8: Table of ILS Activities and Life Cycle Stages

ALP -10 ILS Elements and Activities		AAP-20 Life Cycle Stages						
ILS Element	ILS Activity	Pre-Concept	Concept	Development	Production	Support	Utilization	Retirement
ILS Management	Analyse Alternatives	X	X	X				
	Develop Integrated Lifecycle Support Plan	X	X	X				
	Plan and Manage Guidance Conferences		X	X				
	Document Lessons Learned	X	X	X	X	X	X	X
	Manage Configuration			X	X	X	X	X
	Develop and Manage Contract		X	X	X	X	X	X
	Manage Fleet				X	X	X	X
	Manage Warranty				X	X	X	
	Manage In-Service ILS activities			X	X	X	X	X
	Perform Obsolescence Management			X	X	X	X	
Design Interface	Perform LCC Analysis (LCCA)	X	X	X	X	X	X	X
	Perform Supportability Analysis		X	X	X	X	X	

**Annex 2 to
ALP-10**

ALP -10 ILS Elements and Activities		AAP-20 Life Cycle Stages						
ILS Element	ILS Activity	Pre-Concept	Concept	Development	Production	Support	Utilization	Retirement
	Develop Supportability Analysis Dataset		X	X	X	X	X	
Maintenance	Develop Maintenance Concept		X	X	X			
	Develop Maintenance Plan		X	X	X	X	X	
	Perform the Level of Repair Analysis (LORA)		X	X	X	X	X	
	Perform Maintenance Task Analysis (MTA)		X	X	X	X	X	
	Develop Preventive Maintenance Task Requirements (PMTR)		X	X	X			
	Perform Diagnostics, Prognostics and Health Management (D&PHM) analysis			X	X	X	X	
	Execute Maintenance Tasks			X	X	X	X	X
	Perform Software Support Analysis (SSA)		X	X	X	X	X	
	Perform In-Service Preventive Maintenance Optimization (ISMO)			X	X	X	X	
Supply Support	Develop Supply Support Programme Plan		X	X	X	X	X	

**Annex 2 to
ALP-10**

ALP -10 ILS Elements and Activities		AAP-20 Life Cycle Stages						
ILS Element	ILS Activity	Pre-Concept	Concept	Development	Production	Support	Utilization	Retirement
	Provide provisioning data	X	X	X	X	X	X	X
	Perform Material Supply			X	X	X	X	X
	Manage Stocks			X	X	X	X	X
	Manage Repair and Overhaul Supply				X	X	X	
Support & Test Equipment	Plan Support & Test equipment		X	X	X	X	X	X
	Provide Support & Test equipment			X	X	X	X	X
	Manage S&TE Repair and Calibration			X	X	X	X	
Training and Training Support	Perform TNA	X	X	X	X			
	Perform Training Equipment Analysis	X	X	X	X			
	Develop Training Plan	X	X	X	X			
	Develop Training Package		X	X	X			
	Develop Training Equipment		X	X	X			
	Deploy Training/Training Implementation			X	X	X	X	
Technical Information	Develop Technical Data Package (TDP)		X	X	X			
	Produce Technical Publications			X	X	X	X	
Workforce & Personnel	Perform workforce & personnel analysis	X	X	X	X	X	X	X
	Manage workforce & personnel	X	X	X	X	X	X	X

**Annex 2 to
ALP-10**

ALP -10 ILS Elements and Activities		AAP-20 Life Cycle Stages						
ILS Element	ILS Activity	Pre-Concept	Concept	Development	Production	Support	Utilization	Retirement
Packaging, Handling, Storage and Transportation	Plan PHS&T		X	X	X	X	X	X
	Provide PHS&T			X	X	X	X	X
Facilities and Infrastructure	Plan Facilities & Infrastructure	X	X	X	X	X	X	X
	Provide F&I	X	X	X	X	X	X	X
IT System Support	Plan IT System Support	X	X	X	X			
	Provide IT System Support			X	X	X	X	
Sustaining Engineering	Evaluate Operational Suitability	X	X	X	X	X	X	
	Develop Sustainment Improvements			X	X	X	X	
	Perform Engineering Technical Analysis				X	X	X	X
	Manage Disposal					X		X
Environmental Conditions & Recoverability	Identification of Environmental Conditions and Recoverability Issues	X	X	X	X	X	X	X
	Manage Environmental Conditions and Recoverability			X	X	X	X	X

ANNEX 3: FUTURE TECHNOLOGIES AND INNOVATION

1 INTRODUCTION

When the supportability requirements are being established in the early part of a developmental programme, New Technology can sometimes be an opportunity to reduce life cycle cost. Processes can be speeded up by technology or done in a different and better way. New technology has its risks and these need to be assessed and mitigated. This Annex looks at a range of technology innovations that should be considered during the New Technology task.

This Annex presents a high-level description and an analysis of the following Emergent and Disruptive Technologies (EDTs): Augmented/Virtual Reality (AR/VR), Blockchain, Artificial Intelligence (AI), Additive Manufacturing (3D Printing), Digital Twins, Autonomy, Internet of Things (IoT), Cybersecurity, Hyper automation, RFID and HUMS.

For each EDT the following aspects are covered: a simple definition, its impact on ILS, the main challenges it faces and their possible application cases.

Under the perspective of ILS, once these EDTs are mature enough and integrated in the Systems, they will probably require acquiring new competences and knowledge to exploit and support them. This technological disruption in capabilities might also turn in a disruption in ILS domains, and there is a challenge to face these new opportunities.

2 MODEL BASED PRODUCT SUPPORT AND MODEL BASED SYSTEMS ENGINEERING

The incorporation of Digital Engineering (DE) in the field of design opens up new possibilities in the development of Systems, but also enables novel capacities in the later phases of the life cycle, both in their operation and in their sustainment.

This adoption of the DE is accompanied by the development of Model-Based Systems Engineering (MBSE), which represents a new paradigm in terms of the treatment of project-related information, in which the existence of a common source repository that contains all the information related to the project has a central role.

In this new DE/MBSE environment, in order to achieve an effective “Design Influence” it is necessary to introduce what is known as Model Based Product Support (MBPS), which aims at the development of all relevant models related to supportability and ILS.

Understanding that Lifecycle Support is an integral part of a Capability, the challenge for supportability and logistics engineers is to model said support to the life cycle to incorporate them into the set of models that represent the System in the context of the DE/MBSE. Correctly defined it will be possible, among others, to perform early simulations of reliability, maintainability, accessibility, etc., and so influence the design effectively.

At the organizational level, the implementation of DE/MBSE and MBPS entails a parallel process of digital transformation in organizations, both on the Industry side and on the System’s User side, and the incorporation of new technology enablers, related to this digital transformation.

The supportability and logistics engineers need to be aware of these technologies, in order to incorporate the new capabilities they offer in new Supportability -related use cases, which allow to effectively leverage this digital transformation in the field of Systems sustainability.

The concepts of Digital Twin and Digital Thread are appearing strongly, especially in the field of Industry, but for them to have a real utility in operational life, the participation of operators and maintainers in their definition and development will be essential.

The creation of a Digital Twin, which is essentially a digital information set, requires the necessary participation of supportability and logistics engineers who, together with Systems Engineers, support Software Engineers in all project development phases. The Digital Twin should be considered as an asset with its own lifecycle.

The core of digital transformation in the field of DE/MBSE/MBPS revolves around the creation of a wide variety of models, both geometric and simulation, and the acquisition of data in real time that allow connecting them with reality, in what is known as the cyber-physical space, in which Artificial Intelligence (AI) and Big Data and Advanced Analytics (BDAA) play a key role.

This flow of data in real time makes it possible to continuously monitor the health status of the physical asset, and to try to predict its evolution over time, which will allow the most appropriate decisions to be made. Correctly modelled, it will be possible to continuously monitor the operational availability of the Systems, and through the Digital Thread it will be possible to collect data to implement programs for improvement of reliability and maintainability.

This will be especially relevant in decision-making in the field of Maintenance, since in addition to traditional preventive and corrective maintenance, it will gradually introduce prescriptive maintenance, in which the maintenance tasks to be carried out will be suggested based on the actual state of health of the assets, the operating context and the available resources.

On the other hand, there are other groups of enabling technologies that, based on the digital models provided by the DE, facilitate human-machine interface (HMI), and can have a significant impact on training and maintenance execution, such as the use of virtual and augmented reality on digital mock-ups, or the implementation of additive manufacturing.

Finally, are also relevant those technologies related to the automation of tasks related to the acquisition of feedback data and events produced during the operational life, whose collection and analysis are expensive in terms of man-hours, but which are absolutely necessary if we want to use them to improve and optimize ILS processes upstream.

The technologies mentioned above, among others, in the field of NATO are known as Emergent and Disruptive Technologies (EDT), and there are several references to read, like the report written by NATO S&TO “Science & Technology Trends: 2020-2040” (2020), the NATO ST&O Analysis of “Technology Weak Signals: EDT++” (2021), or the NIAG study SG-252 on “Emerging and Disruptive Technologies, in the context of emerging Powers” (2021).

However, the rapid evolution of technology makes it necessary for both the supportability engineers to be up to date with the state of the art of technologies that can potentially have an impact on some of the ILS elements, activities or outputs, especially in those activities related to decision-making, HMI, and the automation of processes.

3 AUGMENTED, VIRTUAL & MIXED REALITY

3.1 DEFINITION

Virtual Reality (VR) is a representation of scenes or images of objects produced by a computer system, which gives the impression of their real existence.

Augmented Reality (AR) is a type of virtual reality in which synthetic stimuli are superimposed on real world objects.

