General Support Technology Programme

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Directorate of Technology, Engineering and Quality

Slovakia, December 13, 2023

→ Background / Overview of GSTP

→ GSTP Element 1 Compendia and Workplan

→ GSTP Element 1 Frameworks

→ GSTP Element 2 Announcement of Opportunity

→ GSTP Element 3 Technology Demonstration

→ Conclusions

GENERAL SUPPORT TECHNOLOGY PROGRAMME (GSTP)

→ For 30 years the GSTP programme has been developing leading-edge space technologies: enabling missions & supporting the competitiveness of European industry.

→ GSTP allows companies of all sizes and research/academic organisations to perform technology developments and demonstrations

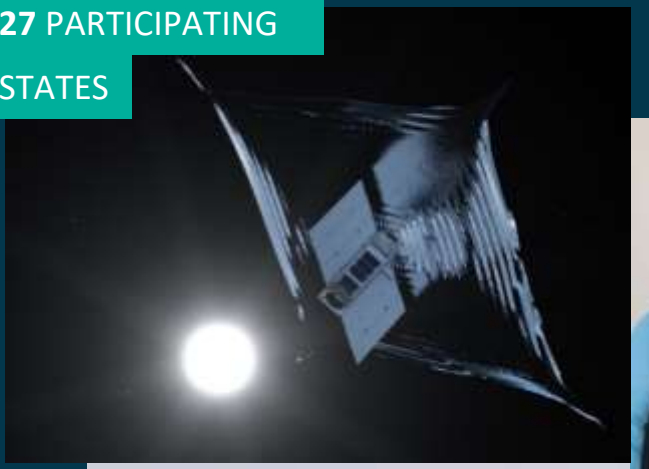
- Building capacities and fostering innovation
- Creating and improving products and services

→ GSTP addresses practically all technology areas for generic or specific application needs for the space segment as well as the ground and space transportation segments

→ GSTP is an optional ESA programme with the participation of all ESA Member, and Associate States:

