Benefits of Standardization in National Space Activities: ASI and the European Cooperation for Space Standardization (ECSS)

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ASI Technical Authority in ECSS

Content

- The Italian Space Agency
- The Space Sector specificity
- ECSS: The European space standard
- Space Project Management branch
- Case studies:
  - Jiram instrument on NASA Juno mission
  - Simbio-sys instrument on ESA Bepi Colombo mission
- Conclusions

The Italian Space Agency

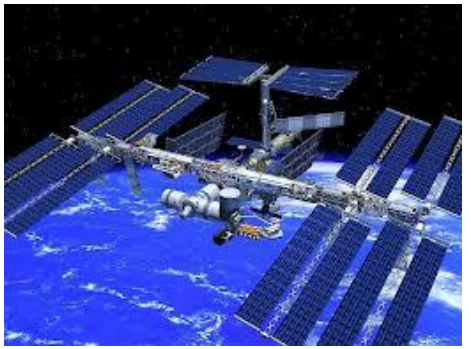
- The Italian Space Agency, established by Law 186/1988, is an italian government agency.
- Mission (as decree 128/2003):

".. To promote, develop and disseminate scientific research, technological innovation and innovative services in the space and aerospace field, pursuing excellence goals, coordinating and managing national projects and the Italian participation in European and international projects, sustaining the competitiveness of Italian industry… »

The Italian Space Agency:
The Space programs

A space program is an endeavor, placed in the framework of scientific and industrial applications, enabled only through huge investments in research and development, with very specific characteristics:

- high financial dimension,
- considerable duration,
- high rate of innovation,
- international dimension,
- significantly level of technological risk.



The Italian Space Agency:
The government investments

Despite the growth of the “commercial” space activities, the main drivers for the development of activities in the space field, the research and the resulting innovation, are promoted through public investment because only the government capacity is able to support these investments in terms of costs and risks.

In this context, the value and function of ASI is given by the technical scientific and professional expertise, that the Agency issues in the management of complex space projects, characterized by high rate of innovation and considerable technological risk.

ECSS

The European space standard

- The distinctive feature of space programs (international dimension, large number of interfaces, significant levels of technological risk) stimulate the value and need, since ASI foundation, for a set of consistent standard rules recognised and accepted for use by the European space community.
- ASI, ESA, European Space Agencies and Industries replaced the multiplicity of project “good practice" and requirements by a single, coherent, recognized, accepted and committed to be used (by the European space community) system of standards.

→ **ECSS, European Cooperation for Space Standardization**

Objectives

Increase the effectiveness of all space programmes in Europe through the application of a single, integrated set of Standards and Requirements from which all generic requirements of future space projects can be derived

- facilitate clear and unambiguous communication between all parties involved, in a form suitable for reference or quotation in legally binding documents,
- improve the quality and safety of space projects and products,
- reduce risk and guarantee interoperability and interface compatibility by applying proved and recognized requirements and methods,
- allow industry to be ready to meet these requirements.