Mixed Reality (MR) is reality, which combines elements of both AR and VR, real-world and digital objects interact.

3.2 IMPACT ON ILS

Virtual/Augmented/Mixed Reality has significant impact on next ILS elements: Supply support, Facilities and infrastructure, Sustaining engineering, Training and training support etc. Mentioned technologies will play significant role to improve storing of spares, repair parts, and supplies activities, facilities Management, systems designing, Immersive Training etc.

3.3 CHALLENGES

- **HUMAN PERCEPTION OF VIRTUAL REALITY.** Virtual reality headset use can induce a type of motion sickness that doesn't necessarily involve any real motion. Motion sickness can occur when there are inconsistent signals between human inner ear's vestibular sense of motion and what eyes are seeing.
- **EXISTING TECHNOLOGICAL GAPS BETWEEN AR/VR SOFTWARE AND HARDWARE.**
- **PRIVACY ISSUES IN AR.**

3.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Store of spares, repair parts, and supplies	Supply support	RFID	Marker is used to serve as an identifier for the point where the augmented reality object will be placed. With a video output device and a video camera, the user can see an augmented reality object on the object in a real environment. 3D models can be identified using RFID. The technology identifies the object itself and the associated 3D model. After identification the system can display the 3D model on the marker.
2.	Facilities Management	Facilities and infrastructure	IoT	A broad range of benefits to using AR, including the automation of maintenance processes, prevention of maintenance issues, reduction of physical contact during the COVID-19 pandemic, creation of new revenue opportunities, insights derived from AR-based analytics, and more. AR can help manage the complexity that comes with emerging technologies: Internet of Things (IoT)-enabled devices in buildings, such as environment sensors, HVAC systems, security systems, doors, lights, and more.

#	Application cases	ILS Element	Support Techs.	Short description
3.	Conception	Sustaining engineering, Technical data	AI	VR helps computer aided conceptual design systems implementation, provides better visualization and understanding of target prototypes, as well as simulation capability regarding components assembly and disassembly; that brings an important improvement of non-conformance detection before the production phase. In the same way, it is possible to perform tests of maintenance in prevention of possible problems when product entry in-service. Likewise, VR/AR is expected to improve collaborative engineering, generating common environments of work for complex equipment.
4.	Immersive Training	Training and training support	AI	Immersive training is a modern educational approach based on gaming technologies, which consists of practical exercises in a realistic scenario, achievable through immersive characteristics into a virtual reality environment. Immersive training can be applied on every core product and mission planning for ground-based operations, as well as for fixed wing aircraft, helicopters and UAV's. Having an easy-to-use and comprehensive collaboration environment, will improve the expansiveness and the overall capability.

4 BLOCKCHAIN

4.1 DEFINITION

Blockchain is a type of Distributed Ledger Technology (DLT) in which transactions are recorded with an immutable cryptographic signature called a hash.

4.2 IMPACT ON ILS

The Blockchain will play a disruptive role in the civil and military applications together with AI for prediction and prognostic based on operational and maintenance data (e.g., flight parameters, data from the Advisory Caution and Warning System, failures and replacement of the defective parts). Blockchain can be used for data authenticity and integrity verification, identification of parts or Cyber-Physical Systems (CPSs), tracking assets and events. AI algorithms enable "better informed" decisions based on verified data and at the same time speed up processes and reduce costs.

4.3 CHALLENGES

- **LACK OF ADOPTION.** Blockchains are ecosystems that require broad adoption to work effectively. Without widespread adoption, the effectiveness and scalability of blockchains will remain limited.
- **SKILLS GAP.**

- **BLOCKCHAIN INTEROPERABILITY.** Blockchain interoperability includes the ability to share, see and access information across different blockchain networks without the need for an intermediary or central authority. The lack of interoperability can make mass adoption an almost impossible task.
- **FINANCIAL RESOURCES.** Implementing blockchain needs to invest essential financial resources.

4.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Digital “passport” of spares, repair parts, and supplies	Supply support	RFID	Digital “passport” proves authenticity of spares, repair parts, and supplies through transmitting of data about where and when the product was made, as well as the route it has travelled
2.	Smart contracts related to logistics functions	Supply support		Blockchain can store and share digitized records, while also creating smart contracts that automatically handle invoices and payments to shorten processing times and ensure accuracy.
3.	Digitized documentation	Supply support Technical Data	IoT	Combining blockchain with the Internet of Things can enabling transmitting of Digitized documentation including Technical data as well as smart contracts data (e.g. bill of landing, certificates, invoices, pre-advice, real-time shipment data), which are embedded into blockchain-based systems.
4.	Blockchain Identity Management	Workforce and Personnel	CYBER SECURITY	Blockchain Identity Management is a secure solution that protects personnel identities against injury or theft. It uses a distributed trust model to ensure privacy where identity documents are secured, verified and validated by authorised participants. Blockchain-based identity management offer, for example, the possibility to manage access rights for companies to input information about pick-up and delivery of items. In addition, third party providers in Know Your Customer/Anti Money Laundering processes, last mile deliveries or driving licensees of truck drivers can be verified by using Blockchain Identity Management.

5 ARTIFICIAL INTELLIGENCE (AI)

5.1 DEFINITION

Artificial Intelligence (AI) is the branch of computer science devoted to developing data processing systems that perform functions normally associated with human intelligence, such as reasoning, learning, and self-improvement.

5.2 IMPACT ON ILS

AI can be considered as one of the most important success factors within the process of the digital transformation of ILS area for optimizing Supportability Analysis and Maintenance Process, transformation from conventional systems to Smart Logistics Systems, increasing condition monitoring, decision-making efficiency, advanced scheduling, planning, and control etc. AI is not permitted for predictive maintenance for critical equipment/critical failures, because the result cannot be repeated. Rule in MSG-3 and S4000P.

5.3 CHALLENGES

- Cost of integration.
- Most AI systems need in huge initial investment regarding cost of AI-specific hardware, training and a higher level of initial start-up users/systems in order to utilize the scalability factor.
- Operational costs of AI.
- Human jobs cuts.

5.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Process Optimization	IT System Support		Optimize Supportability Analysis and Maintenance Process
2.	Cyber-Physical Systems in Logistics	Sustaining engineering	IoT	Transformation from conventional systems to Smart Logistics Systems
3.	Predictive Maintenance	Maintenance planning		Usage of modern learning approaches in the areas of condition monitoring and predictive maintenance for non-critical equipment
4.	Hybrid Decision Support Systems	IT System Support		Hybrid decision-making approaches for an increased decision-making efficiency
5.	Production Planning and Control Systems	Support equipment		Advanced scheduling, planning, and control techniques
6.	Intelligent Transport Logistics	Supply support		AI, machine learning, and deep learning in the context intelligent transport systems and processes

#	Application cases	ILS Element	Support Techs.	Short description
7.	Optimizing stock during in-service phase	Supply support, IT System Support		Using actual customer demand rate, reducing safety stock margins, monitoring availability for parts with high demands and avoiding stock surplus.

6 ADDITIVE MANUFACTURING (3D PRINTING)

6.1 DEFINITION

Additive Manufacturing (AM) is the process of creating an almost arbitrary three-dimensional solid object from a digital model through layered addition of materials. It is often used as a synonym for 3D printing.

6.2 IMPACT ON ILS

AM has been identified as a technology that could significantly reduce the Logistics footprint of armed forces deployed on missions. It can be used for rapid prototyping, in situ production and repair of deployed military equipment, and production of precision, custom, or unique parts.

The planning and management of support and maintenance operations will be substantially affected by AM. From the point of view of obsolescence management, the provision and maintenance of legacy equipment (for which spare parts are no longer supplied by the original producer) is now possible; the autonomy to manufacture elements that are no longer on the market will prolong the useful life of equipment that, although not in the technological vanguard, can continue to play a role. For equipment still under official support, the foreseeable autonomy to manufacture elements can lead to significant changes in contracts and systems of provisioning, storage, and maintenance.

6.3 CHALLENGES

There are still technical challenges that need to be identified to fully achieve AM capabilities, such as machine capabilities (limited to small pieces only, speed and resolution limitations, process control), raw materials issues (variety, cost, availability, handling and storage), costs issues (start-up, personnel and complementary means, maintenance, unit costs...), not suitable for very large scale applications, Quality, Deployment, Training, standardization, qualification & certification, regulation, Environment, Health & Safety, of parts produced in this manner to ensure they will not fail in service.

6.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Design / mock-ups. Prototyping functional models. Pre-products / short series.	Design		3D printing may be used in all stages of Design processes. In the early stages of development of a product, to model the initial design concept without functional capacity. As the design progresses, to generate prototypes to assess the suitability of the selected design concepts. When the design is sufficiently mature, for pre-product samples, or even to produce short series of the final product.
2.	Simple or non-critical elements, products, or single use elements.	Supply Support Maintenance		There will be, in some cases, the need to develop and/or manufacture simple elements, which because of their low demand or criticality can be manufactured on site, thereby eliminating processes that consume resources but add little value. In these cases, the most accessible technologies from the economic and technical points of view (desktop AM machines) will be able to cover a large part of the demand. This use case is represented in the manufacture of plastic elements, which when used as accessories, couplings, customizations or temporary spare parts can increase the operative capacity and solve small problems.
3.	Complex and long-lasting elements.	Design		Other situations will require the on-site development and/or manufacture of elements of higher quality and durability, with a higher level of criticality. In these cases, additive manufacturing resources with ostensibly higher capacities will be required, resulting in higher costs and technical complexities. This use case can be seen in the manufacture of metal and plastic elements of high durability, with applications focused especially on the manufacture of durable spare parts, the manufacture of equipment or accessories of high criticality, and the generation of durable and high strength solutions in general.

