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Space Project Management

Project Breakdown Structures

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Foreword

This standard is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications. 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 must be accomplished, rather than in terms of how to organise and perform the necessary work. This allows existing organisational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this standard takes into account the existing ISO 9000 family of documents.

This standard has been prepared by the ECSS Management Standards Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board.

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Introduction

As a part of the ECSS-Management standards, this standard gives specific requirements about the project breakdown structures for space projects.

The content of this ECSS standard is coherent with the widely known and used processes for preparing and managing the different structures of projects in many fields of activity throughout the world.

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Scope

The present document, 'Project Breakdown Structures', is part of a collection of ECSS standards belonging to the management branch.

In order to create the reference system for project management necessary for implementation of a project and ensure consistency, the project shall be broken down into a unique, orderly and exhaustive manner, to allow unambiguous identification of the associated products and models, as well as the tasks and resources necessary.

The aim of this ECSS standard is to define the principles to be respected for setting up, using and adapting the breakdown structures and implementing them into a project.

The requirements specified herein apply to and affect the supplier and customer at all levels, when the capability to design and supply conforming product needs to be demonstrated. These requirements, as tailored in the related Project Requirements Document, are applicable to any actor of a Space Project.

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References

2.1 Normative References

This ECSS Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these apply to this ECSS Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

This ECSS standard belongs to the Project Management series called up by the Space Project Management standard ECSS-M-00. The standards listed below shall be considered in association with this document.

- ECSS-M-20 Project Organisation.
- ECSS-M-30 Project Phasing and Planning.
- ECSS-M-40 Configuration Management.
- ECSS-M-50 Information/Documentation Management.
- ECSS-M-60 Cost and Schedule Management.
- ECSS-M-70 Integrated Logistic Support.

The applicable revision index shall be that valid at the time the Project Requirements Documents are created.

2.2 Informative References

- RG Aéro 00040 General Recommendation for the Project Management Specification.
- CNES IM-20-00 Organigramme des Tâches.
- MR-P/01 Management Requirements on Industrial Contracts. (supersedes ESA PC/941904/TD/510)
- MIL-STD-881 Work Breakdown Structure for Defense Materiel Items.

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Definitions and Abbreviations

3.1 Definitions

For the purposes of this standard, the definitions given in ECSS-P-001 Issue 1 apply. In particular, it should be noted that the following terms have a specific definition for use in ECSS standards.

Business Agreement
Configuration
Configuration item
Contract
Contractor
Cost
Customer
Data
Document
Documentation
Function or Functional Tree
Implementation Document
Industrial Organisation
Model
Network
Phase (Project Phase)
Process
Product Tree
Project
Project Requirements Document
Purchaser
Resource

Space Element
Space System
Specification
Supplier
System
Task
Technical Specification
Work Breakdown Structure
Work Package
Work Package Description

The following terms and definitions are specific to this standard and shall be applied.

Interfaces allocation: See sub-clause 4.6.4.

“Responsibility Structure: The organisation, describing the functional responsibility structure employed for performing the work.”

“Task of apportioned type: Task where related effort is in direct proportion to product oriented Work Packages.”

“Task of level of effort type: Task where related effort cannot be directly associated with any product but only with the total project or its phase.”

“Task of product type: Task associated with a readily measurable output/product.”

3.2 Abbreviations

The following abbreviations are defined and used within this standard.

Abbreviation	Meaning
ECSS:	European Cooperation for Space Standardization
WBS:	Work Breakdown Structure
WP:	Work Package

Principles for Creating the Project Breakdown Structures

4.1 Basic Principles

The creation of the project breakdown structures will be derived from the first level customer's requirements, starting from the functional requirements to be built into the system. These can be presented in the form of a Function Tree. Then the process will go through Product Tree elaboration, which is the exhaustive definition of the system elements. Delineating the tasks needed to develop and produce an element will lead to the Work Breakdown Structure. The identification of cost categories enables the establishment of the Cost Breakdown Structure. The allocation of the WBS to the Industrial Organisation will result in the Business Agreement Structure and Interface Allocation. The Configuration Item Tree, related to the Product Tree, is defined and used in conjunction with Configuration Management.

The project breakdown structures provide the basis for:

- creating a common language between the various participants, attributing unique item identifications and definitions, as well as the associated tasks and resources;
- unambiguously identifying the responsibilities. The Responsibility Structure is the development of the organisation, describing the functional responsibility structure employed for performing the work;
- co-ordinating and optimising the necessary resources and performing the tasks;
- enabling a structured definition, production and verification of documents for:
 - identification of all the tasks to be performed,
 - identification of all the interfaces and their management,
 - effective management of the configuration,
 - management of changes,
 - management of risks.