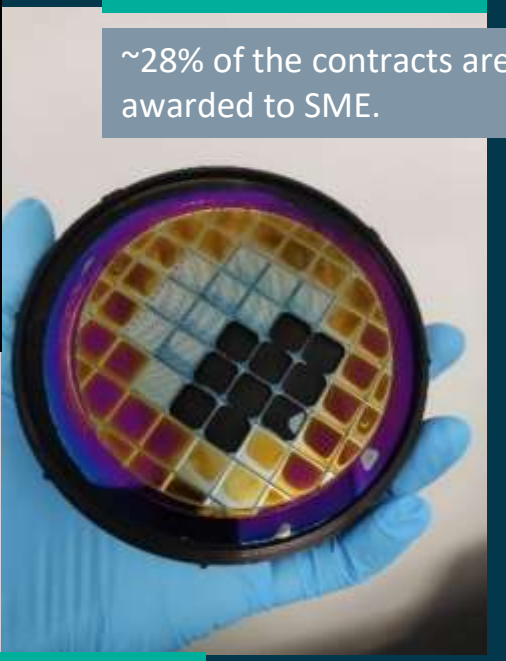
- 27 Participating States in total

27 PARTICIPATING STATES



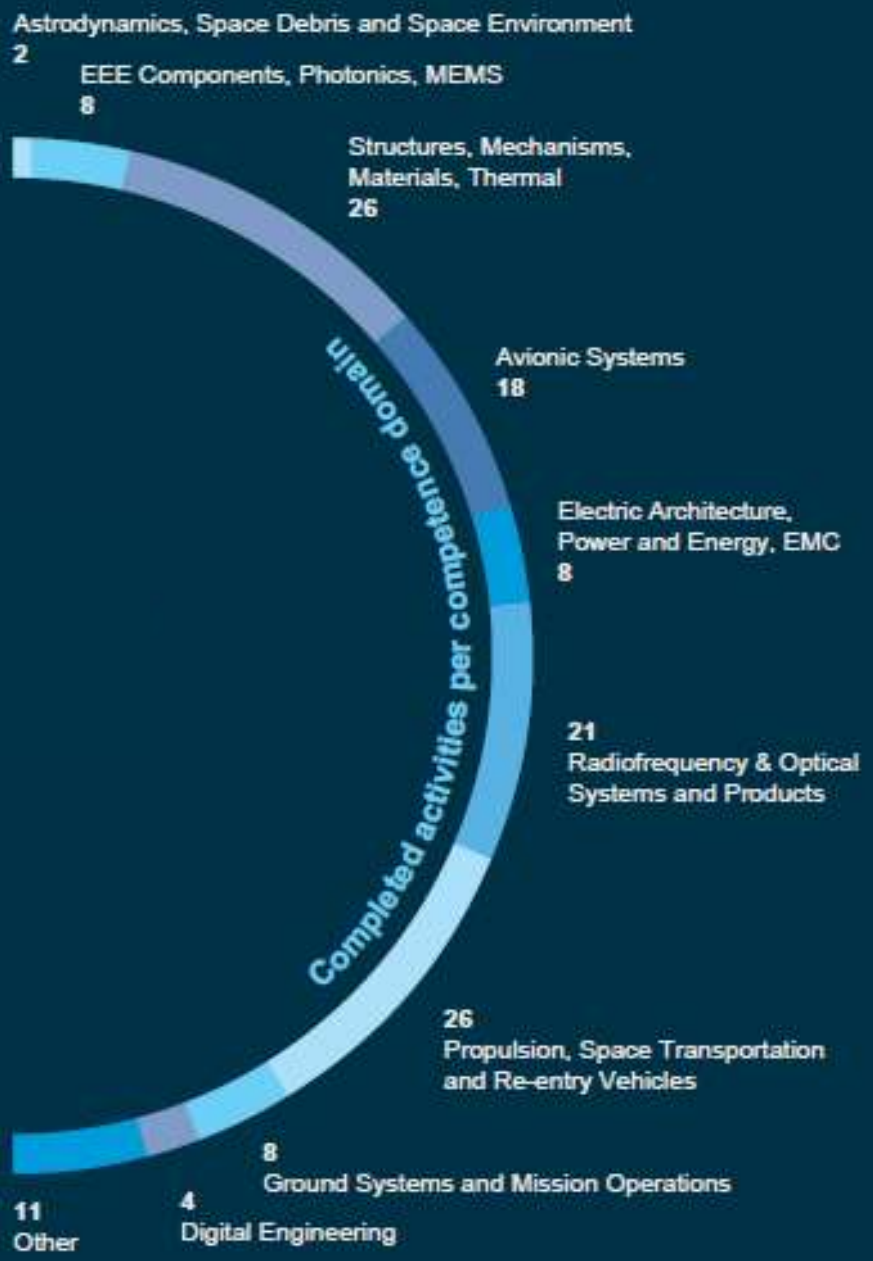
150 - 200 NEW ACTIVITIES PER YEAR

~28% of the contracts are awarded to SME.



OVER **€100** MILLION ANNUAL COMMITMENTS

GSTP: 2022 at a glance



- → Over 500 running activities
- → 140 activities completed
- → 130 technology development and demonstration activities initiated, representing over 100 MEuro in contracts

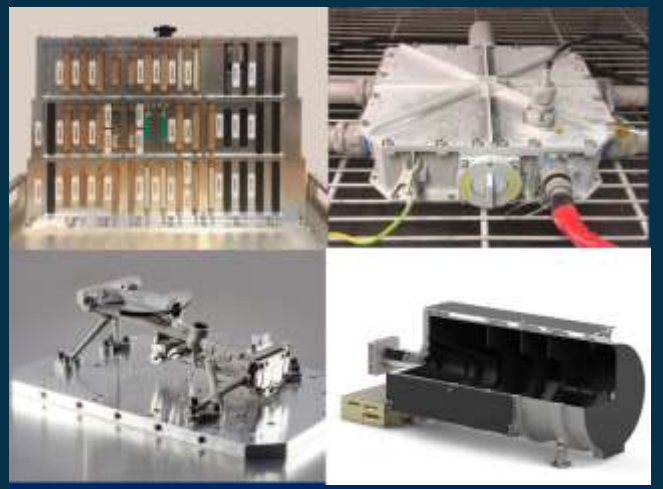
GSTP Subscriptions

27 ESA Member, Associate and Co-operating States are subscribed to GSTP

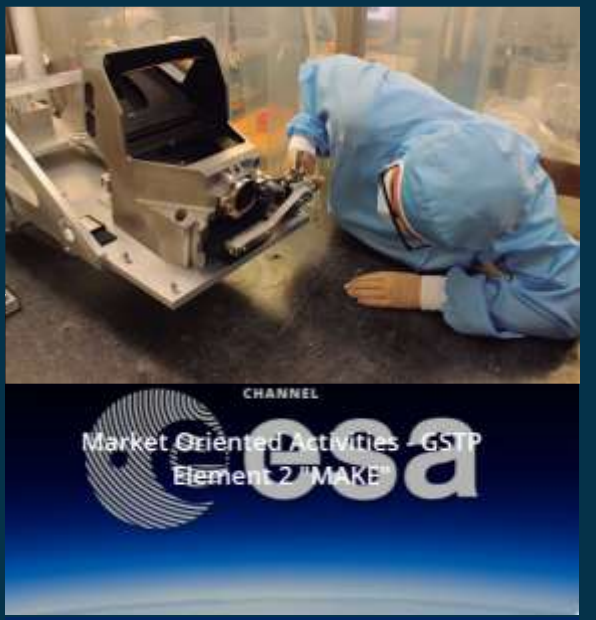
It is possible to propose activities and to bid for activities with partners from these States

Slovakian total subscription: 3 MEuro

GSTP STRUCTURE



ELEMENT 1: DEVELOP



ELEMENT 2: MAKE

ELEMENT 3: FLY

Supports technology developments up to qualification, capacity building & ESA technology aims.

→ **Compendia, Work Plan, Frameworks**

→ Industry initiated and driven, co-funded activities to strengthen competitiveness

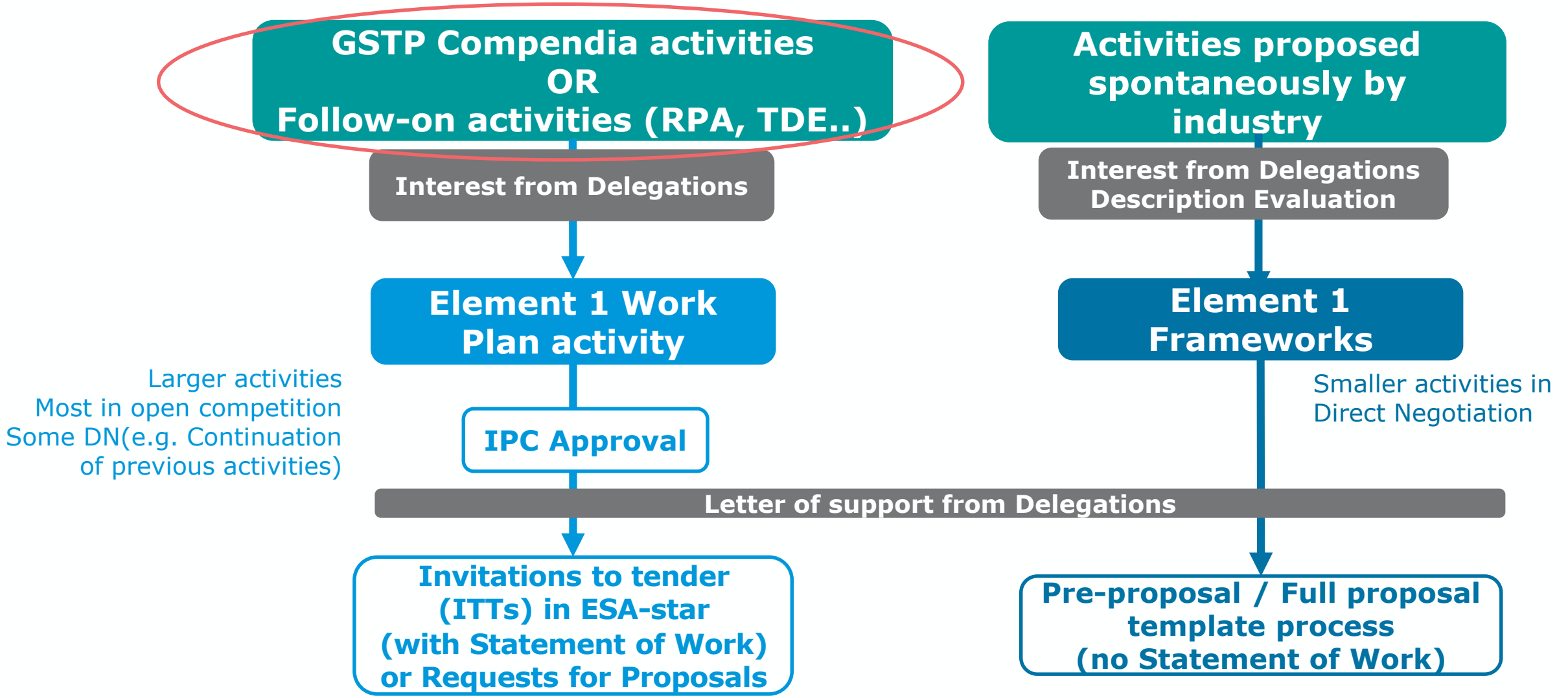
On-ground and in-orbit demonstrations of technologies in need of acquiring in-orbit validation.

