
**Space systems — Unmanned mission
operations concepts — Guidelines for
defining and assessing concept products**

*Systèmes spatiaux — Concept d'opérations de mission non habitée —
Lignes directrices pour la définition et l'évaluation des produits du
concept*

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Foreword

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Introduction

This International Standard defines the steps required to develop a comprehensive space system mission operations concept for the development and operations after the boost phase of a space mission is completed. Effective concept development relies on a development process that runs concurrently with the mission and flight element development efforts, balancing performance, cost, and risk issues. This International Standard is also applicable to the mission operations support to the pre-launch and launch phases of the mission using the mission operations systems.

Standard products enable industry to develop commercial off-the-shelf tools for developing a space systems mission operations concept. This International Standard is specifically tailored for unmanned space missions and may be of partial use for human flight mission operations concepts. Users of this International Standard include project managers, operations personnel, flight element engineers, and operations facility personnel who are responsible for developing and integrating the mission operations system. This International Standard lists items to be considered and defines the contents of a mission operations concept for space systems. This International Standard is applicable for the flow of data from the integration site and/or the launch pad to the operations centre and users, but does not include the items needed for a launch operations concept.

A space systems mission operations concept is prepared in parallel with the mission concept and flight element design and contains increasing levels of detail as the mission matures. During the early study phases, the operations concept is a high-level overview and contains many assumptions. As the mission operations concept evolves and advances to the approval stage, the content becomes more detailed with fewer documented assumptions. The space systems mission operations concept does not detail a mission's development or operational costs, but is the basis of cost estimation. Developing a space system mission operations concept early in the study phase helps to minimize life-cycle costs, make acceptable risk trades, and to determine the effectiveness of using existing system capabilities. The mission operations documentation and development costs are also reduced as all the documents are referenced to a specific operations concept rather than a set of high-level project documents. The earlier the space systems mission operations concept is developed, the more leverage there is for influencing the operability of the entire mission system, including the flight element. This International Standard establishes early in the project's development cycle a conceptual view of the mission data system which allows for

- a) early understanding of data and command transfer between sensors and end users,
- b) testing operational capabilities, and
- c) training personnel as the mission operation system matures.

The development of the space system mission operations concept is most beneficial when done in parallel with the flight element design, thus creating a tight coupling between the two efforts performing trade studies in the areas of cost, performance and risks.

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Space systems — Unmanned mission operations concepts — Guidelines for defining and assessing concept products

1 Scope

This International Standard gives guidelines for areas to be addressed and defines the products that are to be generated to develop a space systems mission operations concept. This International Standard enables the generation of standard space systems mission operations concept products produced either by an industry, a government agency, or by a university.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1

mission data system

hardware and software located both on the space platform and in the ground support systems that provide the transport mechanisms for mission data together with the information system that properly configures and controls this hardware and software

2.2

mission operations concept

description, in operator and user terms, of the operational attributes of a mission's flight and ground elements

2.3

mission operations system

MOS

system consisting of mission data system and the operations organization

2.4

operations organization

people and procedures that control the flight element, including payload, and process the mission data and information

2.5

product

process, document, software tool, workstation, facility, procedure, or training aid that the operations organization develops to support their operation of the space system

2.6

trade study

report on a systematic examination of multiple factors that influence the economic and technical success of a project

3 Requirements for the operations concept

3.1 General

The space systems mission operations concept is a result of a co-operative effort of the various project systems:

- flight element,
- ground support equipment system,
- mission operations system,
- launch vehicle, etc.

Its development is closely coupled and is implemented in parallel with the development of the other project systems to produce a consistent and integrated mission operations concept. The space system's mission operations concept specifies design details and emphasises the way a mission is operated. It describes the operational characteristics of the space elements being controlled. The space system's mission operations concept consists of mission documentation, constraints, and characteristics. It also contains the specific required mission operations products, including operational scenarios, time lines, processes performed by personnel, hardware and software processes, derived requirements, contingency scenarios, and conflict resolution processes. It also may contain a technology plan. End-user data products are specified and, depending on the mission, may be in various forms such as analogue, digital, and physical (e.g. sample return) data products. Another end user data product received from the mission operations system should be a lessons-learned report to help future missions.

A list of elements to be considered, defined, and generated when developing a space system mission operations concept is given in 3.2. Each item of the list is described further in 3.3. This guidance specifies the broadest scope of possible mission operations, tasks, issues, and products to facilitate mission managers and engineers in assessing the full scope of their mission operations concept.

3.2 Mission operations concept guidance

3.2.1 Inputs

Define or make assumptions for the following inputs to the concept:

- a) mission scope, objectives, and requirements on operations;
- b) mission description and science characteristics;
- c) mission environments;
- d) end-user data products;
- e) mission philosophies, strategies, and tactics;
- f) programmatic and operational constraints;
- g) data relay capabilities (space-to-space, space-to-ground);
- h) ground system capabilities and characteristics;
- i) customer and users identified;
- j) relationships with other missions and/or programs;
- k) external dependencies with other agencies or companies.

3.2.2 Mission element characteristics

Describe the following mission element characteristics:

- a) space systems capabilities and characteristics;
- b) payload capabilities and characteristics.

3.2.3 Mission operations processes

Identify and characterize the following mission operations processes:

- a) establishment of a list of top-level operations processes that shall be performed;
- b) descriptions of uplink processes:
 - 1) user request planning;
 - 2) space system resources to be managed by the ground system;
 - 3) space system constraints to be enforced by the ground system;
 - 4) space system maintenance activities to be managed by mission operation system;
 - 5) procedure for processing user requests;
 - 6) process for scheduling data acquisition services;
 - 7) integration of activity requests;
 - 8) method for validating commands (if necessary) prior to uplink;
 - 9) method for converting integrated requests to executable commands;
 - 10) method for transmitting command files to the space system and/or payload;
 - 11) verification process for command execution or command storage;
 - 12) method for receipt of command files by the spacecraft and/or payload and for storage or execution of commands;
 - 13) on-board execution and processing of commands or rules;
 - 14) method for archiving command files;
 - 15) flight software maintenance process;
- c) descriptions of downlink processes:
 - 1) payload-to-user processes and interfaces;
 - 2) transmission of data from:
 - i) payload instruments and flight element subsystems to onboard storage;
 - ii) onboard storage area to the space system transmitter;
 - iii) space system transmitter to the storage in the ground database (Level 0 processing);