Improve the competiveness of the European Space industry

ECSS

Membership

European Space Agency

esa

European Industry, represented by Eurospace

EUROSPACE

Some organization have an Observer role on ECSS e.g. EUMETSAT, CEN

Main European National Space Agencies

agenzia spaziale italiana

BNSC BRITISH NATIONAL SPACE CENTRE

cnes CENTRE NATIONAL D'ETUDES SPATIALES

NIVR

DLR

Norsk Romsenter NORWEGIAN SPACE CENTRE

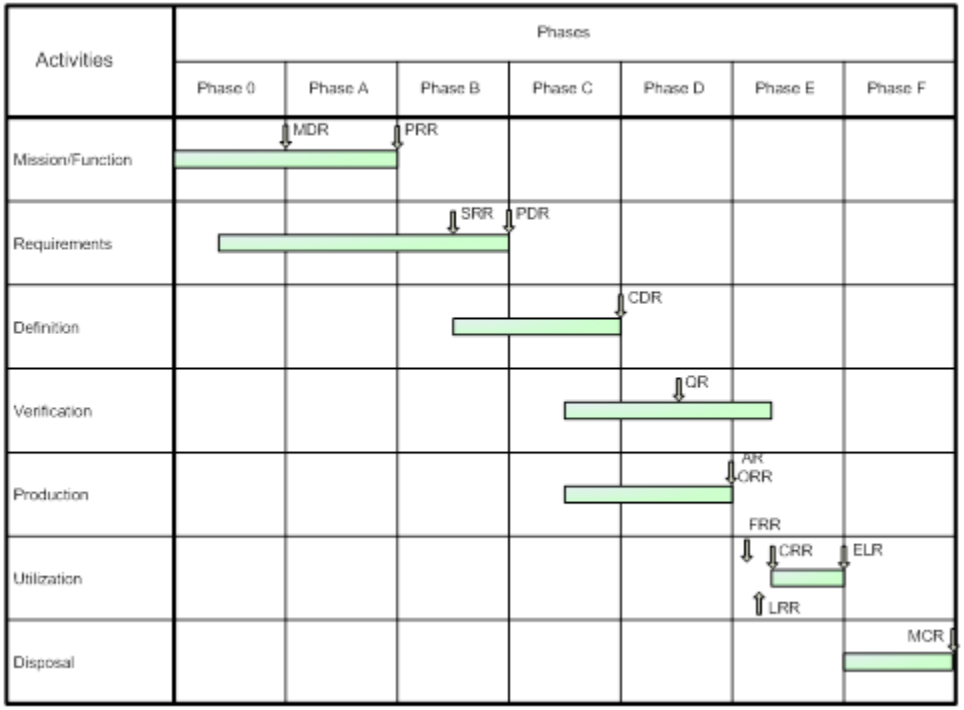
ECSS

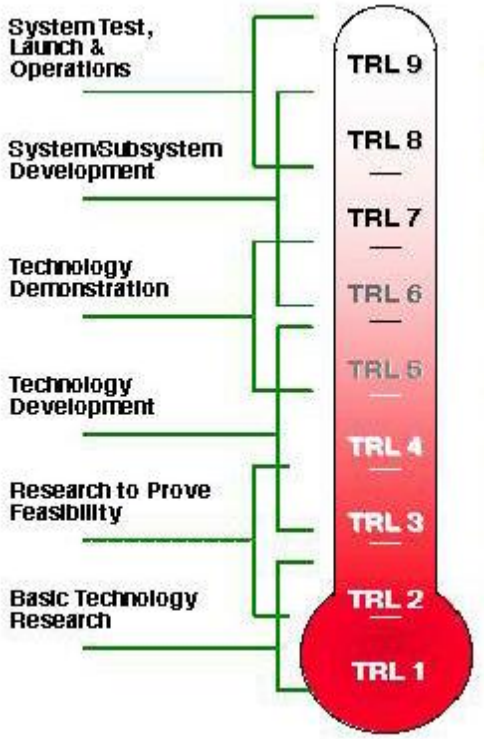
Guidelines

- Driven by a partnership of industries and space agencies
- Based on consensus amongst its members → standard is recognised and accepted by all potential European space project actors (customer or supplier, government or Industry)
- Systematically feed back the experience from past programmes, projects and other appropriate sources into the ECSS System
- Improve industrial efficiency and competitiveness through using an integrated set of management, engineering and product assurance standards which can be tailored to the technical, cost, schedule, programmatic and economic characteristics of the space programmes
- Facilitate standardization of contract requirements in customer/supplier relations throughout all levels of space activities → Call-up of ECSS as applicable standard in contracts has become a recognized practice in European space business.
- Have flexibility through tailoring

The European Space community recognizes ECSS as the single developing body for European Space standards, and the source of requirements for its Space activities.