COMPONENTS

PRECISE FORMATION FLYING COMPONENT
implements phases C/D/E of the PROBA-3 mission

Two additional Components introduced in the context of CM-22:
EEE Space Component Sovereignty for Europe and EuropeaN Devices Using Radioisotope Energy (ENDURE)

GSTP Element 1



GSTP ELEMENT 1 DEVELOP

Compendia prepared in 2022

ESA Driven:

- Generic Technologies

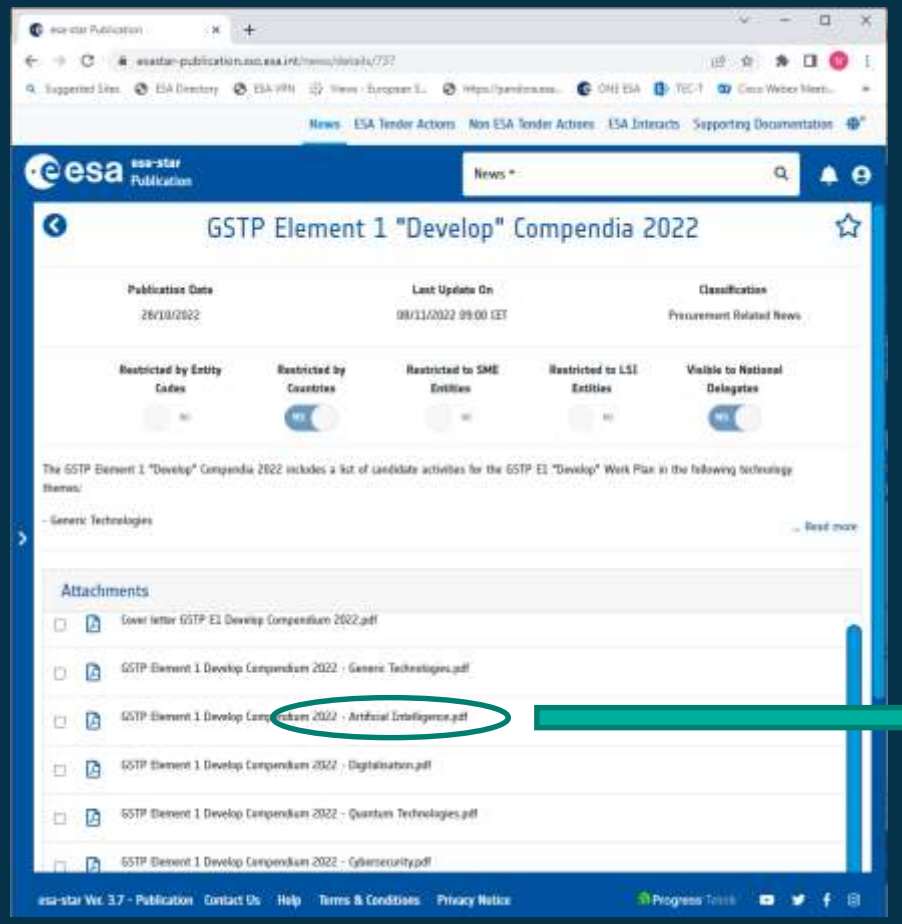
Industry Driven:

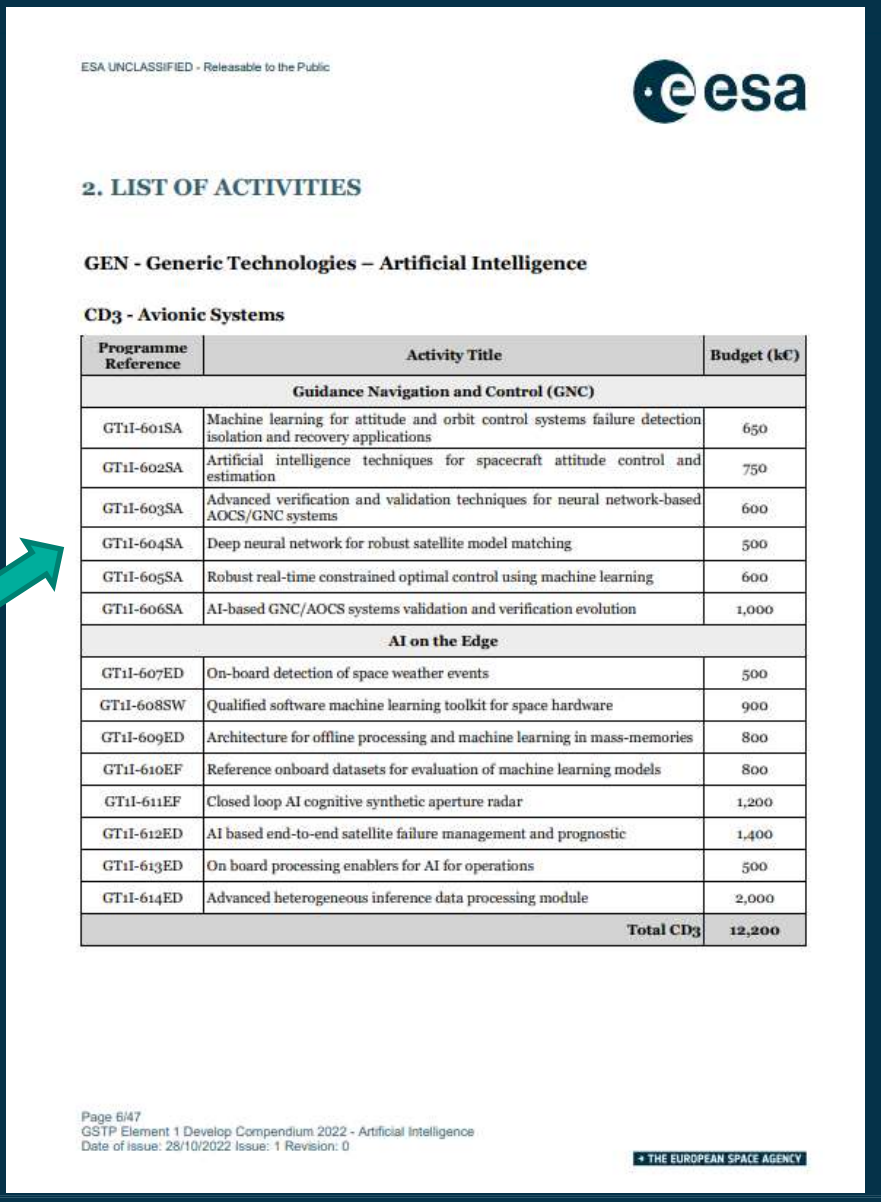
- **Artificial Intelligence** - Edge/AI on Board, GNC, Mission Operations
- **Digitalisation** - Data Management, MBSE, Simulation, Digital Twin
- **Quantum Technologies** – Quantum Sensing, Atom interferometers, Atomic frequency standards, Quantum Computing, Quantum Memories…
- **Cybersecurity**

esa-star Publication

- **Publication in November 2022**
- **Since Feb 2023, 32 activities have been included in GSTP WP**
- **Targeting implementation 2023/25**

GSTP Element 1





ESA UNCLASSIFIED - Releasable to the Public

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2. LIST OF ACTIVITIES

GEN - Generic Technologies – Artificial Intelligence

CD3 - Avionic Systems

Programme Reference	Activity Title	Budget (kC)
	Guidance Navigation and Control (GNC)	
GT1I-601SA	Machine learning for attitude and orbit control systems failure detection isolation and recovery applications	650
GT1I-602SA	Artificial intelligence techniques for spacecraft attitude control and estimation	750
GT1I-603SA	Advanced verification and validation techniques for neural network-based AOCS/GNC systems	600
GT1I-604SA	Deep neural network for robust satellite model matching	500
GT1I-605SA	Robust real-time constrained optimal control using machine learning	600
GT1I-606SA	AI-based GNC/AOCS systems validation and verification evolution	1,000
	AI on the Edge	
GT1I-607ED	On-board detection of space weather events	500
GT1I-608SW	Qualified software machine learning toolkit for space hardware	900
GT1I-609ED	Architecture for offline processing and machine learning in mass-memories	800
GT1I-610EF	Reference onboard datasets for evaluation of machine learning models	800
GT1I-611EF	Closed loop AI cognitive synthetic aperture radar	1,200
GT1I-612ED	AI based end-to-end satellite failure management and prognostic	1,400
GT1I-613ED	On board processing enablers for AI for operations	500
GT1I-614ED	Advanced heterogeneous inference data processing module	2,000
	Total CD3	**12,200**

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GSTP Element 1 Develop Compendium 2022 - Artificial Intelligence
Date of issue: 28/10/2022 Issue: 1 Revision: 0

