ASI ONGOING ACTIVITIES ON EEE COMPONENTS

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  - TECHNOLOGIES DEVELOPMENT, INNOVATION AND COMPETITIVINESS
  - SUPPORT SELELCTION AND USAGE OF “NON TRADITIONAL SPACE” EEE PARTS
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FOREWORD (pros of traditional space)

Traditional space programs are based on conventional standards, procedures, and qualified components that offer undeniable advantages in terms of:

RELIABILITY
Expensive and qualified components, extensive testing, history of successful missions

SAFETY
Stringent safety protocols, redundant systems

QUALITY ASSURANCE
Standardized procedures, extensive testing and control

COMPLIANCE
Compliance with international space standards and regulations, documentation

MISSION SUCCESS AND LONGEVITY
High success rate, predictable outcomes, extended lifetime

FOREWORD (cons of traditional space)

BUT

there is another flip of the coin….

HIGH COSTS
Expensive qualified components, extensive testing activities and controls

LONG DEVELOPMENT TIME
Extended timeline, adherence to complex procedures and standards

LIMITED FLEXIBILITY
Adherence to rigid standards and bureaucratic processes

RISK AVERSION
Conservative approach, risk avoidance, low willingness to change

DEPENANCY ON GOVERNMENT FUNDING
Funding availability, limited commercial involvement

NEW SPACE AND SMALLSATS NEEDS

New space and smallsats market is growing exponentially, requiring a ***shift in mindset*** compared to traditional space programs in terms of:

- ❑ Cost Efficiency
- ❑ Rapid development
- ❑ Innovation and experimentation
- ❑ Miniaturization and scalability
- ❑ Sufficient level of quality and reliability
- ❑ International collaboration and regulatory support
- ❑ Environmental Sustainability (debris mitigation and green technologies)

ROLE OF ASI IN GUIDING THE TRANSITION

ASI, as the other National Space Agencies, plays a pivotal role in facilitating the move from conventional space missions to new space initiatives.

The ***key responsibilities of space agencies*** in this transition include:

- ❑ Establishing suitable Standards and Guidelines
- ❑ Promoting Innovation and Collaboration
- ❑ Supporting Research and Development
- ❑ Regulatory Compliance and Facilitation
- ❑ Educational and Outreach Programs

CHALLENGES AND DIFFICULTIES

Transition to new space offers several benefits, but it also presents several ***challenges and difficulties*** that space agencies must address:

- ❑ Balancing of Costs and Performances
- ❑ Maintaining minimum level of Reliability and Quality
- ❑ Managing Regulatory Compliance
- ❑ Adapting to Rapid Technological Changes
- ❑ Accepting a weighted risk
- ❑ Environmental and Sustainability Concerns

ASI ONGOING ACTIVITIES

ASI has launched several initiatives and activities to address the needs for new space:

- Adoption of mission classification (e.g. ALCOR program) based on ESA one
- ECSS Standards tailoring and DRDs (document reqs definition) based on mission classification
- Support for PA/QA operational guidelines defining an effective Quality policy and management to seize new market opportunities
- Sharing of knowledge, field experience and expert insights in PA/QA
- Periodic meetings to stimulate new ideas for Product Assurance and Quality practices and to contribute to major changes with adequate tools
- Fostering of public-private partnerships, the innovation and sustainability

ASI ONGOING ACTIVITIES

- Funding, grants and promotion of innovation in EEE technologies (e.g. STEP program)
- Support for the Selection and usage of non traditional space Qualified EEE Parts and Materials:
  - Development of ASI common EEE database for a standardized selection
  - Support for radiation prediction and determination of RVT campaigns and dedicated protocols (through the ASIF infrastructure, www.asif.asi.it)
  - Involvement in defining project-specific test flows from parts level to board/unit, subsystems and system level
  - Suggested criteria for selecting suitable EEE components

ASI MISSION CLASSIFICATION

ASI has experimentally adopted, in ALCOR program, a mission classification based on the one proposed by ESA:

ALCOR program at a glance:

- 20 small satellite missions:
9 scientific, 11 applicative

- 7 missions in phases C/D

- Application domains:
Earth observation, telecommunications, in-orbit servicing, space sustainability, astrophysics, and the exploration of the universe

	Mission class							
	I	II	III	IV	V			
Criticality to Agency strategy (flagship mission, international cooperation, impact on Agency strategic goals and image)	Extremely high criticality	High criticality	Medium criticality	Low criticality	Educational purposes	Score	Weight	Weighted score
Select one cell ==>				X		4	0,3	1,2
Mission objectives (directorate priority and purpose, e.g. in-orbit demonstration, educational)	Extremely high priority	High priority	Medium priority	Low priority	Educational purposes	Score	Weight	Weighted score
Select one cell ==>			X			3	0,2	0,6
Cost (cost at completion including phase E1)	> 700 M€	200-700 M€	50-200 M€	1-50 M€	< 1 M€	Score	Weight	Weighted score
Select one cell ==>				X		4	0,1	0,4
Mission lifetime (nominal mission life duration)	> 10 years	5-10 years	2-5 years	3 months - 2 years	< 3 months	Score	Weight	Weighted score
Select one cell ==>			X			3	0,2	0,6
Mission complexity (design interfaces, unique payloads, new technology development)	High	High to medium	Medium to low	High (IOD/IOV) Low (commercially driven)	Low	Score	Weight	Weighted score
Select one cell ==>				X		4	0,2	0,8
							Total	3,6
							Mission class	IV

Feedbacks received from those missions will be used to refine and improve the mission classification process.