#	Application cases	ILS Element	Support Techs.	Short description
4.	Existence of tactical and operational advantages.	Supply Support		In some cases, the fundamental feature of AM will be its ability to provide elements or products in a considerably shorter period of time, either because the traditional centralized production is replaced by production at intermediate points, or even by production on site. In the most favourable cases, provision processes that can take several days from the communication of the need can be fulfilled in a few hours (elements manufactural in on-site facilities).
5.	Production on an “on-demand” basis.	Supply Support	Autonomy	On-demand manufacturing will eliminate volatility demand of spare parts and will improve availability and allow flexibility compared with traditional manufacturing methods. Having the necessary parts when and where they are needed can have a significant impact on an operation’s efficiency. Thanks to an autonomous manufacturing system based on AM technology, it’ll possible to print components continuously any time during the mission. Waiting time will be no more than the cycle time of the AM machine, post processes, qualification, and assembly.
6.	Immediate repairs.	Maintenance		Point-of-use manufacturing: the ability to produce spare parts in the field. Some AM techniques (such as metal deposition) facilitate the repair of essential parts on site to support a mission.
7.	Reduction of inventory.	Supply Support		AM facilitates on-demand manufacturing of spare parts. The technology also makes it possible to have spare parts produced near the point where they are needed or even on-site; the delivery of goods is no longer a restriction. This results in a shortening of the supply chain since shipping and platform inventory is not necessary. The need for excess inventory or stocks will become obsolete, providing more space or reducing storage requirements.

#	Application cases	ILS Element	Support Techs.	Short description
8.	Economic savings.	Sustaining Engineering		Although the final cost of a product is dependent on its cost of production, certain products are greatly impacted in terms of cost by the management and transportation associated with delivery to the end user. Thus, in some cases, products can become economically more advantageous if AM greatly reduces their cost of transport and management.
9.	Simplification of the supply chain.	Supply Support		Local production by AM methods in comparison to centralized production can allow supply chain complexity to be reduced to merely the supply of raw materials such as powder and wire. It can result in a more sustainable after-sales service supply chain.
10.	Replacement discontinued parts.	Supply Support		If maintained properly, assets in a manufacturing plant can operate for many years. But inevitably a machine will become outdated and spare parts may be difficult to find or too expensive to order. The life of an older asset can be extended by outsourcing the 3D printing of discontinued, high-value parts.
11.	Overcoming obsolescence.	Obsolescence Management		For parts which the original manufacturer has stopped production, additive manufacturing methods could be a suitable alternative manufacturing method.

7 DIGITAL TWINS

7.1 DEFINITION

A Digital Twin (DT) is a computer software that creates a virtual replica of a real-world entity (like an element, a product, a process, a system, a fleet...) to provide extended capabilities, like simulations for predicting how the entity will perform. Both Physical and Digital Twins are usually connected by streams of data. The degree of accuracy of this representation should be sufficient enough that it can be the basis for decision making.

7.2 IMPACT ON ILS

Starting from the early conception and design phases, where models of a wide variety of types are supporting the process, afterwards stepping into the production, including validation and verification phases, right up to the final phases where the product is to be delivered, and the end user needs to be trained to effectively make use of it, and to sustain it, during the entire life cycle.

During the Operation of the systems, Modelling and Simulation are becoming more and more important for end user training, especially in complex scenarios, and to enhance the system maintenance, where models are also used to carry out maintenance intervention before the system fails, preventing unplanned downtime.

DT as tool used for the digital transformation of ILS by managing knowledge, information and data, in order to change the traditional processes of management, acquisition, planning, operation and life-cycle support. These digital processes will be integrated into “user’s applications” (or digital services) with the capacity for systematic, evaluative and predictive analysis, endowed with a certain level of learning that support decision-making (use of big data, machine learning, AI...).

The concept of digital thread leads to a full traceability of the SOI across its full lifecycle. As a result, DT will change the relation between User’s, Manufacturers and Industry by the creation of new services.

7.3 CHALLENGES

- **COMPLEXITY.** Complexity increases when the Digital Twin becomes a part of the System it supports. Subsequently, it has its own lifecycle management needs, which should be concurrent to that of its real-world counterpart.

In complex Systems, the DT implementation level must be progressive and evolutionary as well, in terms of enabling technology maturity and complex modelling algorithms availability, ranging between functional models of simple components up to extending this concept to an integrated System of Systems. At the end, a DT will consist, consequently, of a set of system’s DTs which, at the same time, will be a set of component’s DTs.

- **INTEGRATION OF OTHER EMERGENT AND DISRUPTIVE TECHNOLOGIES.** DT is an overarching technology that involves and puts in play more than twelve digital transformation technologies with the goal of providing better products to customer (safer and easier to operate, higher maintainability, achieving more performance, etc.).

DT can integrate most of the Industry 4.0 technologies, such as: IOT, Big Data, AI/ML, VR/AR/MR, Autonomy, IOT, RFID, 3D Printing, HUMS, cloud computing, cybersecurity, virtualization, hyper automatization ...

- **MODELLING AND SIMULATION.** The development of “models” (structural, thermodynamics, electrical...) in order to be able of making simulations for predictive decision-making (virtualization/simulation).
- **CYBERSECURITY.** There are many cybersecurity issues that have to be dealt with when designing a DT, such as: architecture security, integration with the cyber defence system, cloud computing, security controls (access control, identification and authentication, information confidentiality and integrity, wired and wireless networks, cryptographic key management...), etc...
- **IT SYSTEM SUPPORT.** Depending on their complexity, DTs are intensive in IT System Support, especially in computing capacity and memory. This leads to new hardware architectures, such as hyperconvergence, and cloud computing, with the risks that this entails regarding cybersecurity.

7.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Virtual assistants		Autonomy	Provides capabilities to assist in the analysis and evaluation of the tactical situation, based on mission parameters, the information provided by the systems and C2 systems, as well as external data and information that determine the allied environment (Combat cloud), providing decision aids.
2.	Modelling and Simulation			Provide the ability to estimate the degree of readiness of the ship from the platform, logistics and training data of the crew.
3.	Training	Training & Training Support	VR/AR/MR	DT provides new training capabilities, as it allows exercises in hyper-realistic environments and the use of real-time data.
4.	Operational			Provide a simplified 3D model of the asset represents the radar, IR and acoustic signatures according to the configuration of the ship in useful time and updated as its operational life progresses.
5.	Configuration Management			The DT can be used as a tool for the Configuration Control over the Configured Items along their life cycle.
6.	Improved HMI			Relevant information can be better presented directly over the digital mock-up, improving the HMI experience.
7.	Remote assistance			Using the VR/AR functionalities and making use of the digital mock-up, remote assistance use cases for maintenance support could be implemented.

8 RFID

8.1 DEFINITION

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify, and track tags attached to objects. An RFID system consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to track inventory goods.

- A data capture method in which standardized data is encoded and transmitted via signals in the radio frequency portion of the electromagnetic spectrum from or to a tag attached to or incorporated into an asset (*NATOTerm*).

There are two types of RFID tags:

- Passive tags are powered by energy from the RFID reader's interrogating radio waves.
- Active tags are powered by a battery and thus can be read at a greater range from the RFID reader, up to hundreds of meters.

RFID systems can be classified by the type of tag and reader. There are 3 types:

- A Passive Reader Active Tag (PRAT) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). The reception range of a PRAT system reader can be adjusted from 1–2,000 feet (0–600 m), allowing flexibility in applications such as asset protection and supervision.
- An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.
- An Active Reader Active Tag (ARAT) system uses active tags activated with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal.

8.2 IMPACT ON ILS

RFID technology is a traceability solution that will make it possible to identify a resource, describing it as precisely as necessary, to locate and manage it in its life cycle and to document this management. Also, the impacts on ILS are multiple and on the following topics: Facilities and Infrastructure (F&I), Packaging, Handling, Storage and Transportation (PHS&T), Supply Support, Support and Test Equipment (S&TE), Product Support Management, Technical Information & Data, IT System Support.

8.3 CHALLENGES

One of biggest challenges of RFID is a technology challenge with the development of new tags to speed up reading and writing of the "user memory" area.

It should be noted that issues are also related to security and that the issues related to this subject must be examined systematically and periodically in order to ensure the good protection of the RFID solution.

8.4 POTENTIAL USE CASES AND APPLICATIONS

#	Application cases	ILS Element	Support Techs.	Short description
1.	Identification and Supply Chain	Facilities and Infrastructure (F&I)		The global view of stocks enabled by the use of RFID enables infrastructure to be optimized

#	Application cases	ILS Element	Support Techs.	Short description
2.	Identification and Supply Chain	Packaging, Handling, Storage and Transportation (PHS&T), Supply support, Support and Test Equipment		The use of RFID allows identify a resource, describing it as precisely as necessary, locate this resource and manage a resource. Ensure reliable and exhaustive traceability of inventories and transfers of ownership.
3.	Availability of equipment	Product Support Management		Improve the availability of equipment by consolidating the global vision of the resource logistics, which contributes to forecasting and responsiveness.
4.	Supportability processes	Technical Information& Data,		Improve the productivity of logistics processes, better understand physical flows, and thus contribute to the assessment and control of the overall cost of ownership (stake economic)

9 AUTONOMY

9.1 DEFINITION

Autonomy is the ability of a system to respond to uncertain situations by independently composing and selecting among different courses of action in order to accomplish goals based on knowledge and a contextual understanding of the world, itself, and the situation. Autonomy is characterised by degrees of self-directed behaviour (levels of autonomy), ranging from fully manual, with human assistance (man on/in the loop), to fully autonomous.

