



Industrialization, production and maintenance

Integrated Product Support (IPS)

Foreword

ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards. Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

This new Standard has been prepared and reviewed by the ECSS-I-ST-30-10C Working Group, reviewed by the ECSS Executive Secretariat and approved by the ECSS Technical Authority.

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1 Scope

This Standard defines the processes and specifies a set of Integrated Product Support (IPS) requirements aimed at the identification and provision of logistic support, such that the space system can be acquired, operated and maintained in its operational conditions, for the expected lifetime.

NOTE The subject of “Integrated Product Support” was previously known in ECSS as “Integrated Logistic Support” that was covered by ECSS-M-70A. Due to new content of the document the emphasis is more on Engineering than on Management.

The requirements specified in this Standard are also oriented to implement mitigation measures against the risks considered critical for the operational objective during the whole space system life cycle.

This Standard is applicable for support segment of ground, launch and space segments, manned and unmanned space systems, ensuring that they are properly harmonized, mutually optimized and phased together since the very early design and development phases leading to integrated solutions that have the lowest possible Maintenance Costs within the operational and safety limitations and constraints imposed by the operational environment.

This Standard may be tailored for the specific phase, characteristics and constraints of a space project taking into consideration the supplier’s position in the supply chain.

This standard may be tailored for the specific characteristic and constraints of a space project in conformance with ECSS-S-ST-00.

2**Normative references**

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply, however, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

ECSS-S-ST-00-01	ECSS system - Glossary of terms
ECSS-E-AS-11	Adoption Notice of ISO 16290, Space Systems - definition of the Technology Readiness Levels (TRLs) and their criteria of assessment

Terms, definitions and abbreviated terms

3.1 Terms from other standards

- a. For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply, in particular for the following terms:
 1. availability
 2. business agreement
 3. configuration item
 4. critical item
 5. customer
 6. integration
 7. maintainability
 8. product
 9. reliability
 10. safety
 11. space system
 12. supplier
 13. support segment
 14. work breakdown structure

3.2 Terms specific to the present standard

3.2.1 IPS function

entity of the supplier responsible for managing the integrated support and services engineering

NOTE more details are in 4.3.1.3.

3.2.2 PSA function

entity of the supplier responsible for analysing and challenging the design in order to meet Customer requirements and preparing the data for the production of support elements

NOTE More details can be found in 5.3.2.

3.2.3 Technical Publication

[CONTEXT: IPS] entity inside IPS entity defining the processes and activities needed to identify, plan and provide the resources and requirements to assure the Production and Delivery of Maintenance and Operations documentation according to the specific standards.

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms and symbols from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
DRD	document requirements definition
EIS	entry into service
FMECA	failure modes, effects and criticality analysis
GHS	ground handling support
GSE	ground support equipment
IETM	interactive electronic technical manuals
IPS	integrated product support
IPSP	integrated product support plan
IT	information technology
ITAR	International Traffic in Arms Regulations
KPI	key performance indicator
LCC	life cycle cost
LORA	level of repair analysis
LRU	line replaceable unit
MTBF	mean time between failure
PHST	packing, handling, storage and transportation
PSA	product support analysis
PSAP	product support analysis plan
PSAR	product support analysis record (PSA database)
RAMS	reliability, availability, maintainability, safety
SMA	schedule maintenance analysis
SSA	support software analysis
TADSS	training aids, device, simulators, and simulations
WBS	work breakdown structure

3.4 Nomenclature

The following nomenclature applies throughout this document:

- a. The word “*shall*” is used in this Standard to express requirements. All the requirements are expressed with the word “*shall*”.
- b. The word “*should*” is used in this Standard to express recommendations. All the recommendations are expressed with the word “*should*”.

NOTE It is expected that, during tailoring, recommendations in this document are either converted into requirements or tailored out.

- c. The words “*may*” and “*need not*” are used in this Standard to express positive and negative permissions, respectively. All the positive permissions are expressed with the word “*may*”. All the negative permissions are expressed with the words “*need not*”.
- d. The word “*can*” is used in this Standard to express capabilities or possibilities, and therefore, if not accompanied by one of the previous words, it implies descriptive text.

NOTE In ECSS “*may*” and “*can*” have completely different meanings: “*may*” is normative (permission), and “*can*” is descriptive.

- e. The present and past tenses are used in this Standard to express statements of fact, and therefore they imply descriptive text.

4 Principles

4.1 General principles

4.1.1 IPS objectives

IPS is an engineering and management activity responsible for ensuring that the necessary support resources are in place, during all project phases, including analysis, design, manufacturing, testing, launch, operations and end-of-life disposal. The objective is to enable the space system to fulfil its mission on time, with the right quality and within the expected cost.

IPS integration into the project aims at coordinating, throughout the life cycle, the activities and resources involved in the preparation and optimization of the support segment, aiming at minimum Maintenance Costs according to the requirements and operational risks. In summary, the main objectives of IPS are:

- Optimize the support by influencing the space system design in the early project phase.
- Identify and develop the support resource requirements.
- Acquire the appropriate support resources.
- Provide the required in-service support in order to achieve the availability and safety objectives at the optimum Maintenance Costs.
- Ensure that the IPS solution proposed is compliant with Export Control regulation.

The system life cycle refers to the entire spectrum of activities commencing with the identification of the needs for the space system and culminating in its disposal. The objectives of IPS are to ensure that all support requirements are identified and put in place in a manner which contributes to the optimization of Maintenance Costs, throughout its planned life cycle.

4.1.2 IPS process

The IPS process is a deliberate, unified and iterative methodology used to develop a support strategy that:

- Optimizes functional support elements for a space system.
- Leverages existing investments in manpower, systems, equipment, training, facilities, and other resources from various segments.
- Guides the system engineering process to:
 - Identify the support
 - Influence the best design alternative
 - Refine the support strategy

- Influence test and evaluation of both the space segment and the support segment
- Identify resources and acquire the requisite support
- Provide the support to the users
- Continuously monitor and improve the support

IPS is also a process facilitating development and integration of all of the logistic support elements to acquire, test and support complex space systems.

4.2 IPS performance assessment

4.2.1 General overview

IPS is defined as the combination of the management and analysis actions necessary to ensure the effective and economical support of a given system.

4.2.2 Operational availability, safety

The operational availability concept addresses the fact that the required external resources including maintenance resources and other resources are provided for the availability (performance) and are provided in the operational conditions of use.

External resources are provided by the support system in order to maintain the supported system in an operational state, under actual conditions of use and expected economic constraints. The operational availability is derived both from the dependability and safety characteristics.