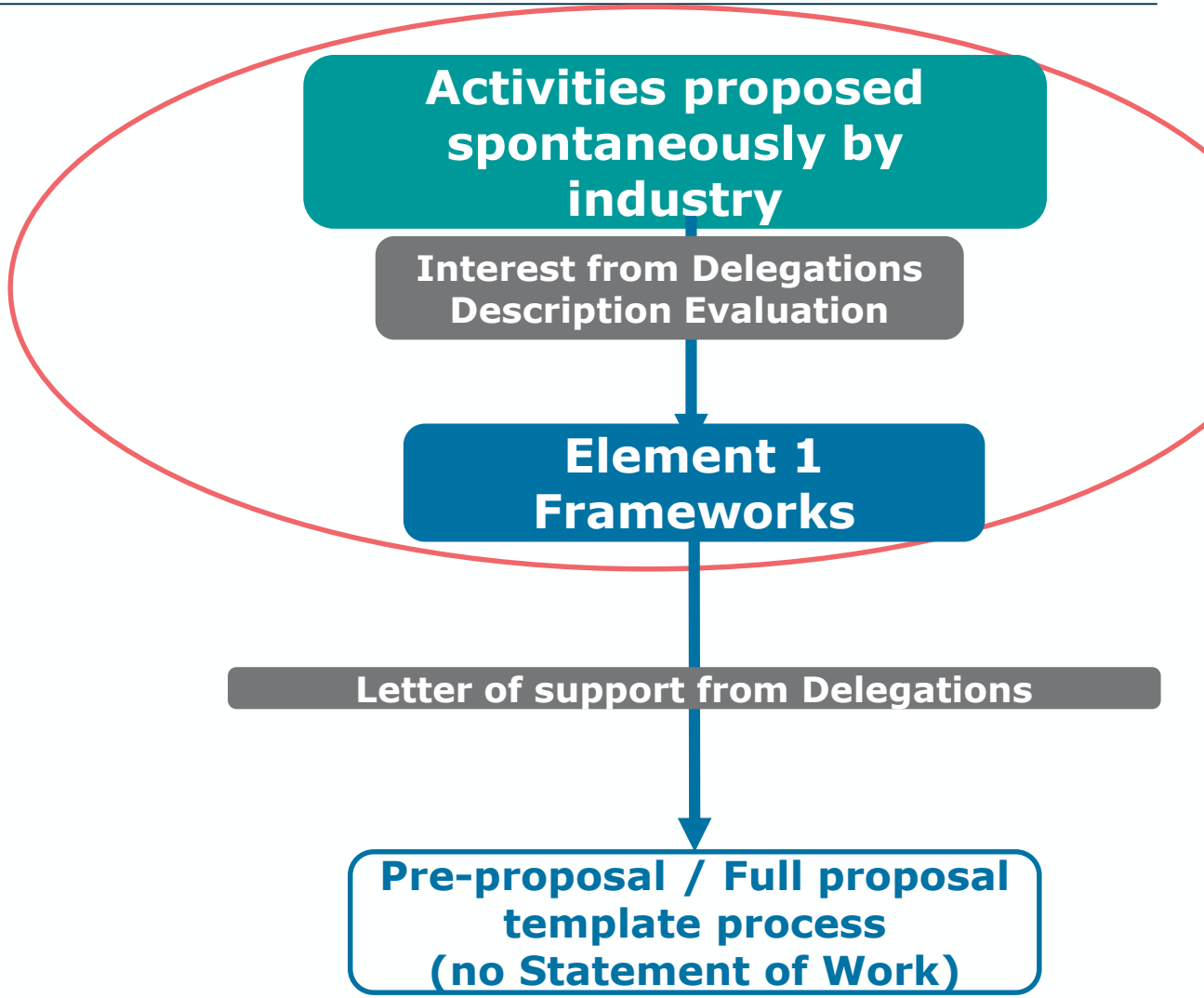
→ THE EUROPEAN SPACE AGENCY

https://esastar-publication.sso.esa.int/news/details/737

GSTP Element 1

GSTP Criteria – Description Evaluation:

- Programmatic: TRLs, Application, Consistency of scope /deliverables /TRLs
- Continuation of previous activities (TDE, frameworks ...)
- Innovation? Competitiveness? Enabling mission?
- Industrial sustainability / Building Capabilities
- Interest from Delegations / National Strategy + Funds Availability



ELEMENT 1 - De-risk framework

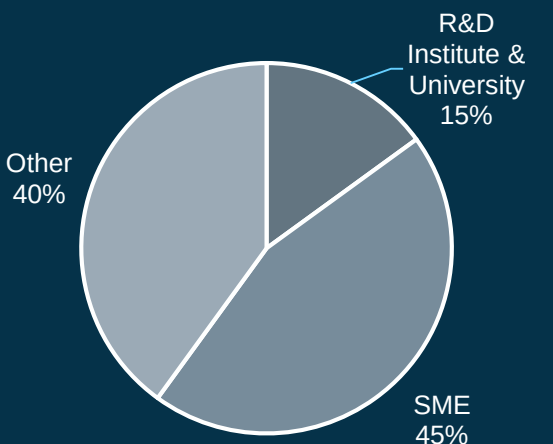
G617-241TA, Assessments to prepare and de-risk technology developments

Approved by IPC in November 2016 "…to allow for assessments that will help prepare and de-risk potential development activities".

Procurement using a template	Follow-on using a template	~40 de-risk initiated / year
• Max budget: €250 K • Max duration: 9 months	• No budget limit • No duration limit • ~ 35% de-risk are continued	• >200 de-risk so far • ~ €35 M overall budget

Permanent Open Call in ESA-Star

Company Type

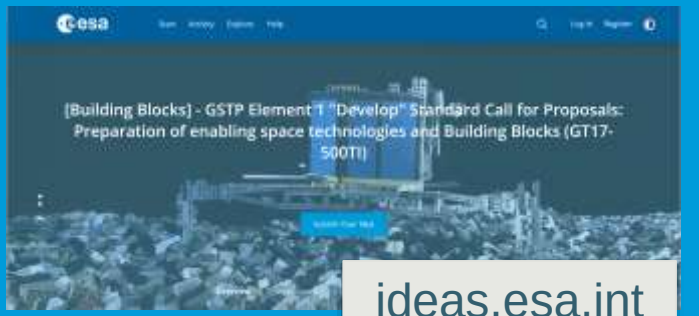


ELEMENT 1 – Building Block framework

GT17-500TI, Preparation of Enabling Space Technologies And Building Blocks Framework

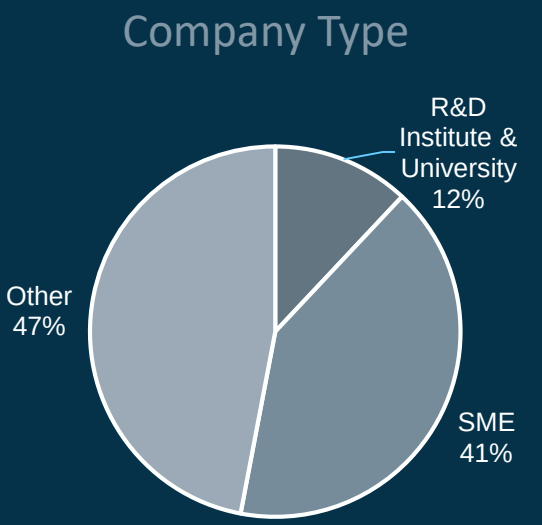
Approved IPC April 2018 and updated October 2022 (operative from mid March)