Robotics is the study of designing and building autonomous systems spanning all levels of autonomy (including full human control).

Unmanned Vehicles (UxV) may be remotely controlled by a person, or may act autonomously, depending on the mission. There are several types of UV: Aerial (UAV), Ground (UGV), and Maritime both Surface (USV) and Underwater (UUV). Applications include allowing for access to unreachable areas, persistent surveillance, endurance, robots in support of soldiers, cheaper, and automated logistics deliveries.

Multiple definitions and understandings currently exist about autonomous systems and the related concepts of autonomy, automation, robotics and unmanned systems. People tend to use the word “autonomy” to refer to very different concepts:

- The human-machine command-and-control relationship (man “in”, “on” or “out” of the loop).
- The sophistication of the machine’s decision making (automatic, automated, autonomous).
- The type or function being automated (define which tasks are performed by humans and which tasks are performed by machines, which are known as “autonomous functions”).

These three dimensions of autonomy are independent, and must be defined in their context.

9.2 IMPACT ON ILS

The “autonomy” impact on ILS could be quite generalist depending on which of the above dimensions we are referring to. On one side, it could be the implementation of some degree of autonomy in almost any of the ILS related tasks, or at the decision level, that have to be made in a sort of “autonomous logistics functions”.

On the other side, it could be the way that UXV’s specific requirements and needs impacts on their logistics support. In the latter case, among others, there will be influences in *Sustaining Engineering (Design Interface)* due to the increasing role of Dependability and Safety techniques (RAMST), *Workforce & Personnel* (crew reduction, support team, new capabilities, etc.), in *Maintenance* (development of new *Maintenance Concepts*, *Perform D&PHM*).

9.3 CHALLENGES

- **ETHICS.** The employment of fully autonomous systems in defence is a longer-term issue. The determination of ethics and technical expectations, the development of an adequate personnel skills-base, the development of cyber security, regulatory, and an operational framework, highlight the limitations for their use.
- **IOT MATURITY.** Autonomous systems tailor behaviour and operations to context. To do this the system needs to ‘sense’ what is going on in its sphere of operation and adapt its course of action in accordance with what it ‘discovers’. Miniaturization of electronic components is being driven by everything from wearable technology and handhelds to the Internet of Things (IoT). Micro and Nano Electromechanical Systems (MEMS/NEMS) in mobile phones are also being exploited.
- **DATA-AI/ML-AUTONOMY:** The synergistic combination of Autonomy, Big Data and AI using intelligent, widely distributed, and cheap sensors alongside autonomous entities (physical or virtual) will leverage new technologies and methods to yield a potential military strategic and operational decision advantage. Learning is critical for autonomous systems to adapt to novel, complex environments. If unmanned, an AI will have to use compiled information passed through ML algorithms in order to make decision and then act upon it in a timely and correct manner, enabling autonomous operations.
- **SENSORS AND CONTROL SYSTEMS.** To interact safely, usefully, and effectively with humans in real-world environments, robots and other autonomous systems will need richer internal models of their environments linked with more flexible movement capabilities.
- **HUMAN-MACHINE TEAMING.** Some key issues that require further development in the autonomy domain are man-machine teaming and the degree of human control required, this latter point influenced by ethical, moral, legal and safety considerations. The impact and inclusion of emerging technologies, especially AI and Big Data, require a high level of trust to be built up with respect to how these autonomous system(s) operate and adapt to their environment. Research is needed on techniques for interaction between autonomous systems and people in complex, real-world tasks. Research on natural language communication and empathic robots could help bridge the human-machine divide.
- **CYBER SECURITY.** Cyber security solutions will require adaptive security architectures that focus on the security needed to support flexible digital ecosystems, the IoT and AI based solutions.

- **DEVELOPMENT OF DEPENDABILITY TECHNIQUES (RAMST).** Dependability studies are to be more detailed, starting from SOI and reaching the component level of every system or equipment: The current commitment of combat forces has seen a number of unmanned systems fielded quickly without the establishment of the required reliability and maintainability infrastructure that normally would be established prior to and during the fielding of a system.

9.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Automated Logistics & Transportation	Supply Support	AI IOT Cybersecurity	Current levels of technology may be sufficient to create remotely piloted or autonomous UxVs that are capable of delivering supplies and ammunition to troops in the field, under well-defined circumstances. Wider application within the logistics and transport system will reduce waste, increase operational availability and support warehousing operations.
2.	Increased Sustainability	Sustaining Engineering	Additive Manufacturing AI	A combination of agile manufacturing and autonomous systems may enable automated logistics support in dangerous or isolated operational environments. Reduced manning may also substantially diminish costs, with commensurate changes required in training and military occupations.
3.	Increased Safety and Reliability	Sustaining Engineering		
4.	Influence in Operation & Maintenance			Artificial Intelligence-driven products including algorithms and predictive maintenance technology. Programmed maintenance platforms including prediction when systems will break down, so they can prepare the necessary maintenance and logistics for parts supplies in advance.

#	Application cases	ILS Element	Support Techs.	Short description
5.	Predictive Logistics and Planning			Military Logistics Planning relates to decisions on resources needed, by whom, when, and how (i.e. required sources, transportation and handling); historical data are collected and used to develop predictive analytics and planning
6.	Expeditionary Logistics			Autonomous Systems could then significantly reduce both the number of personnel needed for expeditionary missions and risk for them, and the number of supplies stored at the front line, while increasing the speed of resupply.
7.	Zero Maintenance	Design Maintenance S&TE Sustaining Engineering	IOT AI HYPER AUTOMATION	It can refer both to the use of autonomy and autonomous systems to perform maintenance and remove human intervention, and on the strategy of the system's self-healing and repair capability.

10 INTERNET OF THINGS (IOT)

10.1 DEFINITION

IoT describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

10.2 IMPACT ON ILS

IoT refers to interconnected RFID, infrared sensors, global positioning systems, instruments and other devices networked together in order to achieve intelligent identification, location, tracking, monitoring and manufacturing in ILS. This connectivity allows for data collection, exchange, and analysis, potentially facilitating improvements in productivity and efficiency as well as other economic benefits.

10.3 CHALLENGES

- **STORAGE ISSUES.** The amount of information generated by smart devices goes up and this causes difficulty in what kind of information should be stored and for how long. This will increase the energy demands.
- **LACK OF SECURITY AND PRIVACY.**
- **SCALABILITY AND INTEROPERABILITY.** The need for highly specialized and highly customized solutions makes IoT difficult to scale through the supply chain. It is challenging

to make meaningful connections between devices and make processes open to foster the interoperability and reutilization.

- **FINANCIAL MATTERS.** Cost sharing while enabling supply chain with IoT can be challenging. The value of the data or service that can be derived from an IoT deployment will not always cover the expense.
- **WASTE DISPOSAL.** The amount of e-waste such as the disposal of computers, phones, and peripherals will be grown up by the extension of IoT devices use.

10.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Inventory tracking and analytics	Supply Support	RFID	IoT-powered methods use microchips that can carry all the information about the product that you need and be updated in real time for complete visibility into inventory movements. They also improve accuracy and reduce error-prone manual operations via automated scanning of inbound and outbound items.
2.	Optimized warehousing	Supply Support		Warehouse management hugely benefits from remote storage conditions monitoring. By using IoT powered sensors, operators can easily set up rules for maintaining stable temperature and humidity levels within a facility, as well as ensure perimeter security, detect fire, etc. They can also use fleet management solutions to track the activity levels of warehouse machinery to optimize workloads. Combined with the previous application (inventory tracking), IoT-powered warehousing operations can be easily observed and coordinated, down to the level of individual physical assets and stored items.

#	Application cases	ILS Element	Support Techs.	Short description
3.	Real-time fleet management	Supply Support		Fleet management is probably the most popular IoT solution for logistics. Using GPS or satellite trackers to collect vehicle telematics, operators can improve driver's compliance, increase the accuracy of delivery schedules, and ensure safety of both drivers and cargo. Fleet management solutions may also feature fuel consumption monitoring and driver behaviour monitoring. This data can be used to have a better visibility into each driver's profile and create personalized training programs that address a driver's professional growth as well as job satisfaction.
4.	Predictive maintenance	Maintenance Planning		Retrofitting various machinery with IoT-powered sensors that monitor the levels of heating, vibration, noise, and other parameters enables engineers to spot early signs of malfunction and prevent serious damage. It also helps reduce the number of physical inspections by taking advantage of remotely collected data to perform vehicle health check-ups.
5.	End-to-end delivery tracking	Supply Support		Modern IoT platforms implement a lot of functionality for flexible, configurable data dashboards. They allow managers to have all the operational data collected by IoT-powered sensors and devices at their fingertips as well as cater to customers' needs to easily view how soon their goods will arrive.

11 CYBER SECURITY

11.1 DEFINITION

The application of security measures for the protection of communication, information and other electronic systems, as well as the information that is stored, processed or transmitted in these systems with respect to confidentiality, integrity, availability, authentication and non-repudiation. Refer to NATO document AEP-67, Engineering For System Assurance NATO In Programmes.

Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. It's also known as information technology security or electronic information security. The term applies in a variety of contexts, from business to mobile computing, and can be divided into a few common categories.

11.2 IMPACT ON ILS

Cybersecurity Engineering might be considered as another engineering speciality that might be taken into account in Systems Engineering, and therefore, it could have its own interface with ILS.