To meet with the high level of system availability requirement, the system requires to be made of high reliability units with sufficient redundancies where necessary. And in order to ensure a high level of safety and availability requirements, the maintenance concept integrates several technical solutions allowing, when a failure in one or several of its systems occurs, to be quickly and efficiently repaired and put back into operational conditions of service with the lower downgrading time possible.

4.2.3 IPS Cost Drivers

The process to assess the maintenance costs of a space system, comprising the space segment and the support segment. This analysis provides important inputs in the decision-making process in the space system design, development, and use.

The logistic support has an impact on the costs during the whole maintenance cost of project. The longer the utilization phase is, the higher the logistic support cost contribute on the maintenance costs.

Since the decisions during the design phase influence the cost drivers, the most effective PSA iterations can be performed only during the design phase (Phase A). In areas where it is not possible to influence the design (e.g. COTS purchases), IPS activities are concentrated on providing the most cost-effective support

infrastructure and influencing the selection process for Maintenance Costs considerations.

The advantages and increased efficiency resulting from integrating the logistic support, requires that the logistic support needs be addressed in the project definition. It also requires that coherence be established between the design and development of the support segment and the operational requirements to be fulfilled by the space system.

4.3 IPS Discipline Interfaces

4.3.1 Common terminologies of IPS

4.3.1.1 Continuing Airworthiness

It specifies the processes and activities needed to assure the continuing airworthiness management of the product to assure the safety of the operation with the highest availability and lowest maintenance cost.

4.3.1.2 In-Service Support

It specifies the processes and activities needed to deliver the services with a level agreement defined in the Integrated Support and Services Engineering Plan (IPSP), and/or contractual requirements as well as obligations, and to collect all service data in order to prepare and to deliver service records. This Major Process includes the planned in services support processes including monitoring and sustaining of in-service performance, preventive maintenance execution incl. modifications / upgrades, integration of hardware / software releases and technical support as well as any corrective maintenance activities with the objective of satisfying contractual requirements and obligations. This Major process assures furthermore the proper disposal of products and systems at the end of Product Lifecycle.

4.3.1.3 IPS Function

The IPS function is in charge of:

- Coordinating and reporting IPS activities progresses to the project team
- Challenging the engineering solutions in order to ensure that Customer requirement regarding IPS will be met
- Negotiating with Project team and Suppliers regarding IPS Topics
- Planning and producing of the support elements
- The accountability for the delivery of Support Elements On Time On cost On quality
- Ensuring the Entry Into Service of the Project regarding Maintenance domain

4.3.1.4 Life cycle cost analysis

It deals with the evaluation of the global cost of the product system during its Life Cycle. It can include system acquisition (e.g. concept, development, and production), operation, support and disposal costs. LCC Analysis provides a detailed view on identified factors contributing to the overall costs. Cost drivers elements and influence factors (e.g. reliability, environment, repair cost, mission profile) are identified and provided to support decision making to others.

4.3.1.5 Logistic chain

It is a set of suppliers and lower-tier suppliers directly linked by one or more products and services to provide the integrated logistic support

4.3.1.6 Material support

It ensures internal and external Customers being supported with best-in-class material availability: all activities related to material management and material supply such as customer order capture, initial definition and re-provisioning of spares, including data compilation, pricing, packaging, storage, transportation, integration of material, checking and performance tests execution.

4.3.1.7 Support concept

It recommends support policy and procedure for a particular product specific to a particular user or application

NOTE The support concept is part of the IPS Concept.

4.3.1.8 Support engineering

It ensures a systematic participation into the Design and Development Configuration of the Product/System in order to fulfil the required Operational and Maintenance requirements. This means the integration of Supportability requirements and safety processes into the Design of a Product/System from the conceptual and definition phases and based on in-service feedback to continue through its Life Cycle.

4.3.2 Overview

In order to meet the established goals of influencing the design and providing the most cost-effective support and service solutions, interfaces between all affected and contributing activities are clearly specified and planned. The major categories of interfaces have been identified as shown in Figure 4-1 “IPS Key Discipline Interfaces”:

- Integrated interfaces between IPS elements: the activities associated to each IPS element are so intertwined and dependent on each other that these interfaces are critical to the overall IPS programme
- Interfaces with engineering and product assurance disciplines: main focus on the definition of logistic requirements at the design level (e.g. design engineering, dependability and safety, system integration and testing, human factors engineering)

- Interfaces with Supply chain, export control (ITAR): these interfaces are critical to prepare operations and ensure their performances

NOTE ECSS-E-ST-10-24 describes three major types of interfaces.

- Interfaces within the Space Segment, Ground Segment or Launch Segment.
- Interfaces between the different Segments of the Space System.
- Interfaces between the Support Segment and the Space Segment, Ground Segment or Launch Segment.