The established trees will be characterised by:

- a summit (zero level)
- levels of breakdown into elements.

Breaking the project down into manageable elements, including interfaces, facilitates effective risk management.

4.2 Function Tree

The Function Tree is the structure resulting from breakdown of the system performances into functions.

Each function can be decomposed into subfunctions, so making a 'tree', independent of the type of products involved.

The 'function' approach is particularly to be applied during project start-up or at least as far as the system definition phase – phases A and B (as defined in ECSS-M-30).

The Function Tree leads to the Product Tree, by translating functions into specifiable hardware and software products.

4.3 Product Tree

The Product Tree is the breakdown of the system into successive levels of partial hardware and software products, based on the functions identified.

The 'product' approach will result in the breakdown of the system (i.e. the one that performs the intended functions) into hardware and/or software elements.

The Product Tree is the basis for the Work Breakdown Structure and is agreed between the actors prior to business agreement and is baselined at business agreement.

The Product Tree creation shall start after the functional structure of the final product has been identified.

The products to be identified in the Product Tree shall, as a minimum, include:

- items submitted to customer configuration control,
- items that are the subject of a Technical Specification.

Each supplier shall then complete the Product Tree at his own level for the products under his responsibility.

4.4 Identification of Models: Model Matrix

The Implementation Document relative to Project Phasing and Planning is a Development Plan (cf. ECSS-M-30) giving the model philosophy applying to the various products making up the system.

In relation to the Product Tree, therefore, an additional breakdown is obtained depending on the types of models used. The model philosophy can be expressed in the form of a matrix defining, for each element on the Product Tree, the various models to be applied.

4.5 Work Breakdown Structure (WBS)

The WBS is the principal structure used in managing a project. The WBS defines the scope of the work. It is based on the analysis of the tasks needed to achieve the products identified in the Product Tree.

It is:

- the basis for identifying the necessary resources,
- the basis for comparing bids and business agreement negotiations,
- the definition of the Work Packages necessary for project management,

- the basis for project schedule and cost planning and management,
- the definition of all the technical interfaces and other relationships within the project during the overall life cycle,
- a support for the development of the documentation and specifications hierarchies,

It is used as an aid to configuration checking.

4.5.1 Determining Tasks, Work Packages and Associated Resources

For each element on the Function Tree and/or Product Tree, it is necessary to determine which tasks have to be performed and the required resources. These tasks are identified by one or more Work Breakdown Structure elements. Typically the lowest level WBS elements are designated as Work Packages (WP) and shall be described in a Work Package Description. The actual level of control will be agreed between the actors at the time of business agreement.

A Work Package shall meet the following conditions; it shall:

- be measurable and manageable in its scope to allow planning, monitoring, and controlling of progress,
- be allocated to a single supervisor (several Work Packages can be allocated to a single supervisor),
- be defined by a 'Work Package Description',
- result in supply (of products or documents), corresponding to accomplishment of the task of the Work Package,
- include identified 'inputs' and 'outputs', forming interfaces with other tasks or Work Packages,
- have clearly identified planning constraints (duration, 'starting' event, 'finishing' event, 'intermediate' events),
- be uniquely identified according to the identification rules employed for the Work Breakdown Structure.

The work of each supplier shall be explicitly identified in the Work Breakdown Structure by at least one Work Package.

4.5.2 Identification of the WBS Elements

Each element of the Work Breakdown Structure shall be identified in a unique manner. The rules for identification shall be clearly defined and specified by the first level customer; they shall be used in this way by all the project participants.

4.6 Other Structures

4.6.1 Cost Breakdown Structure

The Cost Breakdown Structure defines cost elements in terms of agreed cost categories as defined in ECSS-M-60 to be used for cost control, and provides the framework for cost summarization.

Cost collection and analysis shall be performed according to ECSS-M-60 cost categories across the whole project.

Where ECSS-M-60 cost categories alone are not sufficient, they may be extended to include the contractor own categories, as agreed by the purchaser.

4.6.2 Business Agreement Structure

The Business Agreement Structure represents the hierarchy of business agreements of the project. Work Packages shall be related directly to business agreements in the Business Agreement Structure. This also facilitates financial control from a contractual viewpoint.

4.6.3 Configuration Item Tree

The Configuration Item Tree is a subset of the Product Tree in which only Configuration Items appear.

4.6.4 Interface allocation

Interfaces exist between products, functions and tasks, and have to be defined at least between the actors.

Internal interfaces are the ones existing between elements of the Product Tree, and the Work Breakdown Structure shall be used to identify these. All the other interfaces are called external ones. Formal control shall be established for all the interfaces that are business agreement boundaries.

Business Agreement Structure shall be used to allocate interface responsibilities. Rules of control are part of the ECSS-M-40 standard: 'Configuration Management'.