The methodologies used to manage cybersecurity usually start with the characterization of the assets that are part of the IT System of the platform involved in any cybersecurity aspects (hardware, components, their networks, software, data flows and interconnections), so it is required to have an inventory of elements (configured items) that are necessary to identify the real risks, threats and vulnerabilities to those that the system is exposed to.

Once these items are identified, it is necessary to set them under configuration management, which is essential to ensure traceability to any other ILS elements. It might be necessary to introduce new features in the logistics database models to warn the logisticians if any of these cybersecurity related items have some impact on any ILS activities.

Users (crew members, support team, subcontractors, etc.) are, as a general rule, the main attack vector used by hostile actors, and therefore constitute a vulnerable point to consider when protecting the security of a system. It may be the case that they are not aware of the extent to which their actions (voluntary or involuntary) have an impact on the security of the systems and of the information they handle. For this reason, training and cybersecurity awareness among crews and ground staff is crucial.

11.3 CHALLENGES

- **INTERNET OF THINGS (IOT) ATTACKS.** As more data is transmitted between IoT devices, gaps may exist, which leaves room for hackers or other cybercriminals to exploit information. While connected devices are known for their convenience and intelligence, it's clear that it opens up more opportunities for cybercriminals to take advantage of networks.
- **OBSOLESCENCE MANAGEMENT.** Not all challenges of Cyber Security come in the form of software attacks. With software developers realizing the risk of software vulnerabilities, they offer a periodic update. However, these new updates might not be compatible with the hardware of the device. This is what leads to outdated hardware, wherein the hardware isn't advanced enough to run the latest software versions. This leaves such devices on an older version of the software, making them highly susceptible to cyberattacks.
- **TRAINING IN CYBERSECURITY ASPECTS.**

11.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Personnel Security Clearance (PSC)	Workforce & Personnel		A PSC is an administrative determination by a certified adjudicator that an individual is eligible under national security standards for access to classified information. Every maintenance worker that may have access to any potential source of classified information should have a PSC in force, which also implies that have some training in security issues.
2.	Zero Trust	IT System Support		Every access request is fully authenticated, authorized, and encrypted before granting access. Micro-segmentation and least privileged access principles are applied to minimize lateral movement. Rich intelligence and analytics are utilized to detect and respond to anomalies in real time.
3.	Cyber Security on Digital Twins	IT System Support	IoT	Some DT use cases may need classified data, which may imply the need to have two separate networks, one of them for the use of info class.

12 HYPER AUTOMATIZATION

12.1 DEFINITION

According to different sources the term hyper automation refers to an expansion of automation, which is on top of evolving AI techniques (Machine Learning -ML- and others) and Robotic Process Automation (RPA) together with intelligent Business Process Management Systems (BPMS) to automate the process at its maximum capacity in ways that are significantly more impactful than traditional automation capabilities. Hyper automation promotes the idea that anything that can be automated should be automated. Hyper automation is driven by organizations, with more relevance those multinational nature, having legacy business processes that are not streamlined, creating immensely expensive and extensive issues.

12.2 IMPACT ON ILS

As hyper automation is a process-related concept, it can be a tool for the in-service ILS/SA, as it will become an information source for feed-back data (e.g. Automated filling of maintenance forms). The aim is to capture “pieces of information” relevant for ILS processes by automated means.

Hyper automation can drive and steer proper efforts in all ILS phases up to the required level. This concept strategically impacts on all ILS activities enabling hidden linkages among them to build up a comprehensive product lifecycle support.

12.3 CHALLENGES

Hyper automation requires a mindset change shifting from unstructured work to fully oriented structured processes. That is challenging the organisations in several ways as follows:

- Build up processes upon both structured and unstructured data and even unknown inputs that run at that time. This last aspect, demands continuous workflows, an update capability/ capacity and dynamic databases' structure
- Hyper automation refers to translate/transfer tacit processes to digital processes that are not always easy to automate
- Most of the digital processes will not properly collect human intentions and conclusions based on intuition thus not helping the correct decision making
- Hyper automation does not easily keep legacy systems working and requires computer power and complex hardware architectures
- Hyper automating processes involve machine involvement as much as possible thus emerging technologies like AI, RPA, NLP, BD in order 'hyper' makes sense. Those emerging technologies play the role of hyper automation enablers
- Current automation by BPMS focused on repetitive tasks while hyper automation might deal with every possible business activity.

12.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	AAP-48 high level digital processes implementation	All	BPMS	Product Lifecycles can be automated at all levels. High level digital processes according to AAP-48 can be digitalized and orchestrated by Business Process Management Systems
2.	Supply chain automated interfaces	Supply support	RPA	Hyper automation enables external processes integration thus making full control of supply chain. RPA might help in repetitive tasks and regular machine queries

13 HUMS

13.1 DEFINITION

Health and Usage Monitoring Systems (HUMS) is a generic term given to activities that utilize data collection and analysis techniques to help ensure Availability, Reliability and Safety of systems. Activities similar to, or sometimes used interchangeably with, HUMS include condition-based maintenance (CBM) and operational data recording (ODR).

13.2 IMPACT ON ILS

HUMS has significant impact on the following ILS elements: Maintenance, Workforce & Personnel, Sustaining Engineering, Product Support Management, Design Interface, Technical Information & Data.

13.3 CHALLENGES

HUMS, coupled with AI technology, could improve the feed-back and thus detect, for example, the employment profile used.

One of the biggest challenges to implement HUMS is to ensure consistent data with sufficient contextual information to extract a benefit from the data.

13.4 APPLICATION CASES

#	Application cases	ILS Element	Support Techs.	Short description
1.	Predictive maintenance	Maintenance Maintenance Planning Technical Information & Data,		HUMS provides a systematic approach to maintenance planning, resulting in improved mission readiness and capability. The result is lower total cost of ownership by reducing periodic maintenance work and accident rates

HUMS are used not only for Safety but for a number of other reasons including:

- **MAINTENANCE:** reduced mission aborts, fewer instances of aircraft on ground (AOG), simplified logistics for fleet deployment.
- **COST:** “maintain as you fly” maintenance flights are not required. Performing repairs when the damage is minor increases the aircraft mean time between failure (MTBF) and decreases the mean time to repair (MTTR).
- **OPERATIONAL:** improved flight safety, mission reliability and effectiveness

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ANNEX 4: GLOSSARY / ACRONYMS

Acronym/ Terms	Expansion/Description/Explanation
3D	Three dimensional
A4A	Airlines For America
AACP	Allied Acquisition Practices Publications
AAP	Allied Administrative Publication
AC	Allied Committee
ACL	Assessment Criteria List
ACM	Assessment Criteria Matrix
ACMP	Allied Configuration Management Publication
ADATP	Allied Data Publication
ADT	Administrative Delay Time
AEDP	ACE Exercise Directive Program Allied Engineering Documentation Publication
AEP	Allied Engineering Publication
Affordability	Affordability can be considered as the degree to which the life cycle cost of an acquisition programme is in consonance with the long-range investment and force structure plans of national defence administrations. Affordability procedures establish the basis for fostering greater programme stability through the assessment of programme affordability and the determination of affordability constraints. RTO-TR-SAS-054
AI	Artificial Intelligence
AIA	Aerospace Industries Association
ALC	Alternate LSA Control Number
ALCCP	Allied Life Cycle Cost Publication
Allowed Configuration	An approved combination of hardware and software parts that can or must be installed in specific locations or positions, and a set of associated engineering instructions to follow during assembly and operation. – S3000L
ALP	Allied Logistics Publication
AM	Additive Manufacturing, often associated with 3D printing
ANSI/EIA	American National Standards Institute / Electronic Industries Alliance
AQAP	Allied Quality Assurance Publications
AR	Augmented Reality
ARAMP	Allied Risk Management Guide for Acquisition Programmes Publications
ARAT	Active Reader Active Tag, associated with RFID readers
ARMP	Allied Reliability and Maintainability Publication
ASD	AeroSpace and Defence Industries Association of Europe

Acronym/ Terms	Expansion/Description/Explanation
ASME	American Society of Mechanical Engineers
ATA	Air Transport Association founded 1936 - renamed Airlines for America (A4A) in 2011.
Availability	Ability to be in a state to perform as required. NATOTerm
AUIDP	Allied Guidance on unique identification of ITEMS Publications
BAP	Battery Assisted Passive, associated with RFID readers
BCS	Baseline Comparison System
Bill of Material (BOM)	List of constitutive elements of a product / subassembly / component / material. NATOTerm
BREX	Business Rules Exchange. A type of reference Data Module defined by S1000D and a Project to apply the business rules to the other data modules
CADMID	Concept, Assessment, Demonstration, Manufacture, In-Service, Disposal
Capability	Military potential expressed in quantitative and qualitative terms. More information can be found in AAP-48 2.1 NATOTerm
CBL	Contractor Based Logistics
CBM	Condition Based Maintenance
CBS	Cost Break-Down Structure
CCB	Configuration Control Board
CDM	Common Data Model
CDR	Critical Design Review
CDRL	Contract Data Requirements List - The Contract Data Requirements List is a list of authorized data requirements for a specific procurement that forms part of a contract. DAU IPS Element Guidebook
Certification	The process of officially recognizing that organizations, individuals, materiel or systems meet defined standards or criteria. NATOTerm
CI	Configuration Items
CIL	Candidate Items List – A list of the candidate items that identifies the maintenance and structurally significant items (MSI and SSI) upon which to focus supportability analysis and design influence. The CIL also serves as record of the LSA candidate selection process.
CM	Configuration Management
CMDB	Configuration Management Database
CMMI	Capability Maturity Model Integrated
CMP	Configuration Management Plan
Codification	NATO Codification identifies items by functional group, and a unique national item identification number. To aid management of Items of Supply, the reference number category code (RNCC) and variation code (RNVC) are used in combination to identify primary and secondary references. Refer to AcodP-1, Ch IV, Annex G5, Table 08.