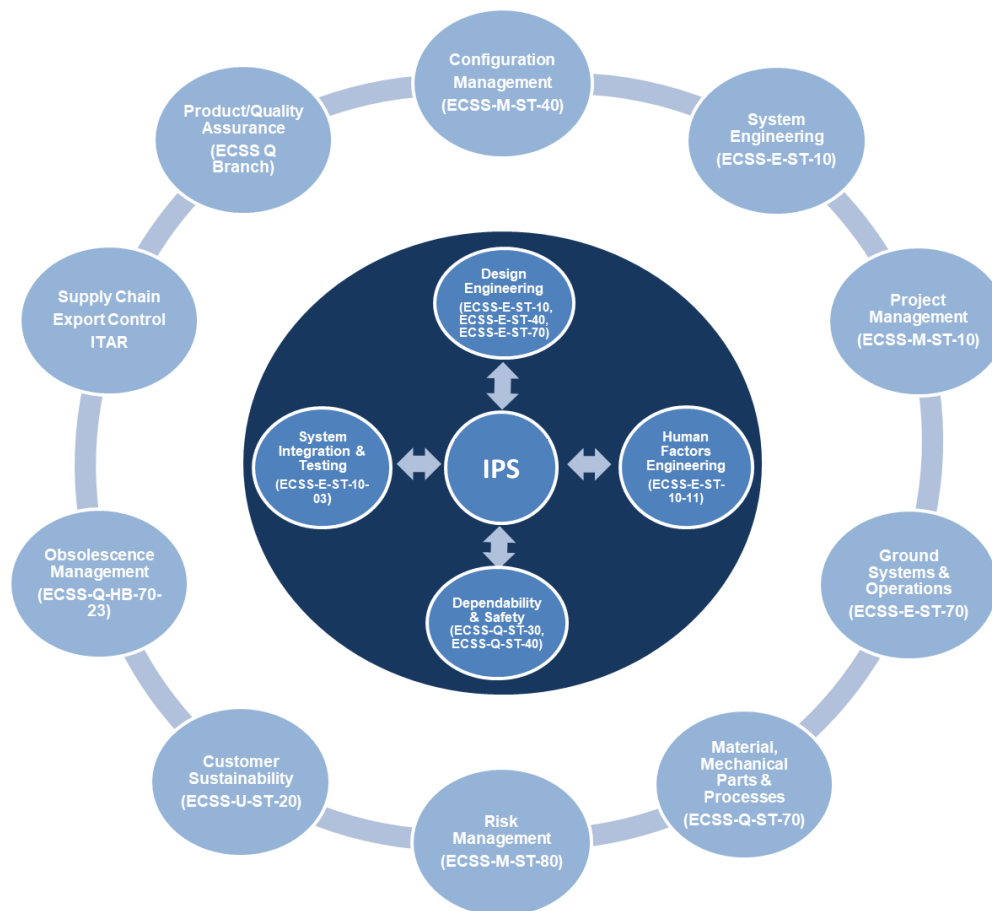


Figure 4-1: IPS Key Discipline Interfaces

Early consideration of IPS aspects in the space system life cycle involves working with multidisciplinary and integrated teams. Without the diversity and integration of the different perspectives there is no integrated space system development or concurrently engineered design.

Consequently the IPS management has a number of interfaces to other disciplines and their associated project team members. Through these interfaces, IPS aims to manage the key disciplines with:

- The project planning and implementation according to the needs of the different project life cycle phases
- The configuration and information management process
- The cost and schedule management process
- The risk management process
- The system design

4.3.3 System engineering

IPS ensures that product support and services requirements are already managed starting from project phases A and B. The existence of this interface ensures the following:

- Consistency and coherence of logistic requirements and space system requirements
- Minimizing needs for specific tools and test equipment
- Reducing required maintenance skill levels
- Designing for rapid and easy repair
- Redundancy of production, operation and mission essential logistic elements.

4.3.4 Space system production and operation

Support issues are identified and resolved prior to the production, deployment and operation of the space system.

In production and during operation, a feed-back loop is established between systems engineering, logistic engineering, and project management on the following topics:

- KPI measured against required performance of the logistic support
- Opportunities and risk management
- Flexibility and margins of the logistic support
- Lessons learned.

4.3.5 Quality assurance

The prime objective of QA management is to ensure that a QA programme for projects covering mission definition, design, development and production and operation of space systems is established, maintained and implemented. All QA requirements are specified through definition and implementation of adequate methods and procedures (see ECSS-Q-ST-20).

Coherent QA requirements are specified for the overall project and are applied to the IPS management, analysis and document control.

4.3.6 Dependability and safety

Dependability (i.e. Reliability, Availability, and Maintainability) and Safety, commonly known as RAMS, are integrated disciplines covering hardware, software as well as ground infrastructure and operations (human aspects).

The dependability and safety activities in a programme have a highly significant influence on the design of a System for supportability. While IPS and RAMS are distinct disciplines, they are closely coordinated. The overall planning needs to reflect the working relationship between IPS and Safety and Dependability. The planning activities also demonstrate that the outputs from the Safety and Dependability activities (specified in the ECSS-Q-ST-30 for Dependability and ECSS-Q-ST-40 for Safety), required as inputs to IPS more particularly for PSA activities (see Figure 4-1), are identified and scheduled to be available in time to allow the support considerations to influence the design and trade-off analysis.

IPS provides the mechanism to identify and optimize the cost of support options relative to the cost of achieving given Dependability and performance requirements throughout maintainability reviews.

4.4 Overview of IPS tasks per project phase

4.4.1 Overview

The allocation of IPS requirements per phase depends strongly on the type of business agreement established between customer and supplier and the nature and level of complexity of the system of interest subject of the agreement. The breakdown and the details of the tasks are specified in the business agreement specific documents.

NOTE Some projects define them in a Statement of work (SoW).

The actors in the customer-supplier relationship change between phases and across levels. In the following clauses each system of interest engineering function is meant to be the supplier's system engineering function during that phase. The planning and management of IPS addresses the work required to carry out the IPS tasks. To this purpose it is necessary that:

- The main elements of the logistic support necessary to achieve the space system function/mission are identified (Phase 0, A)
- The requirements on the logistic support are preliminary specified and the feasibility and risks are assessed (Phase A, B)
- The logistic support is detailed and developed (Phase B, C)
- The logistic support segment is verified and accepted (Phase C, D, E)
- The logistic support is maintained and continuously improved during production and utilization of the space system (Phase C, D, E)
- The logistic support is safely disposed at the life cycle's end (Phase F).

The logistic support is an integral part to the space system's review life cycle. The tasks and structure of the IPS is broken down complementary to the project breakdown structure of the product in a consistent way. However, a tailoring of the logistic support management tasks allocated to the project management is account for the life cycles and the logistic environment (e.g. to the general logistic organization of a company).

4.4.2 Phase 0 Overview: Mission analysis-need identification

For Phase 0, the IPS tasks

- Support the identification of customer needs.
- Support the identification of system of interest concepts.
- Support the Mission Definition Review (MDR) and ensures implementation of the MDR actions.
- Perform an analysis of the Mission Statement document and integrate this analysis and any relevant contribution from lower-level suppliers into a PSAP and maintain this later document for the selected final concept.
- Propose the requirements against the expressed user needs for agreement with the customer.

NOTE Mission Statement captures the declared "user needs".

4.4.3 Phase A Overview: Feasibility

For Phase A, the IPS tasks

- Finalize the expression of the needs identified in Phase 0.
- Propose system of interest solutions (including identification of critical items and risks) to meet the customer needs.
- Support the Preliminary Requirement Review (PRR) and ensure implementation of PRR actions.
- Finalize the validation of the requirements against the expressed needs together with the customer.

NOTE Mission Statement captures the declared "user needs".

4.4.4 Phase B Overview: Preliminary definition

For Phase B, the IPS tasks

- Establish the system of interest preliminary definition for the system of interest solution selected at end of Phase A.
- Demonstrate that the solution meets the technical requirements according to the schedule, the target cost and the customer requirements.
- Support the System Requirements Review (SRR) and Preliminary Design Review (PDR) and ensuring implementation of the SRR and PDR actions.
- Define development approach and plan of engineering activities.