"…to prepare and to develop enabling capabilities and the associated building blocks for space related systems and the associated sub-systems." Targeted and coordinated development of capabilities across different GSTP Participating States



Procurement using a template	~20 activities initiated / year
• Max budget: €1 M • Max duration: 24 months	• 100 activities so far • ~ €43 M overall budget

Permanent Open Call in ESA-Star



Framework procurement process

[Building Blocks] - GSTP Element 1 "Develop"

[De-risk] - GSTP Element 1 "Develop"

Initial contact between bidder and National Delegation (no ESA involvement)

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Outline Proposal in OSIP

Outline Proposal evaluation

Activity scope refinement

Not-Official ESA procurement

Communications allowed with ESA Technical Officer and GSTP

Proposal submission using ESA-Star

ESA-star

TEB & Negotiation

Commitment

Official ESA procurement

Communications allowed only through ESA assigned Contract Officer

Framework procurement process

Outline Proposal → Evaluation → Proposal

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ESA-star

[Building Blocks] - GSTP Element 1 "Develop"

[De-risk] - GSTP Element 1 "Develop"

Outline Proposal Review Criteria

- Clear and credible definition of the technical objectives, key requirements, technical steps and risks to be addressed in this activity.
- Clear indication of the application and potential users of the technology.
- Clarity of the management approach and the adequacy of the proposed costs with the work to be performed
- Clear information about Cost to Completion

GSTP ELEMENT 2 MAKE

Announcement of Opportunity

2020: First full year with the current structure

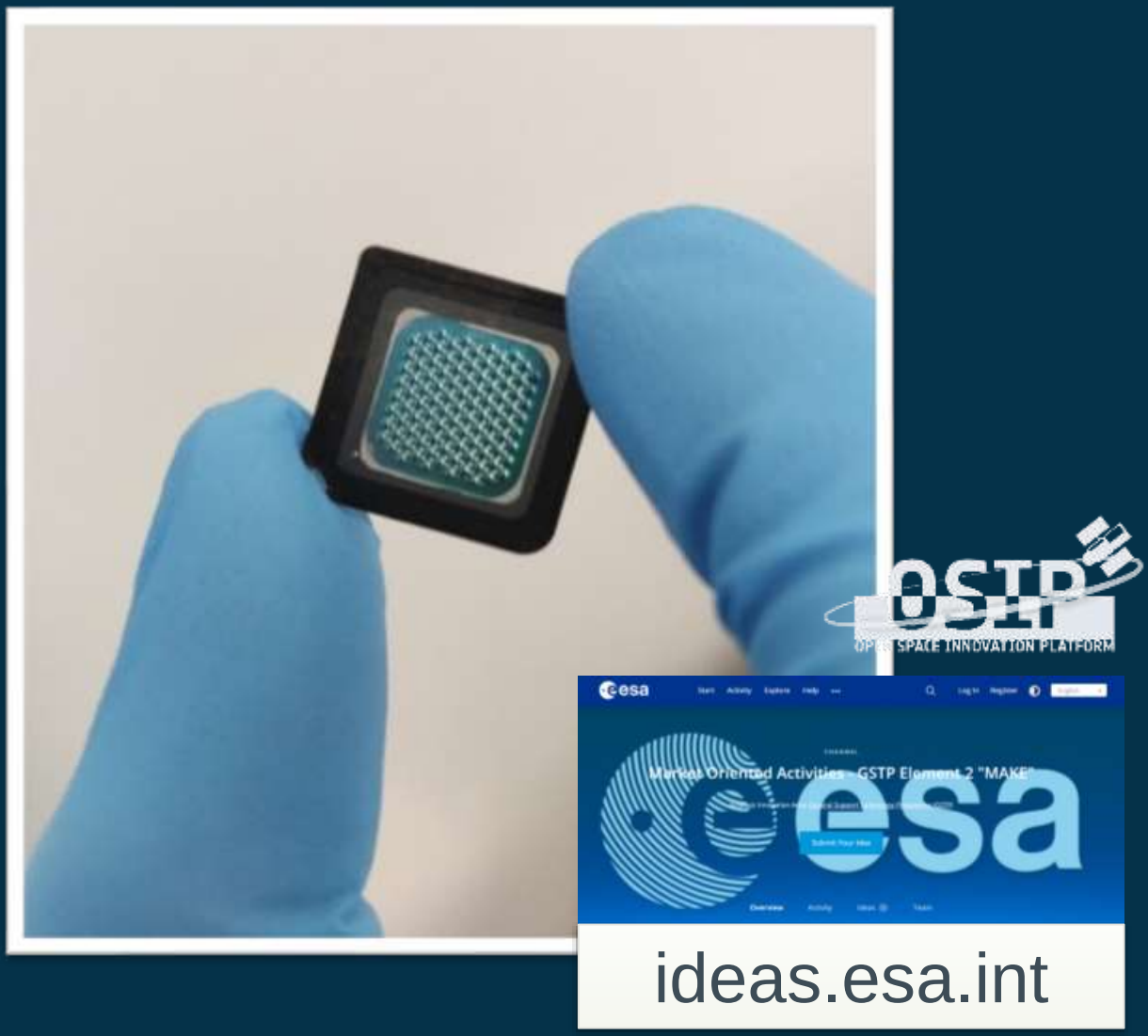
3 segments:

- Market Oriented Opportunities,
- Strategic Opportunities and
- Implementation of National Priorities

Use of OSIP channel (ideas.esa.int) for outline proposal evaluations.

2020 – 2022: significant increase in proposals received

25-30 activities committed per year (€30 M - €35 M)



GSTP ELEMENT 3 FLY

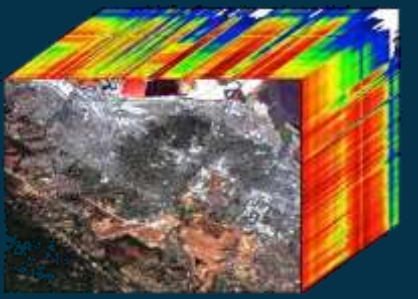
Facilitate Technology Demonstrations

The main objectives related to Element 3 are to:

- Ensure the successful implementation of the **Missions** and **In-Orbit Demonstrations** currently in preparation.
- Identify/prepare new mission/IOD opportunities.
- Expand and enhance the demonstration approach.