Acronym/ Terms	Expansion/Description/Explanation
Comparative Analysis	A major key to having an effective PSA program is the efficient analysis and use of the data obtained on comparative systems. This process is also called a historical data review. It involves making good use of experience information available from other systems/equipment so that the new system/equipment will be an improvement in supportability as well as performance. MIL HDBK 502A
Configuration	The interrelated functional and physical characteristics of a product defined in product configuration information. NATOTerm
Configuration Management	The Configuration Management process establishes and maintains the consistency of a system's functional, performance and physical attributes with its requirements, design and operational information and allows technical insight into all levels of the system design throughout the system's life cycle. – NATOTerm
CONOPS	Concept of Operations – A clear and concise statement of the line of action chosen by a commander in order to accomplish his given mission. NATOTerm
Contract	An agreement of wills between two or more private individuals or legal persons, intended to create, modify, transmit or terminate obligations. NATOTerm
COTS	Commercial-off-the-shelf
CPS	Cyber Physical Systems
CSA	Configuration Status Accounting
CSDB	Common Source Database
CSN	Catalogue Sequence Number
Customer	Person or organization that could or does receive a product or a service that is intended for or required by this person or organization. ISO/IEC/IEEE 15288
DC	Disassembly Code - used by ASD/AIA/A4A S1000D SNS
DCV	Disassembly Code Variant - used by ASD/AIA/A4A S1000D SNS
DE	Digital Engineering
DED	Data Element Description
DEF STAN	Defence Standard
Design Engineering Data	Any recorded or documented information of a scientific or technical nature whatever the format, documentary characteristics or other medium of presentation. ASD/AIA SX000i
Diagnostics, Prognostics and Health Management	Diagnostics is the detection, analysis, or description of faults, failures, or mistakes whereas Prognostics is the design ability of the system to proactively predict maintenance issues based on usage, time, actual performance and other factors. NATOTerm, IPS Element Guidebook
DID	Data Item Description, used to describe an 'item' for deliver in the Contract Data Requirements List (CDRL). Used in both USA and UK
DLT	Distributed Ledger Technology

Acronym/ Terms	Expansion/Description/Explanation
DM	Data Management or Data Module
DMC	Data Module Code
DMRL	Data Module Requirements List
DMSMS	Diminishing Manufacturing Sources and Material Shortages - The loss or impending loss of item manufacturers, suppliers or raw materials. S3000L
DOTMLPFI	Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities and Interoperability
DT	Digital Twin
E&ITD	Education and Individual Training Directive
EBOM	Engineering Bill of Materials
EC&R	Environmental Conditions and Recoverability
EDT	Emergent and Disruptive Technologies
EFY	Effectivity
EIAC	End Item Acronym Code
EMC	Electro-Magnetic Compatibility
EMD	Engineering Manufacturing and Development
Enabling Systems	Enabling systems support a System-of-Interest during the life cycle for the system, but do not necessarily contribute directly to its function during operation. – AAP-48
Engineering Change Request	System/equipment, document or any other contractual item. ASD/AIA SX000i
Environment	Aggregate of surrounding things, conditions, contexts of, or influences upon an entity of interest
Environmental Conditions	Characteristic of the environment which is the aggregate of all (physical, chemical and biological) conditions and influences to which materiel is subjected. Adjusted from STANAG 4370, AECTP-100
Equipment	Components and parts used or required for a particular purpose. IEC Glossary
ERP	Enterprise Resource Planning
ESS	Environmental Stress Screening
F&I	Facilities and Infrastructure
Facility	Physical entity (for example, a hospital, factory, machinery, etc.) that is built, constructed, installed or established to perform some particular function or to serve or facilitate some particular end. IEC Glossary
Fault Tree Analysis	Fault tree analysis is a deductive failure analysis which focuses on one particular undesired event, and which provides a method for determining causes of this event. NUREG-0492, FTA Handbook
FAT	Factory Acceptance Test

Acronym/ Terms	Expansion/Description/Explanation
FCA	Functional Configuration Audit
Feedback Data	Feedback data can be any data exchanged between different stakeholders during the operation and support of a System or the operation of a service. ASD/AIA SX000i
Feedback Information	Feedback data the summarizes the results of a technical analysis of raw Feedback data for a System or service. ASD/AIA SX000i
Fleet	The number of items in a population. Example, a fleet of ships is the number of ships organised as a tactical unit. A fleet could also be a number of aircraft or vehicles operated under one ownership. The fleet concept does not translate well in some languages and the term Population is more easily understood.
Fleet Performance Report	The fleet performance report contains all necessary information concerning the efficiency of a System.
FMEA	Failure Models, and Effects Analysis
FMECA	Failure Models, Effects and Criticality Analysis – A procedure for analysing the potential failure modes of a system to classify them by severity, or to determine the effect of lower-level failures on the entire system. The purpose of a criticality analysis is to chart the probability of failure modes against the severity of their consequences. ASD/AIA S3000L
FN	Figure Number
FNv	Figure Number Variant
FRACAS	Failure Reporting Analysis & Corrective Action System – Reports, classifies, analyses failures and plans corrective actions in response to failures. DAU-IPS ELEMENT Guidebook
FRT	Failure Rate
FRT MB	Failure Rate Measurement Base describes the units of failure rate. Examples: Hours, cycles, rounds, shots, etc.
Guidance Conference	A conference where the contractor and the customer agree on the scope and depth of the LSA business processes and procedures. ASD/AIA S3000L
GD	Guidance Document
GEIA	Government Electronics and Information Technology Association
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GOTS	Government-off-the-shelf
GPS	Global Positioning System
GQA	Government Quality Assurance
HAT	Harbour Acceptance Test

Acronym/ Terms	Expansion/Description/Explanation
Human Factors	A body of scientific facts about human characteristics. The term covers all biomedical and psychosocial considerations; it includes, but is not limited to, principles and applications in the areas of human engineering, personnel selection, training, life support, job performance aids, and human performance evaluation. NATOTerm
HUMS	Health and Usage Monitoring System
HVAC	Heating, Ventilation, and Air Conditioning
I & I	Integration and Implementation
ICD	Initial Capabilities Document – The Initial Capabilities Document (ICD) establishes conditions for the scope of alternatives to be considered in an Analysis of Alternatives (AoA). The AoA process plays a key role in the selection of a preferred system solution that satisfies the capability need documented in the approved ICD. MIL-STD-881C
IEEE STD	Institute of Electrical and Electronics Engineers Structure Technology Demonstration
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electrotechnical Commission
IETP	Interactive Electronic Technical Publications
ILS	Integrated Life Cycle Support – The management and technical process through which supportability and logistic support considerations are integrated into the design and taken into account throughout the life cycle of systems/equipment and by which all elements of logistic support are planned, acquired, tested and provided in a timely and cost-effective manner. NATOTerm
ILSP	ILS Plan
IM	Information Management
IN	Item Number – used by S2000M
INA	Information Need Analysis
Infrastructure	In NATO, the static buildings, facilities and other permanent installations required to support military capabilities. NATOTerm
INV	Item Number Variant – used by S2000M
IoT	Internet of Things
IP	Initial Provisioning / Intellectual Property
IPL	The Initial Provisioning List (IPL) contains the range and quantity of items (i.e., spares and repair parts, special tools, test equipment, and support equipment) required to support and maintain an item for an initial period of service.
IPR	In Process Review / Intellectual Property Rights
IPS	Integrated Product Support

Acronym/ Terms	Expansion/Description/Explanation
ISMO	In-Service Maintenance Optimisation – Within ASD S4000P the focus of ISMO is on Preventative Maintenance. The In-Service Maintenance Optimization (ISMO) process and logic define the rules and methodologies for correctly optimizing the scheduled maintenance during the Utilization stage In NATO regions using other standards, the focus of ISMO is broader and addresses both Corrective and Preventative Maintenance.
ISO	International Standards Organisation
ISP	Integrated Support Plan
IT	Information Technology
IT System	Refers to all types of computer hardware, software, communications devices, equipment, networks, passwords, licensing and attendant policies, manuals and guides.
ITIL	IT Infrastructure Library
ITT	Invitation To Tender
JSP	Joint Service Publication, a type of UK military publication
KM	Knowledge Management
KSA	Knowledge Skills at Abilities
LBS	LSA Breakdown Structure
LCC	Life Cycle Cost – All direct costs plus indirect variable costs associated with the life cycle stages of the system of interest.
LCCE	Life Cycle Cost Estimation
LCM	Life Cycle Management
LCN	LSA Control Number – A code that represents a functional or hardware generation breakdown/disassembly sequence of system/equipment hardware including support equipment, training equipment and installation (connecting) hardware. MIL-STD-1388-2B
LDT	Logistics Delay Time
Life Cycle	The period of time that starts with the assessment of the requirement for a system, facility or product and ends with its final disposal. NATOTerm
LORA	Level of Repair Analysis – A Level of Repair Analysis (LORA) is a prescribed procedure for determining the most economical and efficient level at which maintenance is performed. ASD/AIA SX000i
LSA	Logistics Support Analysis – A structured approach to increasing maintenance efficiency and reducing the life cycle cost of providing support by planning all aspects of ILS as far in advance as possible. Originally defined by MIL STD 1388-1A, and superseded by later standards: SAE-TA-STD-0017A and ASD/AIA S3000L
LSA Dataset	A dataset that addresses/includes the supportability data gathered through the LSA process. ASD/AIA S3000L