Inputs:

- Customer requirements
- Retex from in service similar systems
- Preliminary design data
- 3D/2D model
- RAMS & FDIR: FA, FTA, FMEA
- Technical specification

Activities:

- Specify IPS concept
 - Develop support strategies and outline support plans
 - Estimate first Maintenance Cost
 - Derive Customer requirements toward IPS requirements
 - Preliminary assessment of overall design according to IPS objectives
 - Specify preliminary disposal requirements
 - Specify preliminary obsolescence management

Outputs:

- Preliminary IPS Plan (in conformance with DRD from Annex A) with according IPS Schedule and Risks and Opportunity Evaluation
- Preliminary PSA Plan (in conformance with DRD from Annex B)
- Preliminary Maintenance Costs
- Preliminary IPS Requirements to flow down to System of interest Design and Support Elements (Technical Publication, Training, Spares, Tools, Infrastructures)

4.4.5 Phase C Overview: Detailed definition

For Phase C, the IPS tasks

- Establish the system of interest detailed definition.
- Demonstrate the capability to meet the technical requirements of the system of interest technical requirements specification.
- Support the Critical Design Review (CDR) and ensures implementation of the CDR actions.

Inputs:

- PDR IPS outputs
- Detailed design data
- 3D/2D model
- Technical specifications
- RAMS analysis (MTBF, MTTR, ..)

Activities:

- Refinement and Validation of IPS requirements toward System of interest Design and Support Elements
- Assessment of IPS Requirements coverage in System of interest Design and Support Elements
- Specify in detail the support elements (technical publication, spare parts, tools, training) to reach customer's needs
- Specify the logistic of support elements
- Refinement and consolidation of Maintenance Costs
- Specify Obsolescence strategy in regards of customer's requirements
- Specify validation strategy for support elements and system of interest maintainability
- Specify preliminary maintenance plan
- PSA Data Base filled out with logistic data

Outputs:

- IPS Plan (in conformance with DRD from Annex A) according to IPS Schedule, Support Strategy and Risks and Opportunity Evaluation
- PSA Plan (in conformance with DRD from Annex B)
- Training Plan
- IPS Requirements sent to System of interest Design and Support Elements
- Maintenance Costs consolidated
- PSA Data Base
- Preliminary version of Support Elements: Technical publication, PHST, GSE, GSH, Initial Provisioning Spare List

4.4.6 Phase D Overview: Entry into Service - Qualification and production

For Phase D, the IPS tasks

- Finalize the development of the system of interest by qualification and acceptance.
- Finalize the preparation for operations and utilization.
- Support Qualification Review (QR) and Acceptance Review (AR) and ensures implementation of the QR and AR actions.

Inputs:

- CDR IPS outputs
- RAMS analysis final release (MTBF, MTTR, ...)

Activities:

- Review the logistic support analysis strategy and update the support plans and data requirements
- Update and complete the PSA analysis to include changes
- Complete and store PSAR data
- Validate the Support Elements: Technical publication, PHST, GSE, GSH, Initial Provisioning Spare List
- Acquire or produce logistic Support Elements, and perform test and evaluation of logistic support capability
- Perform Obsolescence Management
- Review the disposal strategy and update disposal plans and data requirements
- Declare the operational readiness of both the space system and the support segment with its support elements.

Outputs:

- Maintenance Costs consolidated
- Delivery of up-to-date PSA Data Base
- Final release delivery of:
 - IPS Plan according to IPS Schedule, Support Strategy and Risks and Opportunity Evaluation
 - PSA Plan
 - PHS&T Plan
 - Technical Publication
- Initial Training executed
- Initial Provisioning of Spares on sites
- GSE/GSH on sites
- Obsolescence management plan

4.4.7 Phase E Overview: Operations / utilization

For Phase E, the IPS tasks

- Support the launch campaign.
- Support the entity in charge of the operations and utilization following the terms of a business agreement.
- Support the Flight Readiness Review (FRR), Operations Readiness Review (ORR), Launch Readiness Review (LRR), Commissioning Results Review (CRR), End-of-Life Review (ELR), and recurring products AR, and ensure implementation of the actions of those reviews.
- Support the execution of all system engineering activities and provision of documents in support to anomaly investigations and resolutions.

Inputs:

- EIS IPS outputs

Activities:

- Implement the logistic support plan whilst operating and maintaining the space system in conformance with the system maintenance documentation
- Complete the logistic support Elements acquisition and delivery according to the needs and the planning
- Collect logistic data from the field, and perform analysis and corrective action
- Measure support performance and update PSAR and Maintenance Costs model
- Perform Obsolescence Management
- Apply disposal strategy for any equipment to be removed from the space system and its support segment

Outputs:

- Maintenance Costs consolidated with field costs
- PSAR updated with field data
- Updated release of according to changes:
 - PSA Plan
 - Technical Publication
- Continuous training executed according to Customer's needs (turn over, maintenance plan,...)

4.4.8 Phase F Overview: Disposal

For Phase F, the IPS tasks

- Support the entity in charge of the disposal following the terms of a business agreement.
- Support the Mission Close-out Review (MCR) and ensure implementation of the actions of the MCR.
- Apply disposal strategy for support system.

NOTE Examples: dismantling, recycling, energetic valorisation. Those activities are regulated by national laws

4.5 IPS Requirement Validation and Verification management

All IPS deliverables expected per phase and design reviews are validated and verified according to the IPS V&V plan (specific section in the IPS Plan) that is normally specified before starting the development phase.

The IPS plan, formerly also known as ILS plan, is part of the System Engineering Plan (specified in ECSS-E-ST-10)

5 Requirements

5.1 General

The task of the IPS function is to analyse the requirements for the system issued by the customer. This IPS analysis enables the transformation of the customer requirements into supplier solution.

The IPS function produces and maintains an IPS plan in conformance with Annex A.

5.2 IPS Requirement Management

5.2.1 General

The task of the IPS function is to derive, generate, control and maintain the set of IPS requirements to ensure consistency of the requirements at system level and lower level.

5.2.2 Requirements

ECSS-I-ST-30-10_1610001

- a. The IPS function shall analyse requirements for the system issued by the customer in conformance with the Mission Description Document (MDD) and provide the IPS requirements.

ECSS-I-ST-30-10_1610002

- b. The IPS function shall ensure the IPS requirements traceability.

ECSS-I-ST-30-10_1610003

- c. The IPS function shall ensure that each requirement for the lower-level elements has been validated and verified.

5.2.3 Planning and setting up IPS

ECSS-I-ST-30-10_1610004

- a. The supplier shall establish an IPS function in the project.

ECSS-I-ST-30-10_1610005

- b. The supplier shall issue an IPS plan in conformance with Annex A.

NOTE The IPS plan is called by the System Engineering Plan (SEP).

5.3 IPS Technical management

5.3.1 IPS Technical disciplines

IPS addresses a wide range of technical disciplines in an integrated manner into the project design.