Space Project Management Building Blocks

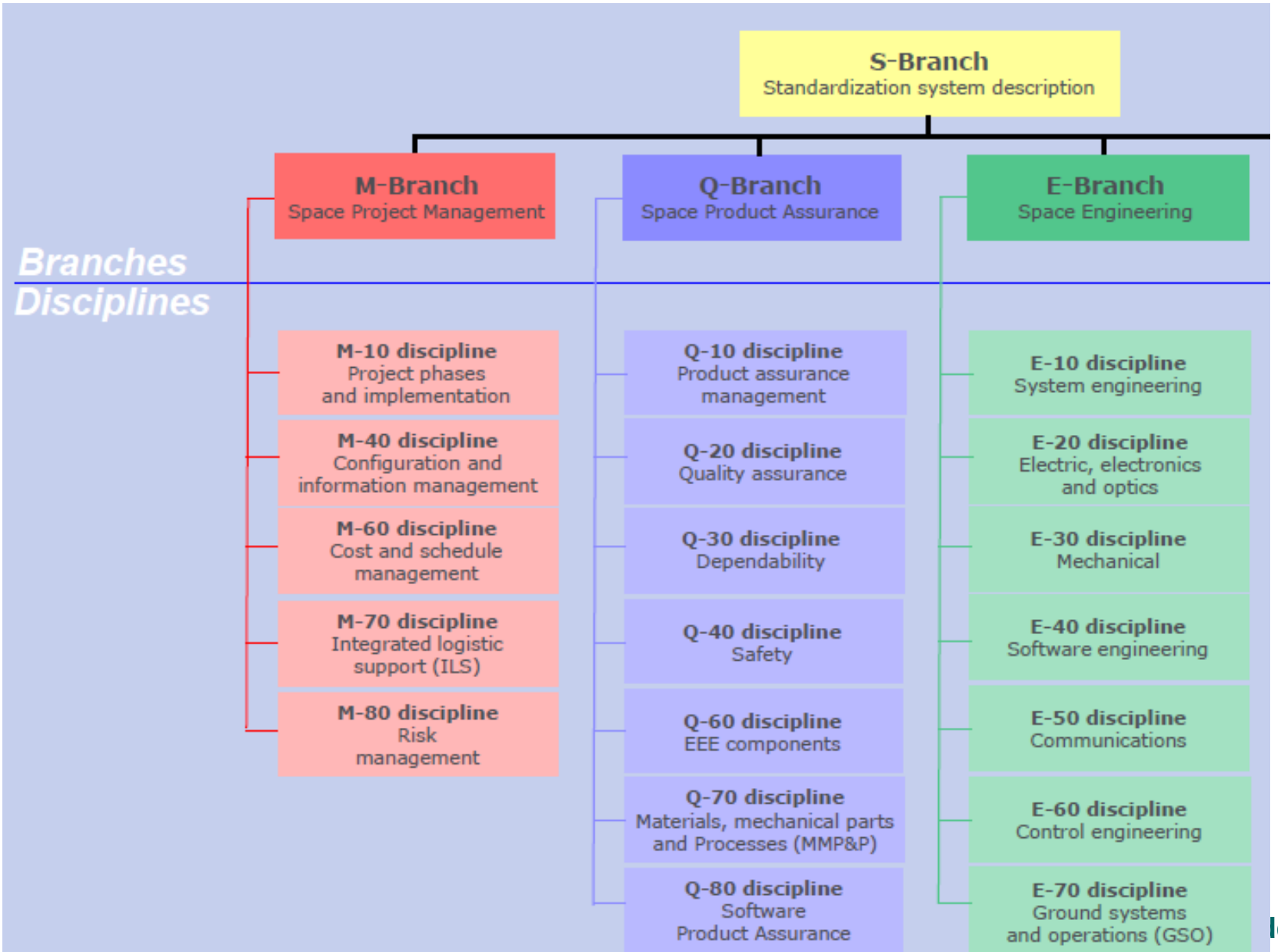




Project life cycle/phases describe the maturity of the System and are closely linked to product Technology Readiness Level!

ECSS

Tree of standards



ECSS

Anatomy of the standard

1. Change log, ToC & [Introduction]
2. Scope
   Clearly and concise identification of the coverage and the applicability of the standard
3. Normative references
   Listing ONLY documents referenced from requirements.
4. Terms, definitions and abbreviations
5. [Principles and/or background]
   Containing ONLY informative/guidance material
6. Requirements
   Containing the normative provisions.
   It may contain some NOTES and some few guidance sub-clauses with only guidance material.
7. [More requirements…]

A, B, … [Annexes]
First Normative annexes (DRDs), and then Informative annexes]

Bibliography
Listing the documents referenced from the informative/guidance text

Document delivery (Informative)

- ✓ Identification of deliverable (DRDS) with respect to major project milestones