Acronym/ Terms	Expansion/Description/Explanation
LSAR	Logistics Support Analysis Record, the logistics dataset or database depending on the standards used
LSD	Logistics Support Date – The LSD is defined as the date that the support solution is in place with the appropriate range and scale to support the initial delivery of a capability and a plan is in place to meet the roll out of the Capability. JSP 886 Vol 7, Pt2
LRU	An item that can be removed and installed at the organizational maintenance, or field level. ASD/AIA S3000L
Maintainability	The ability to be retained in, or restored to a state to perform as required, under given conditions of use and maintenance. NATOTerm
Maintenance Concept	A maintenance concept is a statement of maintenance considerations, constraints, and strategy for the operational support that governs the maintenance levels and type of maintenance activities to be carried out for the System under analysis. ASD/AIA SX000i
Maintenance Echelon	Position in an organization where specified levels of maintenance are to be carried out. IEC Glossary
Management Reports (In-Service)	The management report can be any official report generated by the ILS manager. ASD/AIA SX000i
MaxTTR	Maximum Time to Repair, usually associated with a percentile value to apply a bound to the maximum time to repair the SOI value
MB	Measurement Base, describes the units of measure to be applied to a data element, e.g. kg for Weight
MBPS	Model Based Product Support
MBSE	Model Based Systems Engineering
MC	Military Committee
MDAL	Master Data and Assumptions Log, used to support resource and LCC modelling
MDT	Mean Downtime
MI	Model Identifier - used by ASD/AIA/A4A S1000D
MICC	Material item Category Code - used by ASD/AIA/A4A S1000D
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
ML	Machine Learning
MOA	Memorandum Of Association
Mock-ups	A model, built to scale, of a machine, apparatus, or weapon, used in studying the construction of, and in testing a new development, or in teaching personnel how to operate the actual machine, apparatus, or weapon. NATOTerm
MODAF	MOD Architecture Framework
MOE	Measures of Effectiveness

Acronym/ Terms	Expansion/Description/Explanation
MOI	Model Identification, used in S2000M to identify Systems and End Items. This must align with UOC codes used in the Supportability Analysis dataset
MOP	Measures of Performance
MOTS	Military-Off-The-Shelf
MOU	Memorandum of Understanding
MOV	Model Version - used by ASD/AIA S2000M
MR	Mixed Reality, a combination of AR and VR
MRR	Manufacturing Readiness Review
MSA	Material Solution Analysis
MSG-3	Maintenance Steering Group 3, a group that produced an early preventative maintenance analysis methodology for civil aircraft certification. Reliability Centred Maintenance is now used.
MSI	MSI. Maintenance Significant Items - An item identified by any selection process to be the result of a Maintenance Analysis procedure. ASD/AIA S3000L
MTA	Maintenance Task Analysis – Maintenance Task Analysis (MTA) is a detailed analysis process that results in the identification of the procedures, spares and materials, tools, support equipment, personnel skill levels, estimated and elapsed times as well as any facility issues that must be considered for a corrective, repair or preventive maintenance task. ASD/AIA S3000L In other NATO regions Task Analysis additionally includes: Identifying new and critical resources, Training requirements, Design Influence, Risk Reduction for New/Critical items, Transportability Analysis, Supply Support including Provisioning data, Codification screening/application, Logistics Product Data, and Environmental Safety and Occupational Health Analysis. SAE-TA-STD-0017A and SAE-TA-HB-0007-1
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Action, a combination of unscheduled and Scheduled maintenance activities
MTTF	Mean Time to Failure
MTTR	Mean Time to Repair
NAC	North Atlantic Council
NAF	NATO Architectural Framework
NAV	NATO All view
NCAGE	NATO Commercial and Government Entity Code, a code that identifies a supplier by the combination of Company Name and location address.
NCS	NATO Codification System. The NCS is the official programme under which equipment components and parts of the military supply systems are uniformly named, described, classified, and assigned a NATO Stock Number (NSN). AcodP-1

Acronym/ Terms	Expansion/Description/Explanation
NCV	NATO Capability View
NDPP	NATO Defence Planning Process
NIMP	NATO Information Management Policy
NMCRL	NATO Master Cross Reference List, used in NATO codification and parts screening.
NOV	NATO Operational View
NPV	NATO Programme View / Net Present Value – used in LCC modelling to bring future costs and revenue to a decision point.
NSN	NATO Stock Number, derived through NATO Codification processes controlled by AC135
NSOV	NATO Service Oriented View
NSPA	NATO Support and Procurement Agency
NSV	NATO System View
NTV	NATO Technical View
O&S	Operations and Support
OBC	On Board Courier
Obsolescence	Obsolescence is the state of an item that is no longer needed because something newer or more efficient has been invented or its components are no longer available, and it can therefore no longer be maintained or operated. ASD/AIA SX000i
ODR	Operational Data Recording
OEM	Original Equipment Manufacturer – manufacturer of an assembly or a product NOTE 1 OEM is a common term used to identify a position in the supply chain. NOTE 2 The assembly or product might be regarded as a component by a customer. IEC Glossary
Operational Concept	The operational concept specifies how the new system/equipment will be integrated into the force structure and deployed and operated in peacetime and wartime to satisfy the mission need. This concept provides the framework around which the support system should be developed. MIL-HDBK 502A
Operational Requirement	The Operational Requirements are presented by the Customer and details the specific operational parameters of the operational scenarios for the System. ASD/AIA SX000i

Acronym/ Terms	Expansion/Description/Explanation
Operational Suitability Report	The degree to which a system can be satisfactorily placed in field use with consideration to reliability, availability, compatibility, transportability, interoperability, wartime usage rates, maintainability, safety, human factors, habitability, manpower supportability, logistics supportability, documentation, environmental effects and training requirements. DAU Glossary
Operator	A person who runs a device. NATOTerm
ORD	Operational Requirements Document – Defines the operational requirements in a qualitative way for the System. See CONOPS. ASD/AIA S3000L
OTA	Operator Task Analysis
OTS	Off The Shelf
Overhaul	Action to restore to a fully serviceable condition, equipment which has been in use or in storage for a period of time, but which is not faulty. IEC Glossary
PBL	Performance Based Logistics
PCA	Physical Configuration Audit
PD	Production and Deployment
PDR	Preliminary Design Review
PESTEL	Political, Economic, Social, Technological, Environment and Legal
PHS&T	Packaging Handling Storage and Transportation. PHS&T is the combination of resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly, including environmental considerations, equipment preservation for the short and long storage, and transportability. Some items require special environmentally controlled, shock isolated containers for transport to and from repair and storage facilities via all modes of transportation (land, rail, air, and sea). – DAU IPS Element Guide
PLCS	Product Life Cycle Support
PLM	Product Lifecycle Management
PLT	Purchase Lead Time – includes sum of: Order processing time + Production lead time + delivery time (if not Ex-works)
PMTR	Preventive Maintenance Task Requirements - The PMTR defines and selects the requirements for preventive maintenance tasks with intervals for systems including installed components and equipment. ASD/AIA SX000i
PPS	Post-Production Support. Systems management and support activities necessary to ensure continued attainment of System Readiness Objectives (SROs) with economical logistics support (LS) after cessation of production of the end item (weapon system or equipment). DAU Glossary
PPH	Policy and Procedures Handbook

Acronym/ Terms	Expansion/Description/Explanation
PRAT	Passive Reader Active Tag, associated with RFID readers
Prototype	A model or preliminary implementation suitable for evaluation of system design, performance, and production potential; or for better understanding or determination of the requirements. NATOTerm
Provisioning Data	Provisioning data is defined as any recorded or documented information prepared expressly for the identification, description, installation location and verification of items, materials, supplies, and services that are to be purchased, inspected, packaged, packed and supplied, or delivered to users. ASD/AIA SX000i
PRR	Production Readiness Review
PSA	Product Support Analysis
PSC	Personal Security Clearance
Public Private Partnership	A Public Private Partnership is a cooperative arrangement between an organic support provider and one or more private sector entities to perform defense-related work. DAU IPS ELEMENT Guidebook
QA	Quality Assurance
QM	Quality Management
QMS	Quality Management System
R&D	Research and Development
R&M	Reliability and Maintainability
RAIDO	Risks, Assumptions, Issues, Dependencies and Opportunities
RAMST	Reliability, Availability, Maintainability, Safety and Testability
RAMT	Reliability, Availability, Maintainability and Testability
RBD	Reliability Block Diagram
RCIL	Recommended Critical Items List
RCM	Reliability Centred Maintenance - A disciplined logic or methodology used to identify scheduled maintenance tasks in order to maintain the inherent reliability of equipment, with a minimum expenditure of resources. ASD/AIA S3000L
RDGT	Reliability Development Growth/Test
Recoverability	The ability to achieve restoration (with or without repair) following a failure. IEC Glossary
Reliability	The ability of an item to perform a required function under stated conditions for a specified period of time. NATOTerm
Requirement	- A formal statement of what is needed. - An essential condition that a system has to satisfy. NATOTerm
RFID	Radio Frequency Identification
RFP	Request for Proposal
RFQ	Request for Quotation