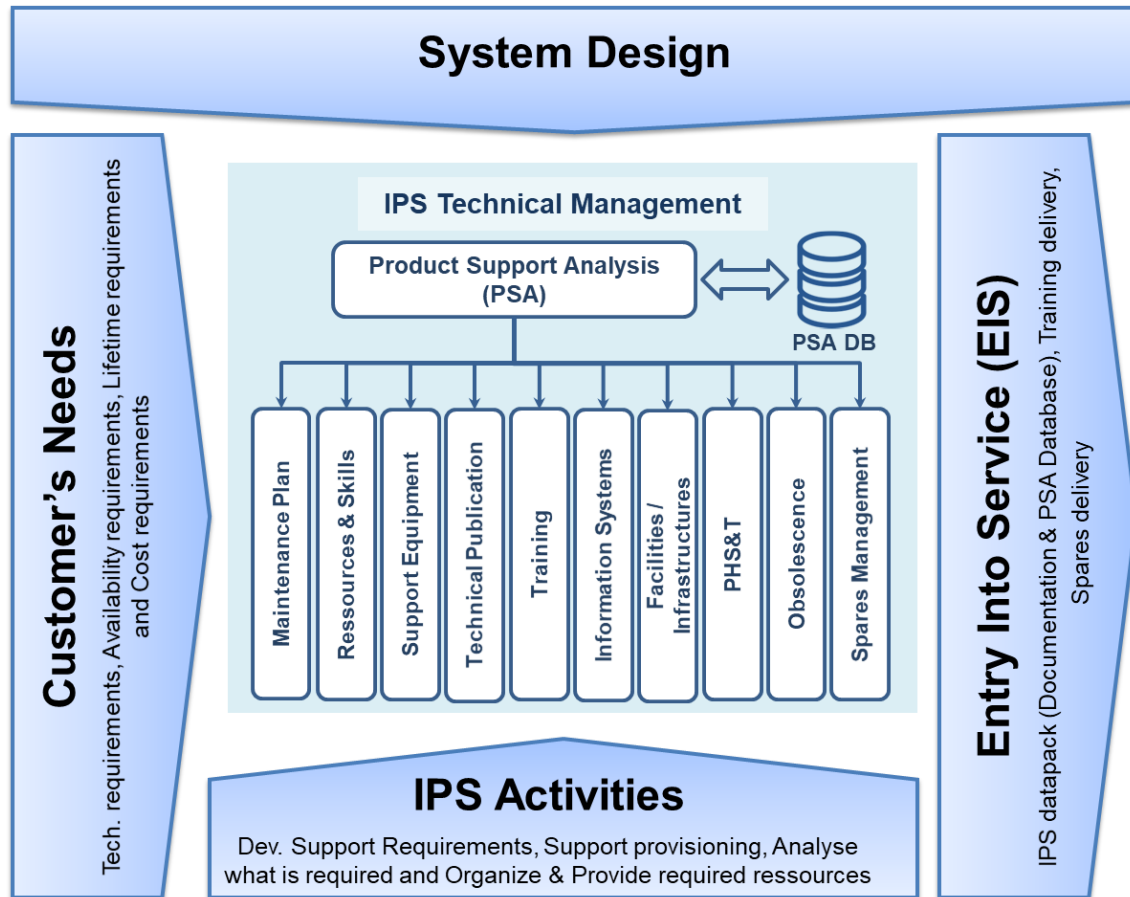


Figure 5-1: IPS Technical Disciplines Management

Figure 5-1, commonly referred to as IPS elements, are dedicated to a specific aspect of the overall logistic support programme and include but are not limited to:

- Maintenance Plan
- Resources and Skills
- Support Equipment
- Technical Publication
- Training
- Information Technology Resources Support
- Facilities/Infrastructures
- Packaging, Handling, Storage & Transportation (covered in ECSS-Q-ST-20-08)
- Obsolescence
- Spares Management

All IPS elements are developed as an integral part of the system engineering and integral part of each other. Trade-offs are often performed between elements in order to acquire a space system that is affordable, operable, supportable, sustainable, transportable, and environmentally sound within the resources available.

5.3.2 Product Support Analysis (PSA)

5.3.2.1 Objective

PSA is the primary means by which the objectives of IPS are achieved; PSA is a recursive technique applied all over the phases of the project in order to integrate the designed system with its logistic.

5.3.2.2 Description

PSA activities consist of a series of analytical tasks performed iteratively aiming at:

- Influencing the design of the equipment through logistic support considerations
- Identifying support issues, readiness requirements and cost drivers as early as possible in the equipment life cycle
- Specifying logistic support resource requirements for the life of the equipment
- Developing a logistic support database called the PSA Record Database (PSAR) for use in the through-life equipment support management of the equipment.

5.3.2.3 Requirements

- a. The PSA function shall issue a PSA Plan, in conformance with the DRD in Annex B.
ECSS-I-ST-30-10_1610006
- b. The PSA function shall validate and verify the PSA requirements.
ECSS-I-ST-30-10_1610007
- c. The supplier shall use the PSA Record Database to monitor all the logistic data.
ECSS-I-ST-30-10_1610008
- d. The PSA function shall manage the central repository PSA Record Database.
ECSS-I-ST-30-10_1610009

5.3.3 Maintenance Plan

5.3.3.1 Objective

Identify, plan, resource, and implement maintenance concepts and requirements to ensure that the adequate equipment/capability is available when the space system needs it at the lowest possible Maintenance Costs impact.

5.3.3.2 Description

Establish maintenance concepts and requirements for hardware and software, for the life cycle of the system. It includes, but is not limited to levels of repair, repair times, repair responsibilities, testability requirements, support equipment needs, training and TADSS, man-power skills, facilities, development of maintenance programs and in service software support. This element has a great impact on the planning, development, and acquisition of other logistic support elements.

5.3.3.3 Requirements

ECSS-I-ST-30-10_1610010

- a. The PSA function shall provide maintenance plan.

NOTE The maintenance plan contains preventive and corrective operations.

ECSS-I-ST-30-10_1610011

- b. The PSA function shall monitor and record IPS performance targets in the PSAR.

NOTE The IPS plan is called by the System Engineering Plan (SEP).

5.3.4 Resources and Skills

5.3.4.1 Objective

Identify, plan, resource and acquire personnel, with the grades and skills to:

- Operate and maintain equipment
- Complete the missions
- Support the users
- Ensure that the adequate capability is available for the space system.

5.3.4.2 Description

Involves the identification and acquisition of personnel with the skills and grades to operate, maintain, and support segment over his lifetime. Early identification is essential.

5.3.4.3 Requirements

ECSS-I-ST-30-10_1610012

- a. The IPS function shall identify at early stage of system development the resources and skill needed.

5.3.5 Support Equipment

5.3.5.1 Objective

Identify, plan, resource and implement management actions to acquire and support the equipment (mobile or fixed) used to sustain the operation and maintenance of the system to ensure that the system is available at the lowest Maintenance Cost.