Opportunities cover:

- Demonstration of technology (e.g. platform units, Li-ion batteries).
- Demonstration of techniques (e.g. ADS-B, hyper-spectral, …).
- First demonstrations of potential capabilities.



GSTP Conclusions/Summary

For 30 years, GSTP allows companies of all sizes and research and academic organisations to perform technology developments and demonstrations.

- more than 150+ activities are started per year in **27 Participating Countries**

Activities are implemented through:

- **Element 1 Work Plan activities**, building on the GSTP Compendia and large industry driven activities
- **Element 1 Frameworks** (De-risk, Building Block), for smaller industry driven activities
- **Element 2 AO** for market oriented co-funded industry driven activities
- **Element 3** for technology demonstrations (in-orbit…) as well as missions

Additional considerations:

- **GSTP** is complementary to the RPA scheme
- Slovakian entities may request financial support from their delegation to perform technology development/demonstrations
- Consult the GSTP Element 1 Compendia for ESA driven activity ideas
- Slovakian entities may propose projects for GSTP, notably via the frameworks

LINKS

esa-star the procurement portal

a source for:

- Registration of new companies to do business with ESA
- Invitations to tender
- News/Procurement related announcements: **GSTP Compendia Publication**

www.esastar-publication.sso.esa.int

Open Space Innovation Platform

channels/campaigns for submitting ideas, pre-proposals and outline proposals

www.ideas.esa.int

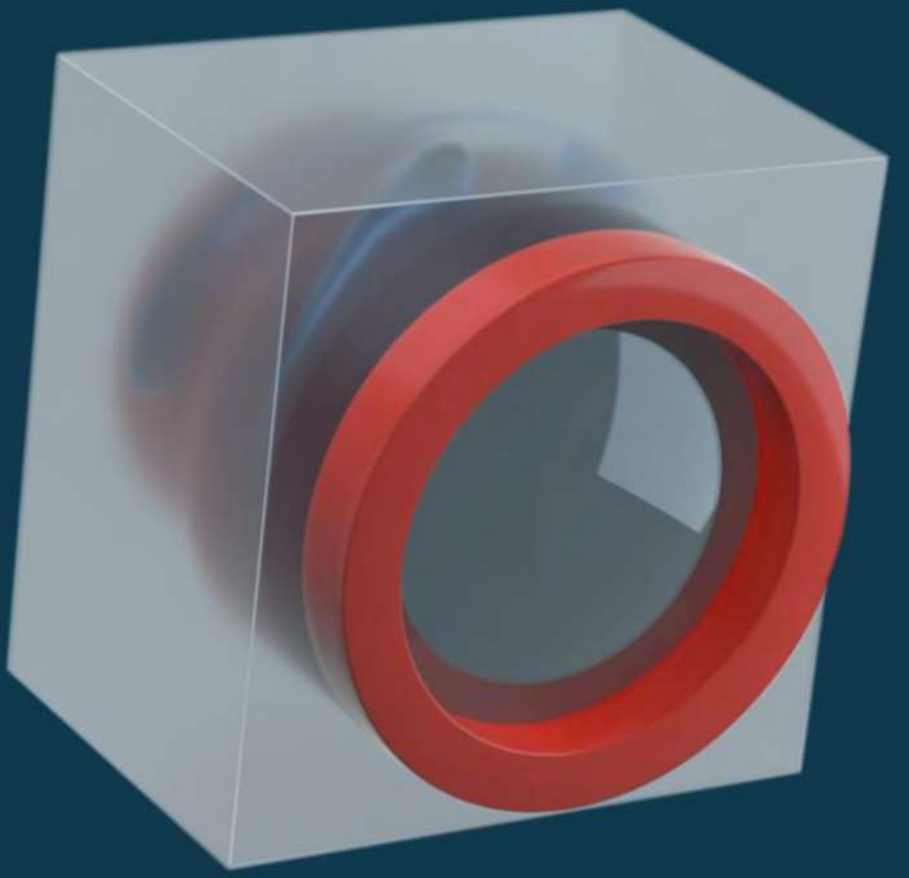
Shaping the future website

- Articles on the latest GSTP funded space technology R&D developments
- GSTP annual reports