Acronym/ Terms	Expansion/Description/Explanation
RM	Risk Management
RNCC	Reference Number Category Code, used in NATO Codification
RNJC	Reference Number Justification Code, used in NATO Codification
RNVC	Reference Number Variation Code, used in NATO Codification
RSPL	Recommended Spare Parts List
S&TE	Support and Test Equipment
SA	Supportability Analysis - An analytical tool, conducted as part of the Systems Engineering Process (SEP), to determine how to most cost-effectively support the system over its entire life cycle. It provides the basis for related design requirements that may be included in specifications. DAU Glossary
SAE	SAE International
Safety	Expectation that a system does not, under defined conditions, lead to a state in which human life, health, property, or the environment is endangered. ISO/IEC/IEEE 15288
SAR	System Acceptance Review, part of systems engineering review processes
SBS	System Breakdown Structure - Hierarchy of elements which can represent the structure of a system at different levels of detail. Structure here means the organisation of relations among the system constituents. IEC Glossary
SCORM	Shareable Contents Object Reference Model
SDA	System Design Authority
SDC	System Difference Code, used in S1000D
SDR	System Definition Review
SE	Section – Used by S1000D SNS
SEBoK	Systems Engineering Body of Knowledge
SEMP	Systems Engineering Management Plan
SERD	Support Equipment Requirements Data, a data definition used by USA DoD to collect data for items being introduced into service. Refer to DI-ILSS-80118C and Mil HDBK 2097A.
SFR	System Functional Review – a systems engineering design review
SJ	Subject – used by S1000D SNS
SLC	System Life Cycle
SLCM	System Life Cycle Management - System Life Cycle Management describes how a SOI and enabling systems are managed throughout its life cycle using the methods of Programme Management, Project Management by NATO, Agencies and Nations on the base of AAP-20.
SM	Software Management
SME	Subject Matter Experts

Acronym/ Terms	Expansion/Description/Explanation
SML	Sustainment Maturity Levels (SML) are a life cycle sustainment management tool used to assess the program's progress in implementing the System support strategy, including the design and the resultant Product Support Package to achieve the sustainment metrics. DAU IPS ELEMENT Guidebook
SMR	Source Maintenance and Recoverability, a code from Logistics Support Analysis to describe the repair policy, in terms of maintenance level for removal/replacement, repair and recoverability or Condemnation. Defined by Mil Std 1388-2B DED 389 or within ASD/AIA S2000M in the data element definition through the text element identifier, SMR
SOI	System of Interest - The System of Interest (SOI) consists of the sum of subsystems, main components, components (assemblies), and parts to meet a specific and defined purpose as distinguished from other systems. AAP-48
SoW	Statement of Work
Specification	A clear and accurate description of the technical requirements for a material, a product, or a service, including the procedure by which it can be determined that the requirements have been met. A detailed formulation, in document form, which provides a definitive description of a system for the purpose of developing or validating the system. NATOTerm
SPIS	Service Packaging Instruction Sheet, see Def Stan 81-41 Pt4. Mil Std 2073-1E Chg4 refers to SPIs Special Packaging Instructions, which are similar
SPOC	Single Point of Contact
SQEP	Suitably Qualified and Experienced Personnel
SR	System Requirements
SRD	System Requirements Document
SRR	System Requirements Review – a systems engineering design review
SRU	Shop Replaceable Unit, a subassembly of an LRU
SSA	Software Support Analysis - The method used to identify a cost-effective software support concept. ASD/AIA S3000L
SSE	Sub-Section – used by S1000D SNS
SSI	Structurally Significant Item - A structural item or assembly that is significant due to its requirement to carry high aerodynamic, ground, pressure or control loads and whose failure could affect the structural integrity necessary for System safety, human safety, legal operation or environmental integrity. ASD/AIA S3000L
STANAG	Standardisation Agreement
Standardisation	The activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context. NATOTerm
STANREC	Standardization Recommendation

Acronym/ Terms	Expansion/Description/Explanation
STC	Special To contents Container, a reusable container to protect high value items during handling or transport. This is similar/equivalent to a Category 1 Container as defined by S2000M.
STEV	Supportability Test, Evaluation, and Verification is the process by which a system or components are compared against requirements and specifications through testing. DAU IPS ELEMENT Guidebook. Supportability, Test, Evaluation and Verification, a supportability analysis task, Mil Std 1388-1A, Task 501, Mil HDBK 502A Activity 17 or SAE TA-STD-0017 Task F1. S3000L Chapter 3 describes Verification, but not in the same way as STEV. In-service planning for data feedback mechanisms is described in S5000F.
STO	NATO Science and Technology Organization
Supplier	Organization or an individual that enters into an agreement with the acquirer for the supply of a product or service. ISO/IEC/IEEE 15288
Supportability	Extent to which item design characteristics and planned logistic support resources meet operational utilization requirements. IEC Glossary
Support Concept	The support concept describes the scheme for support which is derived from the support requirements. The concept is the basis for planning, executing and documenting the support as well as activation, use, maintenance/repair and disposal of a System. It describes required support resources. ASD/AIA SX000i
Sustaining Engineering	Technical tasks (engineering and logistics investigations and analysis) to ensure the continuous operation and maintenance of a system with managed risk. This involves the identification, review, evaluation and resolution of deficiencies throughout the life cycle of a system. DAU IPS Element Guidebook
SVR	System Verification Review, part of systems engineering review processes
SWOT	Strengths, Weakness, Opportunities, Threats
System	A system is a set of elements which, orderly related to each other, contribute to a determined object. A system tends to be a set of interconnected, interdependent parts, forming an identifiable, organised complex and dynamic whole. It may encompass elements, activities, people or ideas. See AAP-48 for more information. NATOTerm
System Disposal File	System disposal file contains the disposal activities under consideration and documentation of the possibilities of re-deployment, sale, waste disposal, the environmental impacts and the possible disposal of recovered materials by sale. (updated according to ALP-10.) ASD/AIA SX000i

Acronym/ Terms	Expansion/Description/Explanation
Systems Engineering	An interdisciplinary approach and process encompassing the entire technical effort to evolve, verify and sustain an integrated and total life cycle balanced set of system, people, and process solutions that satisfy customer needs. SE is the integrating mechanism for the technical and technical management efforts related to the concept analysis, Materiel Solution Analysis (MSA), Technology Maturation and Risk Reduction (TMRR), Engineering and Manufacturing Development (EMD), Production and Deployment (P&D), Operations and Support (O&S), disposal of, and user training for systems and their life cycle processes. DAU Glossary
System Hazard Analysis	It is conducted to verify system compliance with requirements to eliminate hazards or reduce the associated risks; to identify previously unidentified hazards associated with the subsystem interfaces and faults; identify hazards associated with the integrated system design, including software and subsystem interfaces; and to recommend actions necessary to eliminate identified hazards or mitigate their associated risks. MIL-STD-882E
Task Inventory	Task Inventory identifies a set of tasks for a given purpose. ASD/AIA S6000T Task inventory is identified using three analysis techniques: (1) Failure Analysis (FMECA and FTA), (2) RCM analysis, and (3) a detailed review of the system/equipment functional requirements. MIL-HDBK-502A
TD	Technology Development
TDP	Technical data package - The authoritative technical description of an item. This technical description supports the acquisition, production, inspection, engineering, and logistics support of the item. The description defines the required design configuration and/or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, engineering design data, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation and packaging details. MIL-STD-31000B
Technical Data	Technical data is recorded information (regardless of form of method of recording) that is of a scientific or technical nature (including computer software documentation). – IPS ELEMENT DAU
Technical Publications	Technical data, providing instructions for installation, operation, maintenance, training, and support, formatted into a technical manual. Data may be presented in any form regardless of the form or method of recording.
TEI	Text Element Identifier, used in ASD/AIA S2000M to define data elements
TNA	Training Needs Analysis
TOGAF	The Open Group Architecture Framework
Total Ownership Cost	All direct costs plus indirect variable costs associated with the life cycle stages of the system of interest. NATOTerm

Acronym/ Terms	Expansion/Description/Explanation
Training Documentation	Any piece of documentation required to plan and conduct training
Training Equipment	Training equipment is equipment developed and used to conduct training or support a training system. ASD/AIA S6000T
Training Package	A self-contained package of training within a readily identifiable training establishment. JSP 822 Pt 2
Training Support	Training and training support consist of the policy, processes, procedures, techniques, Training Aids, Devices, Simulators, and Simulations (TADSS), planning and provisioning for the training base including equipment used to train civilian and military personnel to acquire, operate, maintain, and support a system.
TRR	Test Readiness Review
Turn Around Time	Time required to return an item to use between missions or after removal from use. DAU Glossary
UID	Unique Identification
UK CONEMP	Concept of Employment
UML	Unified Modelling Language
UOC	Usable On Code, usually a 3-character code in military use. Used to identify System Configuration and System variants. Mil Std 1388-2B defines this in data element description 501.
UPS	Uninterruptable Power Supply
URD	User Requirements Document - Defines the user requirement in the form of the outputs or results that the users require from the product. ASD/AIA SX000i
User	User is a person that has authority to use an item for a specific purpose. ASD/AIA SX000i
US DOD	US Department of Defense
US DODAF	DOD Architecture Framework
UUT	Unit Under Test, identifies an item associated with Support and Test Equipment
UxV	Unmanned Vehicles, includes UAV, UGV, USV and UUV
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
USV	Unmanned Surface Vehicle
UUV	Unmanned Underwater Vehicle
V & V	Verification & Validation
Validation	The process of ensuring that the System is being designed and developed in the appropriate way
Verification	The action of making sure or demonstrating that something is true, accurate or justified. NATOTerm

Acronym/ Terms	Expansion/Description/Explanation
VR	Virtual Reality
XML	Extensible Markup Language
WLC	Whole Life Cost

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ALP-10(D)(1)