5.3.5.2 Description

It consists of all equipment (mobile or fixed) intended to support the operation and maintenance of a system. This includes but is not limited to ground handling and maintenance equipment, trucks, air conditioners, generators, tools, metrology and calibration equipment, and manual and automatic test equipment. During the acquisition of systems, programme managers are expected to decrease the proliferation of support equipment into the inventory by minimizing the development of new support equipment and giving more attention to the use of existing equipment.

5.3.5.3 Requirements

ECSS-I-ST-30-10_1610013

- a. The PSA function shall specify a list of needed Support Equipment and include this into the product tree.

NOTE Examples of support equipment are: GSE, GHS, test benches and electronic tools.

5.3.6 Support Software Analysis (SSA)

5.3.6.1 Objective

Support Software Analysis (SSA) is a consistent methodology to guarantee proper software supportability throughout design phases in order to specify the best cost-effective support concept that meets the operational and software modification requirements. It is important to include software considerations in the early program phases and the influence of the software design to ensure supportability for both system operation and later modification processes by establishing the necessary support infrastructure before the product enters in the in-service phase.

In modern space products, software aspects are of increasing importance. More and more functionalities are supported or realized by complex software packages.

Similar to the PSA activities for hardware, software is analyzed concerning its operational and maintenance requirements.

For software itself, a clear distinction between operational and maintenance aspects and real software modification is established.

Warning: Software modification is a design activity!

Preparation, loading configuration are maintenance activities concerning software.

5.3.6.2 Description

In general, the SSA process covers similar logistic aspects as described for the other PSA process:

- SSA candidate selection: in general, SSA candidates are elements of either physical or functional breakdowns that are subject to any kind of SSA.
- Maintenance relevant events for software: the starting point of documenting the maintenance relevant aspects is the identification of any event that initiates maintenance activities.
- FMECA/FMEA aspects: the results of a technical FMECA/FMEA are relevant for software since the FMECA/FMEA represents an analysis method carried out for the overall equipment/system (covering HW and SW aspects).
- SMA (Schedule Maintenance Analysis) for software: SW failures are the result of unintended effects of the SW design. Such failures cannot be avoided by the means of SMA since they correspond to design flaws. However, potential SW failures can affect safety. It can be possible that the result of SMA carried out for a piece of HW equipment which contains SW, identifies scheduled maintenance tasks that are of operational character concerning SW.
- LORA aspects: The identification of the support level that a task is expected to be performed, can be provided by a Level of Repair Analysis (LORA) procedure.
- Software support tasks, after the identification of the relevant support initiators (events), the appropriate tasks are identified (operational/maintenance tasks or modification tasks). The goal is to define all operational, maintenance or modification relevant tasks, their related resources and further tasks characteristics such as duration manpower requirements preconditions or safety conditions.

5.3.6.3 Requirements

ECSS-I-ST-30-10_1610014

- a. The PSA function shall specify the Software Support Analysis (SSA).

ECSS-I-ST-30-10_1610015

- b. The supplier shall establish and maintain a Software Support Analysis (SSA) during the complete project life cycle.

5.3.7 Technical Publication

5.3.7.1 Objective

Identify, plan, resource and implement management actions to develop and acquire information:

- to operate, maintain, and train on the equipment to maximize its effectiveness and availability.
- to catalogue effectively and acquire spares and repair parts, support equipment, and all classes of supply.
- to specify the configuration baseline of the system (hardware and software) to effectively support the system with the best capability at the time it is needed.

5.3.7.2 Description

Represents recorded information of scientific or technical nature, regardless of form or character (such as equipment technical manuals and engineering drawings), engineering data, specifications, standards and data item descriptions. Technical Manuals including IETMs (Interactive Electronic Technical Manuals), and engineering drawings are the most expensive and probably the most important data acquisitions made in support of a space system. They provide the instructions for operation and maintenance of a space system. IETMs also provide integrated training and diagnostic fault isolation procedures.

5.3.7.3 Requirements

ECSS-I-ST-30-10_1610016

- a. The PSA function shall ensure the assessment of the maintenance procedures is completed before entry into service.

5.3.8 Training

5.3.8.1 Objective

Plan, resource, and implement a cohesive integrated strategy to train personnel to maximize the effectiveness of the support segment, manpower and competences, to operate, and maintain the equipment throughout the life cycle.

As part of the strategy, plan, resource, and implement management actions to identify, develop, and acquire Training Aids Devices Simulators and Simulations, planning (TADSS) to maximize the effectiveness of the manpower and competences, operate, and sustain equipment at the lowest Maintenance Costs.

5.3.8.2 Description

The Training deliverables issued from a Training Needs Analysis (TNA) consists of the policy, processes, procedures, techniques, Training Aids Devices Simulators and Simulations, planning and provisioning for the training base

including equipment used to train personnel to acquire, operate, maintain, and support a system.

This includes new equipment training, support training and displaced equipment training for the individual, and for the collective, and maintenance through initial, formal, and informal, on the job training, and having proficiency training. Significant efforts are focused on New Equipment Training (NET) which in conjunction with the overall training strategy needs to be validated during system evaluation and test at the individual and collective level.

5.3.8.3 Requirements

ECSS-I-ST-30-10_1610017

- a. The IPS shall deliver the training needs analysis and the material resource availability before entry into service.

5.3.9 Information System

5.3.9.1 Objective

Identify, plan, resource, and acquire facilities, hardware, software, documentation, manpower and competences necessary for planning and management of mission critical information technology hardware and software systems.

5.3.9.2 Description

The Information System encompasses the facilities, hardware, software, documentation, manpower, and personnel that operate and support mission critical information technology hardware and software systems. As the primary end item, support equipment, and training devices increase in complexity, more and more software is being used.

The expense associated with the design and maintenance of software programs can be so high that one cannot afford not to manage this process effectively. It is standard practice to establish some form of IT resource working group to accomplish the necessary planning and management of IT resources support.

IT programs and software are often part of the technical data that specifies the current and future configuration baseline of the system necessary to develop safe and effective procedures for operation and maintenance of the system.

Software technical data comes in many forms to include, but not limited to, specifications, flow and logic diagrams, IT software configuration Item definitions, test descriptions, operating environments, user and maintenance manuals, and computer code.

5.3.9.3 Requirements

ECSS-I-ST-30-10_1610018

- a. The IPS function shall specify and verify the Information System (IS) requirements before entry into service.

5.3.10 Facilities / Infrastructures

5.3.10.1 Objective

Identify, plan, resource, and acquire facilities to enable training, maintenance and storage to maximize effectiveness of system operation and the logistic support segment at the lowest cost. Identify and prepare plans for the acquisition of facilities to enable responsive support for the system.