DRDs description

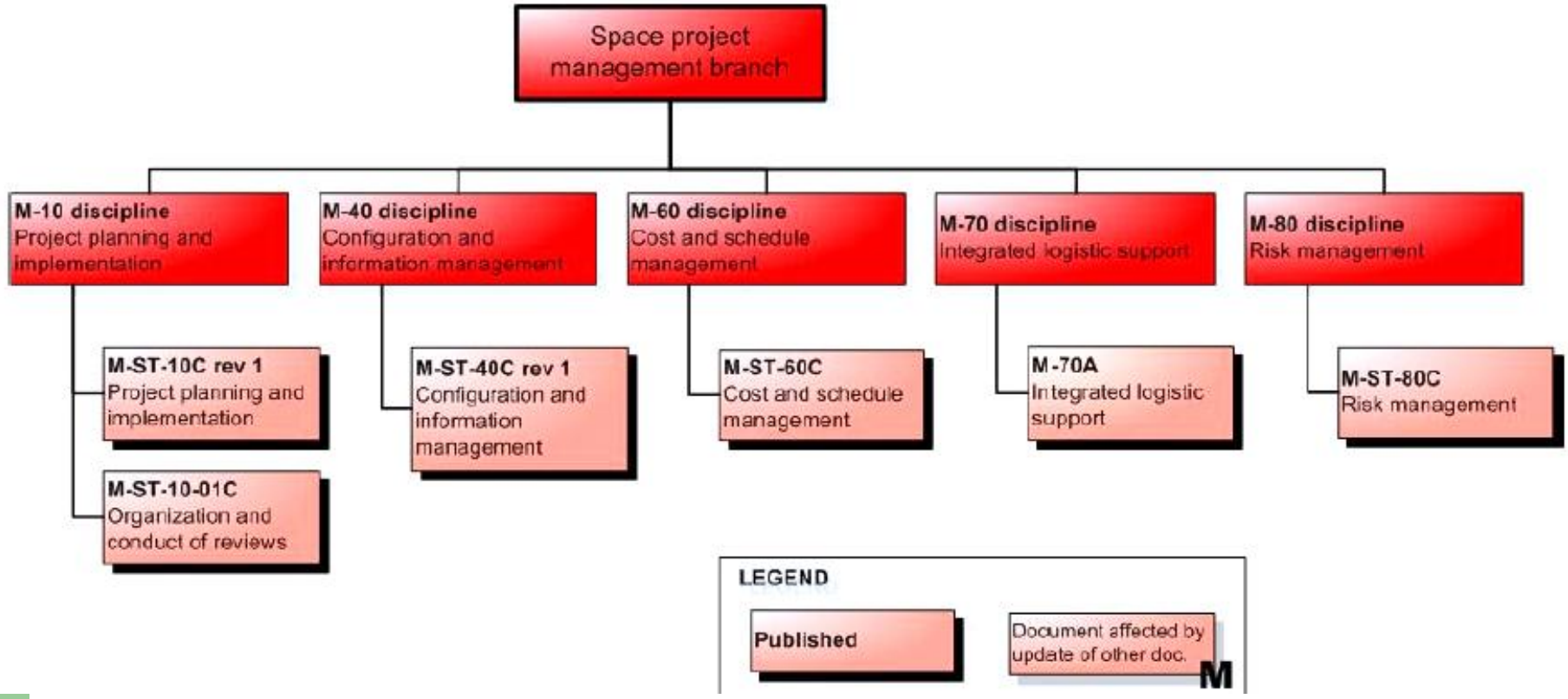
- ✓ DRDs are Normative Annexes, i.e. they are requirements
- ✓ They specify the content of a deliverable document
- ✓ They do not specify the format, only the information to be provided.
- ✓ They optionally identify if the content of the deliverable may be merged with another one

ECSS

M – management

- ECSS standards focus mainly on “WHAT” is required rather than “HOW” to achieve (Some lower level E or Q-standards specify “How” for processes, e.g. soldering)
- Common structure and format of standards across the different branches/disciplines
- Standard identification for normative statements as follows:
  - Requirements, with SHALL
  - Recommendations, with SHOULD
  - Permissions, with MAY
- Descriptive and normative statements are separated
- Only short descriptive texts to support understanding of the requirements
- Documents produced in response to requirements are specified in Document Requirements Descriptions (DRDs)

ECSS
Management tree



M – management

- Current set of documents available comprises: 114 standards (of which 6 are M standards)
- Project Management is intended as an integrated process for documenting, monitoring, and controlling complex projects from conception, through design, development, manufacturing, operations, and disposal (i.e. throughout the life cycle of a space project)
- Key objective is to continuously "**keep in balance**" **4 key parameters**:
  - **Project Risk**
  - **Project Scope**
  - **Project Schedule**
  - **Project Cost**

M-ST-10

Project Planning and Implementation

Requirements related to:

- Project Planning

  Organisation structure, communication and reporting, Audits.