4.7 Work Package Description

The Work Package contents shall be described in a formal way, which is the Work Package Description. It defines the scope of supply and the outgoing results, as well as input constraints and descriptions of the tasks to be accomplished. The Work Package Description shall address at the minimum the following subjects:

- WP title
- unique identification of the WP (for each phase of the project) per the previous identification rules
- supplier or entity in charge of the WP performance
- supervisor's name
- supplier's country (when politico/economic constraints exist)
- product to which the tasks of the WP are allocated
- project phase
- general description of the objectives of the WP
- detailed description of the tasks giving cost categories (cf. ECSS-M-60) and types of task (product, level of effort, apportioned types)
- list of the inputs necessary to achieve the tasks
- links with other tasks needed to build the schedule network as defined in ECSS-M-60
- list of constraints, requirements, standards, regulations
- description of the expected results
- list of deliverables
- start event identification including date
- end event identification including date

The excluded tasks should be identified.

Depending on the financial aspect of the contract (refer to ECSS-M-60), the Work Package Description can be under configuration management.

Requirements

In this ECSS standard, in order to facilitate reading and traceability, the requirements are listed according to numbered topics. Each numbered requirement is composed of a general wording (**bold text**), and often by an explanatory text attached to the general requirement and an expected output (text in *italics*).

In applying the principles defined in Clause 4, the following requirements shall be fulfilled.

5.1 Product Tree

5.1.1

In collaboration with the customer, each supplier shall develop the Product Tree according to the principles given in Clause 4.3.

AIM: Define the structure of the system in terms of its constituents (components, subsystems, equipment assemblies etc.)

The first level of the tree (and other levels if required) shall be defined by the customer.

The supplier will develop the additional levels.

5.1.2

The Product Tree shall be subject to customer approval.

AIM: Provide an agreed working base between the customer and all the actors.

EXPECTED OUTPUT: *A Product Tree agreed by the customer.*

5.1.3

The approved Product Tree shall be maintained up-to-date under configuration control.

AIM: Ensure that all the modifications in services and/or in requirements agreed between the actors are taken into account.

Applicable configuration control rules are as per ECSS-M-40.

5.2 Model Matrix

5.2.1

The supplier shall establish a model matrix describing the applicability of models to each element on the Product Tree. This matrix is submitted for the customer's approval.

AIM: Identify models in relation to the Product Tree.

The model matrix shall be compatible with the Development Plan.

EXPECTED OUTPUT: *Model matrix agreed by the customer.*

5.2.2

The model matrix shall be updated throughout the life of the project.

AIM: This will permit changes in the Development Plan to be traced.

The supplier shall take into account the modifications in services and/or in requirements agreed between the actors; these shall be verified according to business agreement rules.

EXPECTED OUTPUT: *Current valid model matrix.*

5.3 Work Breakdown Structure

5.3.1

The supplier shall develop a Work Breakdown Structure for the total scope of his participation or business agreement and the applicable elements necessary to implement the project (based on the agreed Product Tree).

AIM: Establish the principal structure for managing the project.

5.3.2

The supplier shall submit the Work Breakdown Structure to the customer for agreement.

AIM: Provide an agreed working basis between the customer and all the other actors.

EXPECTED OUTPUT: *WBS agreed between the actors at the time of business agreement.*

5.3.3

The supplier shall identify the level of control on the Work Breakdown Structure and agree it with the customer for inclusion in the business agreement.

AIM: Provide a level of control agreed by the customer.

5.3.4

The supplier shall maintain the agreed WBS up-to-date.

AIM: Ensure that all the modifications in services and/or in requirements agreed between the actors are taken into account.

The supplier shall take into account the modifications in services and/or in requirements agreed between the actors; these shall be verified according to business agreement rules (modification of clauses, riders etc.).

5.3.5

Each Work Package identifier shall be unique.

AIM: Provide a unique identification of the Work Package.

5.4 Other Structures

5.4.1

The contractor shall implement a Cost Breakdown Structure.

AIM: Provide the framework for cost summarization.

5.4.2

The supplier shall provide a Business Agreement Structure associated with the WBS.

AIM: Facilitate financial control from a contractual viewpoint.

5.4.3

The supplier shall provide a Configuration Item Tree in accordance with the Product Tree.

AIM: Provide a basis for configuration management.

5.4.4

Every customer shall identify and allocate interfaces responsibilities to his suppliers.

AIM: Provide a framework for interface management.

5.5 Work Package Description

5.5.1

The supplier shall identify the content of each Work Package.

AIM: Found a common basis for understanding the definitions of the tasks to be performed, the identification of responsibilities.

EXPECTED OUTPUT: *Set of Work Package Descriptions agreed between the actors.*