5.3.10.2 Description

The Facilities and Infrastructures consist of the permanent and semi-permanent real property assets intended to support a system, including studies to define types of facilities or facility improvements, location, space needs, environmental and security requirements, and equipment. It includes facilities for training, equipment storage, maintenance, supply storage, and so forth.

5.3.10.3 Requirements

ECSS-I-ST-30-10_1610019

- a. The IPS function shall specify and verify the Facilities and Infrastructures requirements before entry into service.

5.3.11 Packaging, Handling, Storage, Transportation (PHST)

5.3.11.1 Objective

Identify, plan, resource, and acquire PHST requirements to maximize availability and usability of the materiel to include support items whenever they are needed for training or mission.

5.3.11.2 Description

The combination of resources, processes, procedures, design, considerations, and methods intended to preserve, pack, handle and transport all system, equipment, and support items. They include 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).

5.3.11.3 Requirements

ECSS-I-ST-30-10_1610020

- a. The PHST requirements shall be consolidated with PSA requirements at early stage of system development.

NOTE It is good practice to perform the consolidation before the Preliminary Design Review (PDR).

5.3.12 Obsolescence

5.3.12.1 Objective

Obsolescence Management is used during the acquisition lifecycle as part of design, development, production and utilization of the space system and the support segment. The objective of Obsolescence Management is to minimize the cost and impact of obsolescence on the capability.

5.3.12.2 Description

The sophisticated technologies associated with space systems and acquisitions have a high risk of rapid obsolescence. The space industry has little influence over the removal of parts from the market and therefore their availability. Obsolescence can occur during all stages of the life of equipment, affecting hardware, software and support equipment equally. Obsolescence is inevitable, can be expensive and is not to be ignored. Timely planning reduces the impact and cost, so project teams use Obsolescence Management as an integral part of its consultation with the supplier during the phases of the acquisition lifecycle. This maximizes availability and optimizes costs throughout the space system life.

5.3.12.3 Requirements

ECSS-I-ST-30-10_1610021

- a. The IPS function shall specify and agree obsolescence strategy with Customer at early stage of system development

NOTE It is good practice to agree on the obsolescence strategy before the Preliminary design review (PDR).

5.3.13 Spares Management

5.3.13.1 Objective

Identify, plan, resource and implement management actions to acquire repair parts, spares, and all classes of supply to ensure the adequate equipment and capability are available to support the space system or maintenance when it is needed at the lowest possible cost.

5.3.13.2 Description

The Spare Management consists of all management actions, procedures, and techniques necessary to determine requirements to acquire, catalogue, receive, store, transfer, issue and dispose of spares, repair parts, and supplies to perform both preventive and corrective maintenance. This means having the right spares, repair parts, and all classes of supplies available, in the right quantities, at the right place, at the right time, at the right price. The process includes provisioning for initial support, as well as acquiring, distributing, and replenishing inventories.

5.3.13.3 Requirements

ECSS-I-ST-30-10_1610022

- a. The PSA function shall agree and issue a list of spares before validating the Design Solution and agreed with Customer.

NOTE The list of spares is an output of the PSA Plan that is described in Annex B.

Annex A (normative)

IPS Plan (IPSP) - DRD

A.1 DRD identification

A.1.1 Requirement identification and source document

This DRD is called from ECSS-I-ST-30-10 requirement 5.2.2c.

This call makes the complete content of this DRD normative. The information to be provided can be subject to tailoring by the customer as an integral part of the calling requirement/recommendation.

A.1.2 Purpose and objective

The IPS Plan specifies the purpose and provides a brief introduction to the Logistic Support Management. It covers all aspects of the latter by establishing the essential processes and procedures applicable to a planning, management and execution of an IPS programme.

The plan is produced according to the project phase in order to ensure that IPS activities are considered during the project life cycle. This is to demonstrate that IPS activities influence the system design process and considered in due time.

A.2 Expected response

A.2.1 Scope and content

<1> Introduction

ECSS-I-ST-30-10_1610023

- a. The IPSP shall specify the purpose, objective and the reason for its preparation.

<2> Applicable and reference documents

ECSS-I-ST-30-10_1610024

- a. The IPSP shall list the applicable and reference documents used in support of the generation of the document.

<3> Space system overview

ECSS-I-ST-30-10_1610025

- a. The IPSP shall contain a high-level description of the space system mission requirements to IPS system and its elements.

<4> IPS management

ECSS-I-ST-30-10_1610026

- a. The IPSP shall specify the objectives and constraints of the logistic support management process in conformance with the project management documents.

ECSS-I-ST-30-10_1610027

- b. The IPSP shall contain the following information:
1. A description of IPS management in terms of industrial organization,
 2. An introduction to the IPS team,
 3. An approach adopted to develop the IPS plan,
 4. A summary of the IPS concepts, or a reference to the document defining it, resulting from the analysis of the applicable documents, including:
 - (a) definition of all the logistics needs, to cover the mission definition,
 - (b) operation concept,
 - (c) definition of the overall Maintenance concept.

NOTE The Maintenance concept includes for example maintenance environment (hardware and software) and levels of maintenance (hardware and software) strategy.

ECSS-I-ST-30-10_1610028

- c. The IPSP shall include a description of the working relationship and interfaces among IPS elements with other disciplines, other project functions and organizations.

NOTE Examples of other disciplines include product assurance, RAMS, configuration management, system engineering.

ECSS-I-ST-30-10_1610029

- d. The IPSP shall include the schedule and the inter-dependency for all tasks in the IPS programme, integrating information from the IPSP of the elements of the support segment.

ECSS-I-ST-30-10_1610030

- e. The IPSP shall describe the risk mitigation strategy.

<5> IPS development, maintenance and improvement

ECSS-I-ST-30-10_1610031

- a. The IPSP shall specify the development process of the support segment, its reviews and the milestones.

ECSS-I-ST-30-10_1610032

- b. The IPSP shall specify the maintenance concept of the support segment throughout the entire project lifecycle.

ECSS-I-ST-30-10_1610033

- c. The IPSP shall specify the monitoring concept of the support segment by mean of the KPI's.

ECSS-I-ST-30-10_1610034

- d. The IPSP shall specify how to analyse the data obtained through monitoring in order to improve the support segment throughout its lifecycle.

<6> **IPS implementation**

ECSS-I-ST-30-10_1610035

- a. The IPSP shall specify the covered logistic activities to be performed and their implementation.

ECSS-I-ST-30-10_1610036

- b. The IPSP shall identify the resources necessary to perform the logistic activities and their mapping into the project's WBS.