- Project Breakdown Structures

  Product tree, WBS, WPD, OBS

- Project Phasing and Reviews

- Normative DRDS as:

  PMP, PT, WBS, WPD, PR

- Informative Annexes as:

  Management document delivery per review

M-ST-10-01

Organization and conduct of reviews

Requirements related to:

Review Bodies, Roles and tasks, Prerequisites for holding a review, Review meetings and RID processing

Normative DRDS as:

Review item discrepancy, Review team report, Review authority report

Informative Annexes as:

Logic diagram for RID processing

M-ST-40

Configuration and information management

Requirements related to:

Configuration management plan Configuration management interfaces

Configuration control

Configuration verification

Configuration management system audit Configuration management system approach for operations

Implementation of information/ documentation management

Normative DRDS as:

Configuration Management Plan, Configuration Item List, Configuration item data list, As built configuration list, Change Request Request for deviation, Request for waiver

Informative Annexes as:

Configuration Item Selection, Technical data package description

M-ST-60

Cost and schedule management

Requirements related to:

- Project Structure –Cost Breakdown Structure
- Schedule
- Cost management Contractual & financial interfaces Audited rates and cost structure

Normative DRDS as :

- Cost breakdown structure
- Schedule
- Schedule progress report
- Cost estimating plan
- Milestone payment plan
- Contract Change Notice (CCN)

Informative Annexes as:

- ESA PSS Forms A2, A8, and A10
- Cost estimating methods
- Inventory control

M-ST-80

Risk management

- Contains all requirements for this standard. They cover:
  - Risk management process
  - Risk management implementation
- Normative DRDs included in this standard are:
  - Risk Management Policy Document
  - Risk Management Plan
- Informative Annexes included in this standard are:
  - Risk register example and ranked risk log example
  - Contribution of ECSS Standards to the risk management process

Using the standards in a project

Tailoring

For a specific project, standards are tailored according to the type and phase of the project, the acceptable risks, the project complexity, cost,…

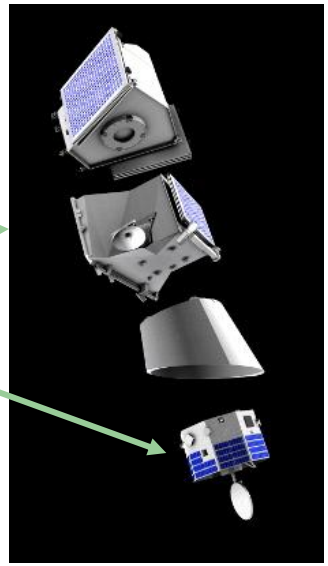
The list of standards and their content is analysed in order to make one of the following choices for each requirement statement:

- Applicable (including associated DRD)
- Not Applicable (Not required to meet project needs)
- Applicable with modification (Modified text to be shown in full)
- New (Needed by project, but not covered by ECSS)

SIMBIO-SYS on BepiColombo

"Common space standards" mission

BepiColombo: Mercury joint mission between ESA and JAXA (Japan Aerospace Exploration Agency) executed under ESA leadership.



The mission comprises two spacecraft:

- Mercury Planetary Orbiter (MPO),
- Mercury Magnetospheric Orbiter (MMO).

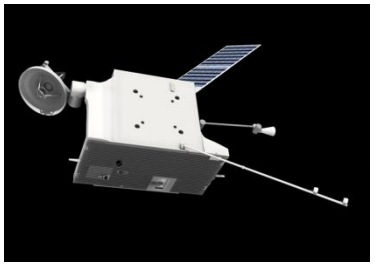
Launch date: 2015

Mission end: Nominally 1 year in Mercury orbit after arriving in 2022

SIMBIO-SYS: Italian contribution to BC mission with French partecipation to the Visible Infrared Hyperspectral Imaging (VIHI) part. The instrument is a suite of Spectrometers and Imagers for MPO: High resolution and stereo cameras, Visual and NIR spectrometer.