STANDARDS TAILORING AND GUIDELINES

Mission classification means also tailoring of traditional standards and definition of suitable guidelines:

- ❑ Reduction and merging of the documentation typically expected by ECSS:

  from around 346 documents for phases C, D and E → to about 42 documents

- ❑ Definition of «Ad hoc» DRDs:

  from ECSS DRDs → to DRDs providing requirements for the content of the expected PA documentation

- ❑ Evaluation of alternative means of compliance to achieve requirements:

  from ECSS requirements → alternative ways proposed and justified by Contractors

FUNDING AND INNOVATION: STEP PROGRAM

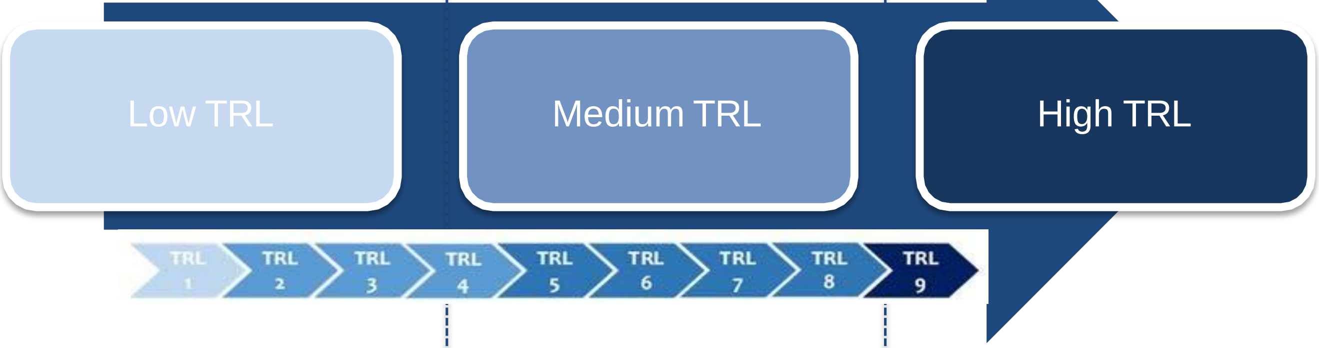
Success in executing future ASI space missions will depend on advanced technology developments that are already underway.

It has been years since ASI has started an intense and broad-based program in advanced space technologies, including STEP, in order to:

- **sustain technology programs** that can enable the development of more **capable**, **reliable**, and **lower-cost** spacecraft and launch vehicles as a foundation for future leadership in space
- **enhance technology readiness** of new missions, **mitigate** their technological risks, **improve** their quality as a foundation of a strong advanced technology development

MULTI STEPS DEVELOPMENT

STEP.1 | STEP.2 | STEP.3



Disruptive and innovative technologies
(mainly from R&D and SME)

Consolidation of key technologies

Qualification and Testing including IOV/IOD

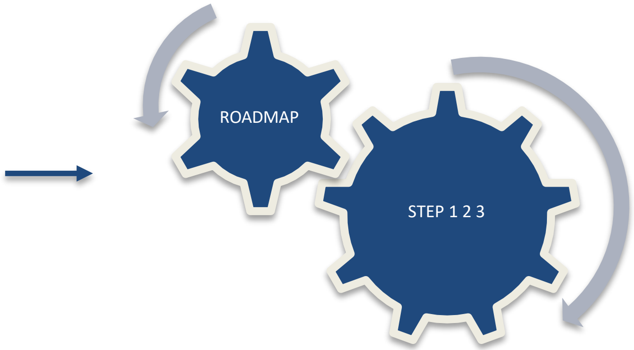
STEP.4

STEP is based on a multi steps approach

DOMAINS OF INTEREST

The technology priorities were defined with an awareness of ASI’s current mission plans covering several domains of interest.

- Earth Observation
- Telecommunication
- Satellite Navigation
- Human And Robotic Exploration
- Science
- Space Transportation
- Space Situational Awareness (SSA)



AREAS OF INTEREST

Technologies of main interest of STEP program are identified on the basis of future and strategic needs:

- ❑ Technologies for rendezvous, proximity and docking
- ❑ Robotics
- ❑ Artificial Intelligence
- ❑ Advanced processors
- ❑ Materials and thermal management
- ❑ Power generation and management
- ❑ Propulsion
- ❑ AOCS for improved agility (e.g. CMG, optical gyro)
- ❑ Additive manufacturing
- ❑ **EEE COTS, Radiation environment**
- ❑ Cybersecurity.
- ❑ Photonics and Quantum Technologies
- ❑ …

TECHNOLOGY ROADMAP

Roadmap for technology development is done through a coordination with the specific disciplines and international organizations, based on common strategic needs:

- Roadmap THAG (Technology Harmonization Advisory Board)
- **Joint Task Force for critical technology non-dependence**
- **Participation to ESCC (European Space Component Coordination) boards**
- Contribute for the definition of Horizon Europe work program
- Involvement of national stakeholders:
  - **B2B meetings dedicated to technology developments**
  - Thematic workshops & Consultation with industries and associations

european space technology harmonisation

ESCC European Space Components Coordination

esa

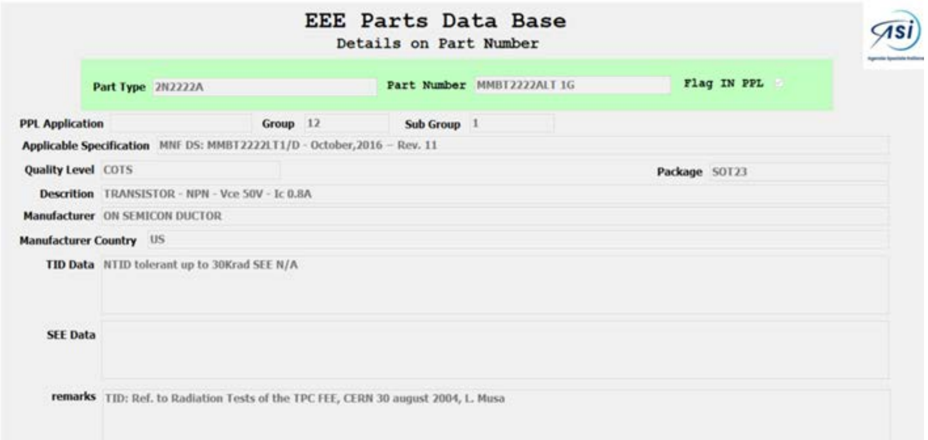
EUROPEAN DEFENCE AGENCY

Commissione europea

SUPPORT TO EEE PARTS SELECTION

ASI is developing and maintaining an EEE Database that allows the extraction of several PPL lists corresponding to the different quality levels. For what concern the COTS components at the moment the DB has been populated with data from the several ASI projects such as:

- PLATiNO
- LICIA CUBE
- ARGOMOON
- LIMADOU2
- MicroHET



In the future, will be included also the EEE parts selected and used for all the ALCOR missions

EEE PARTS GUIDELINES AND BEST PRACTICES (1)

ASI suggests partners to select COTS components for space application taking into account:

- Accurate collection of available data on candidates' COTS parts (SPC, life test, RVT, and flight heritage);
- standardization of part type/part number and adoption of ASI EEE parts DB;
- Preferred use of Automotive parts or EP provided that radiation behaviour is acceptable;
- An ad hoc screening and qualification test flow considering already available data and mission requirements:
  - Constructional Analysis (CA) is mandatory for parts without heritage;
  - Radiation Tests shall be performed when sufficient data are not available;
  - Life test data from the Manufacturer shall be available for commercial parts. Otherwise, LAT shall be performed (mandatory for class III missions)
- Verification by test, of the performances, declared in the relevant datasheets and critical for the intended design application

EEE PARTS GUIDELINES AND BEST PRACTICES (2)

- Use of the same or higher derating margins as defined in the ECSS-Q-ST-30-11;
- Screening and qualification test performed at board/equipment level;
- Forbidden parts as per ECSS-Q-ST-60-13C;
- Obsolescence and storage:
  - Procurement of complete reels of components from the beginning;
  - Identification of possible replacements during the project's early phases;
  - Verification of manufacturer's storage conditions.
- Limited traceability & counterfeit:
  - Procurement from the relevant manufacturers or official distributors;
  - Procurement of active parts with SLDC;
- Reliability dependence on the production lot:
  - Procurement from manufacturers with an effective statistical process control (SPC)

EEE PARTS GUIDELINES AND BEST PRACTICES (3)

- Pure tin and whiskers:
  - Mitigation actions
  - Compliance with the applicable standards (JESD-201 class 2 o GEIA-STD-0005-2/Class 2B), and in the case of NC implementation of “state of the art” risk mitigation approaches;
  - Avoid the use of pure tin components for power function (voltage>15V and current >2A)
  - Not needed for class V programs
- Package:
  - For not hermetic packages: MSL≥3 as per J-STD-020, inspection by CSAM, and compliance to requirements of ECSS-Q-ST-70 regarding off-gassing, out-gassing flammability, toxicity
  - For packages with cavities: PIND and leak test.

CONCLUSIONS

- The Role of Space Agencies is pivotal in terms of:
  - fostering international collaboration, standardization, and knowledge-sharing to address industry challenges.
  - support research, innovation, and the development of technologies that enable small players and startups to contribute to the space ecosystem.
  - enforce public-private partnerships to accelerate technological progress and reduce barriers to entry for emerging players.

- New space is introducing undeniable advantages, but:
  - challenges related to radiation hardening, reliability, qualification and acceptable risk persist
  - establishing robust and tailored standards and testing frameworks is critical to ensuring quality
  - sustainability strategies are crucial in order to reduce space debris

THANK YOU FOR YOUR ATTENTION