<7> **Product Support Analysis Plan (PSAP)**

ECSS-I-ST-30-10_1610037

- a. The IPSP shall include or refer to the PSAP in conformance with Annex B.

<8> **IPS information management**

ECSS-I-ST-30-10_1610038

- a. The IPSP shall specify how information is managed within the IPS programme.

ECSS-I-ST-30-10_1610039

- b. The IPSP shall describe how information needs are mapped into the information recording.

ECSS-I-ST-30-10_1610040

- c. The IPSP shall specify the information security measures

ECSS-I-ST-30-10_1610041

- d. The IPSP shall describe the measures to ensure the data quality, their integrity and consistency.

<9> **Supplier and lower tier supplier premises**

ECSS-I-ST-30-10_1610042

- a. The IPSP shall describe the method to control and specify IPS-related activities and requirements at suppliers' and lower tier suppliers' premises.

A.2.2 Special remarks

None.

Annex B (normative)

Product Support and Services Analysis Plan (PSAP) - DRD

B.1 DRD identification

B.1.1 Requirement identification and source document

This DRD is called from ECSS-I-ST-30-10, requirement 5.3.2.3a.

This call makes the complete content of this DRD normative. The information to be provided can be subject to tailoring by the customer as an integral part of the calling requirement/recommendation.

B.1.2 Purpose and objective

The Product Support Analysis Plan (PSAP) establishes the essential information, processes and procedures to initiate and maintain the PSA programme and identifies effective communications and data exchange procedures in the PSA process and related IPS disciplines.

PSAP is considered to be the steering document for those activities necessary for planning, management and execution of a PSA programme including the underlying Information Management.

B.2 Expected response

B.2.1 Scope and content

<1> Introduction

ECSS-I-ST-30-10_1610043

- a. The PSAP shall contain a description of the purpose, objective and the reason for its preparation.

<2> Applicable and reference documents

ECSS-I-ST-30-10_1610044

- a. The PSAP shall list the applicable and reference documents used in support of the generation of the PSAP.

<3> Product support Analysis Programme

ECSS-I-ST-30-10_1610045

- a. The PSAP shall describe the Product Support Analysis programme and its implementation.

ECSS-I-ST-30-10_1610046

- b. The PSAP shall describe the management structure and authorities applicable to PSA, including the description of the interfaces with other IPS and non-IPS disciplines.

<4> Logistic support analysis tasks

ECSS-I-ST-30-10_1610047

- a. The PSAP shall specify the main PSA tasks and how these tasks are performed to cover the following:

1. Programme planning and control
2. Mission and support segment definition
3. Preparation and evaluation of alternatives for the support segment
4. Determination of the logistic support requirements
5. Logistic support assessment.

<5> Logistic data requirements and development

ECSS-I-ST-30-10_1610048

- a. The PSAP shall describe the logistic data development, data documentation and data exchange.

ECSS-I-ST-30-10_1610049

- b. The PSAP shall provide the following:

1. Scheme for uniquely identification of Logistic Data Records
2. Procedures for updating and validating PSA data, including configuration control procedures
3. Description of the data collection system to be used to document, disseminate and control PSA and related design data.

<6> Management of logistic information

ECSS-I-ST-30-10_1610050

- a. The PSAP shall describe or make reference to the IPSP about the information management within the IPS programme.

ECSS-I-ST-30-10_1610051

- b. The PSAP shall describe or make reference to the IPSP about the mapping of information needs into the envisaged information recording.

ECSS-I-ST-30-10_1610052

- c. The PSAP shall describe or make reference to the IPSP about the information security measures.

ECSS-I-ST-30-10_1610053

- d. The PSAP shall describe or make reference to the IPSP about the measures to ensure the data quality, their integrity and consistency.

<7> **Planning and schedule**

ECSS-I-ST-30-10_1610054

- a. The PSAP shall contain the planning and the scheduling for each PSA iteration during the project phases after phase A.

ECSS-I-ST-30-10_1610055

- b. The PSAP shall identify all PSA tasks, schedule relationship with other IPS programme requirements and associated system engineering activities.

Annex C (informative)

IPS documents delivery per Design review

Table C-1 provides the information concerning the expected delivery of IPS documents per review.

NOTE This table constitutes a first indication for the IPS data package content at various reviews. The full content of such data package is established as part of the business agreement, which also defines the delivery of the document between reviews.

The various crosses in a row indicate the increased levels of maturity progressively expected versus reviews. The last cross in a row indicates that at that review the document is expected to be completed and finalized.

NOTE All the documents called out by the Standard, even when not marked as deliverables in the Table C-1, are made available and maintained under configuration management as per ECSS-M-ST-40.

Table C-1: IPS Documents Delivery per Review

Document Title	Phase					
	A	B	C	D	E	F
IPS Concept*	IPS preliminary concept definition	IPS concept validated	IPS concept verified	-	-	-
IPSP (Annex A)	-	IPS preliminary plan	IPS approved plan	IPS updated plan	IPS updated plan	IPS updated plan
PSAP (Annex B)	-	PSAP preliminary plan	PSAP approved plan	PSAP updated plan	PSAP updated plan	PSAP updated plan
PSA Report	-	Preliminary Report	Validated report	Updated report	Updated report	Updated report
PSA Record database	-	Record database template	Record database delivery	Record database updated	Record database updated	Record database updated

* The IPS Concept can be included in the IPSP

Bibliography

ECSS-S-ST-00	ECSS system – Description, implementation and general requirements
ECSS-E-ST-10	Space engineering - System engineering general requirements
ECSS-E-ST-10-03	Space engineering – Testing
ECSS-E-ST-10-11	Space engineering – Human factors engineering
ECSS-E-ST-10-24	Space engineering - Interfaces management
ECSS-E-ST-70	Space engineering - Ground systems and operations
ECSS-M-ST-10	Space project management - Project planning and implementation
ECSS-M-ST-40	Space project management - Configuration and information management
ECSS-M-ST-80	Space project management - Risk management
ECSS-Q-ST-10	Space product assurance - Product assurance management
ECSS-Q-ST-20	Space product assurance - Quality assurance
ECSS-Q-ST-20-08	Space product assurance - Storage, handling and transportation of a spacecraft hardware
ECSS-Q-ST-30	Space product assurance - Dependability
ECSS-Q-ST-40	Space product assurance - Safety
ECSS-Q-ST-70	Space product assurance - Materials, mechanical parts and processes
ECSS-Q-HB-70-23	Space product assurance - Materials, mechanical parts and processes obsolescence management handbook
ECSS-U-ST-20	Space sustainability – Planetary protection

Additional Literature on IPS domain:

Logistic Support Analysis Handbook, James V. Jones, 1989

Systems Engineering and Analysis, S. Blanchard, W. Fabrycky, 2006