SIMBIO-SYS on BepiColombo

"Common space standards" mission

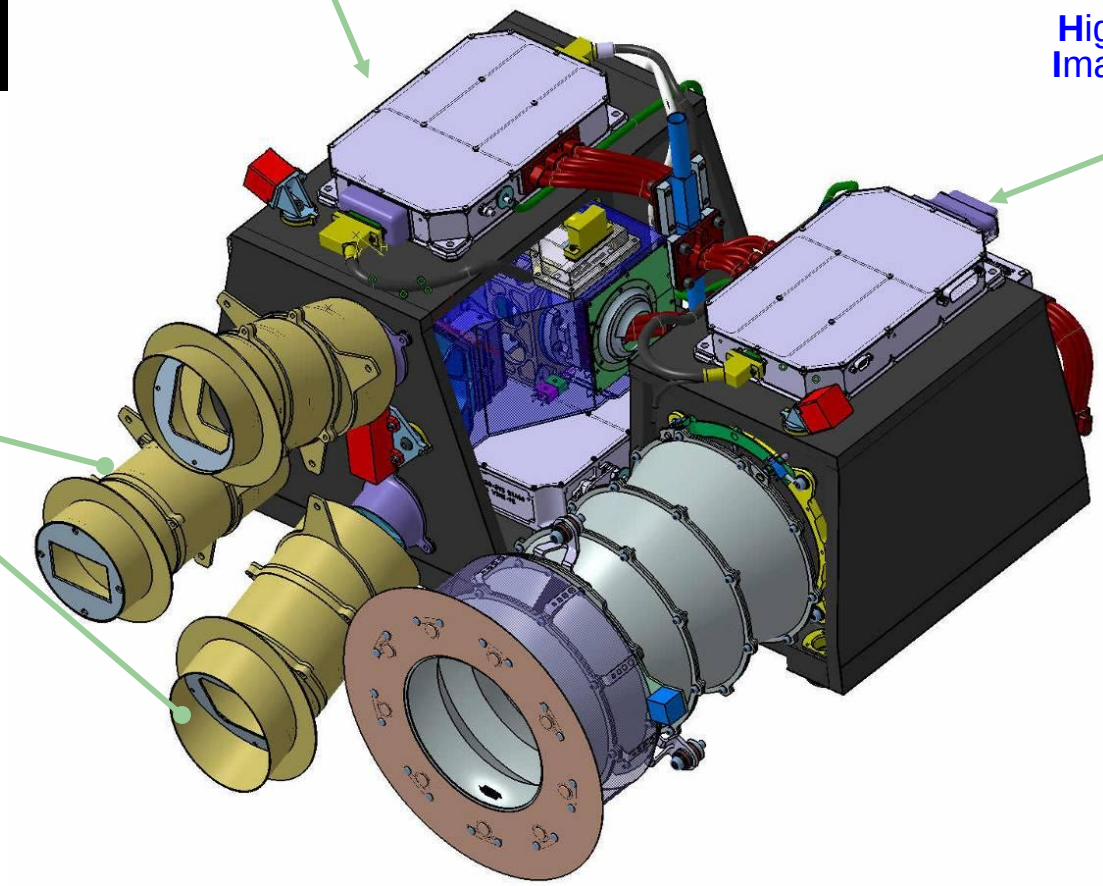


MPO

Visible **I**nfrared
Hyperspectral **I**maging

High **R**esolution
Imaging **C**amera

STereo **imaging**
Camera



SIMBIO-SYS = Spectrometers and Imagers for MPO Bepi Colombo – integrated observatory SYStem

SIMBIO-SYS on BepiColombo

"Common space standards" mission

- Clear and unambiguous communication between all parties involved, reducing risk and guaranteeing interoperability and interface compatibility
- Common structure and format of standards/reqs
- Documents produced in response to requirements as specified in Document Requirements Descriptions (DRDs)

JIRAM on JUNO

“Different space standards” mission

Juno: NASA mission that will conduct an in-depth study of Jupiter, the most massive planet in our solar system. Juno, launched on, will arrive at Jupiter in 2016, when it will be farther from the sun than any previous solar powered spacecraft.

Launch date: August 2011

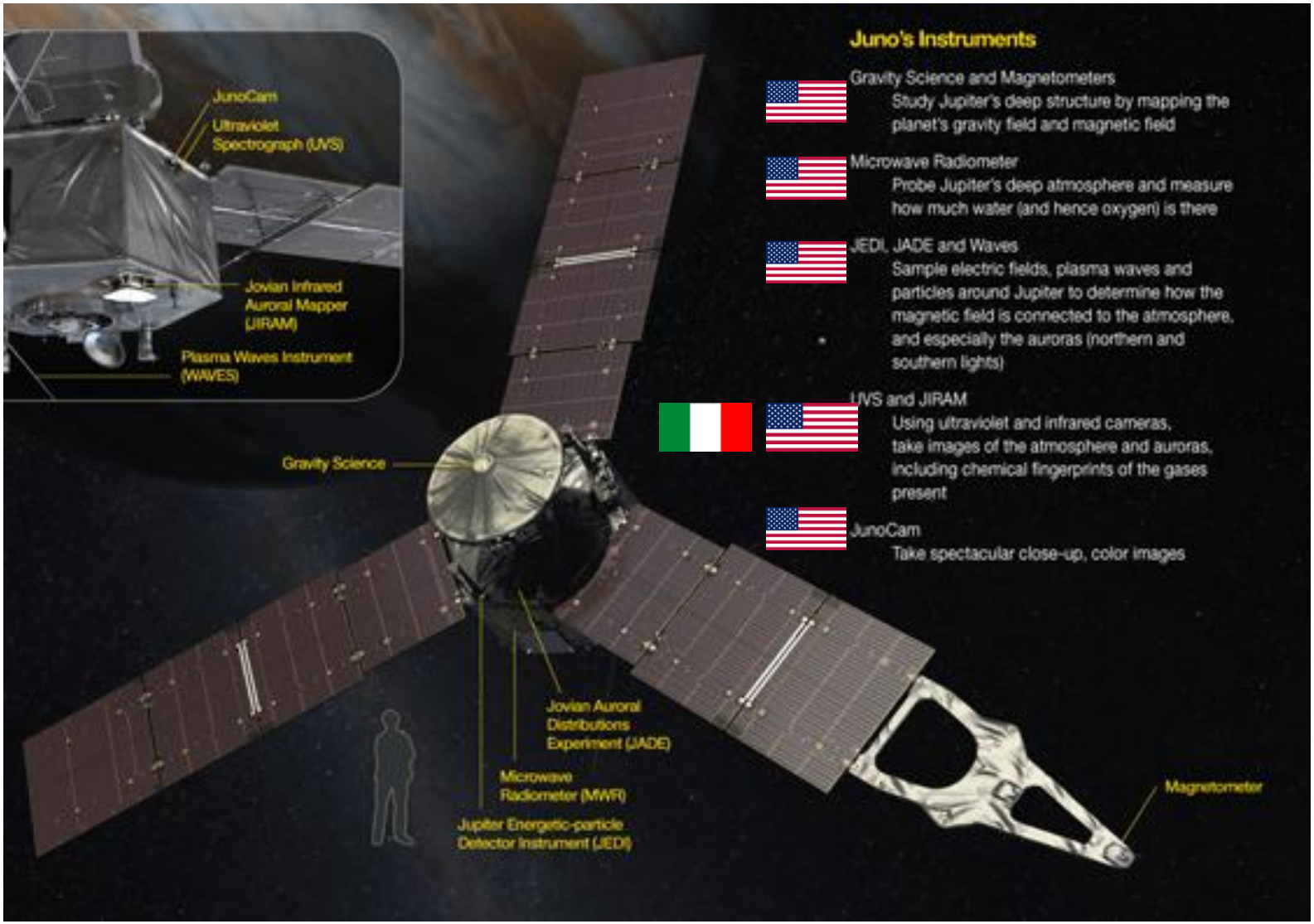
Jupiter arrival: 2016

JUNO

JIRAM: Italian contribution to JUNO mission. The instrument is the first Italian instrument of this kind to be sent to Jupiter. It belongs to a family of image spectrometers, which are currently flying on the ESA Rosetta and Venus Express missions as well as the NASA Dawn mission. The "first born" of this family is the visual channel of VIMS on Cassini satellite.

JIRAM on JUNO

"Different space standards" mission



JIRAM on JUNO

"Different space standards" mission

- Different structure and format of standards across the different branches/disciplines
- Documents produced in response to requirements not as specified in Document Requirements Descriptions (DRDs)
- Additional documentation to be produced in order to prove compliance to spacecraft requirements
- Additional activities (i.e. testing, face to face activities mainly for ITAR issues, Milestone contents misalinements, etc)

Conclusions

- Facilitate standardization of contract requirements in customer/supplier relations at all levels of space activities → Call-up of ECSS as applicable standard.
- Clear and unambiguous communication between all parties involved.
- Flexibility through tailoring
- Improve costs reduction, products internazionalization, industrial efficiency and competitiveness through using an integrated set of management, engineering and product assurance standards
- Improve product TRL understanding → opportunity to use as building blocks

Thank you for your attention.