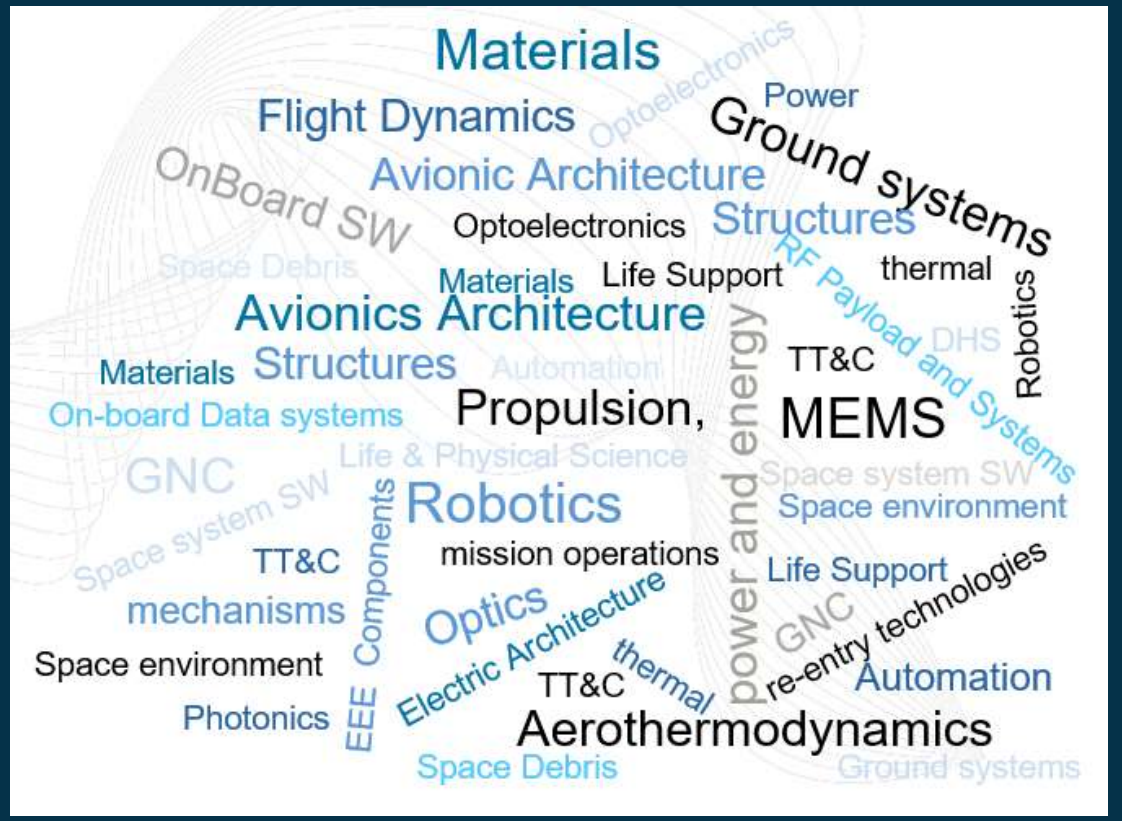
www.esa.int/Enabling_Support/Space_Engineering_Technology/Shaping_the_Future

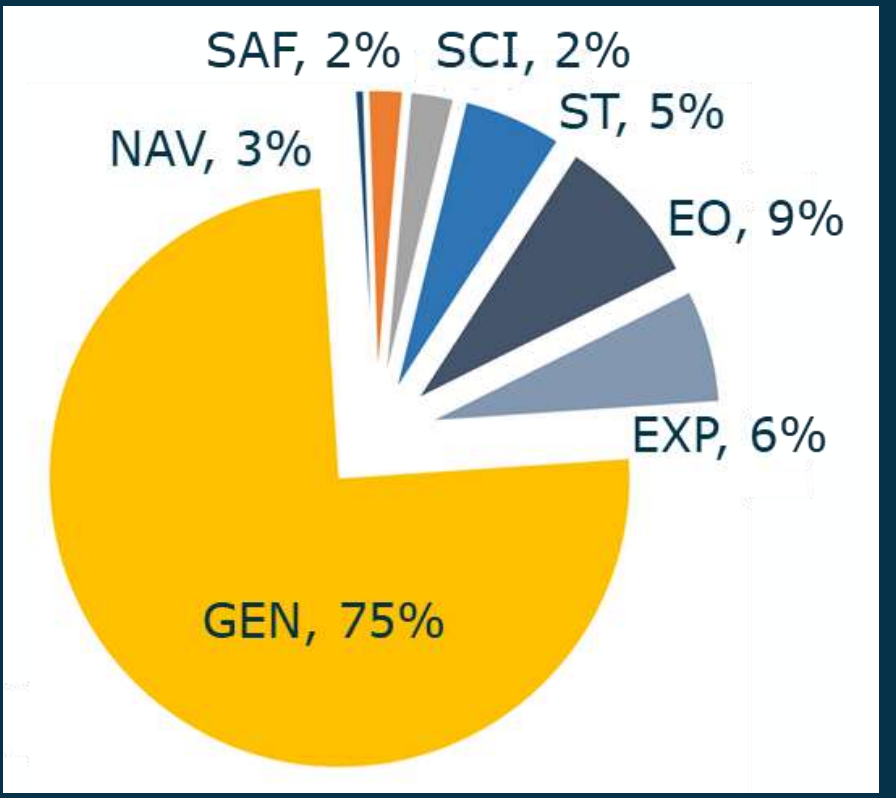
THANK YOU!

DIRECTORATE OF TECHNOLOGY, ENGINEERING AND QUALITY



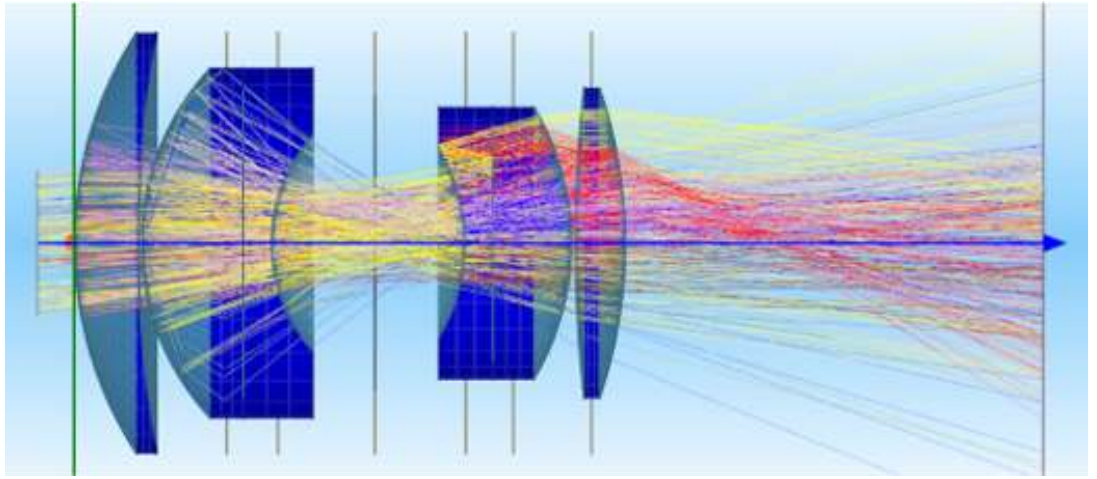
GSTP Technology and Application Areas





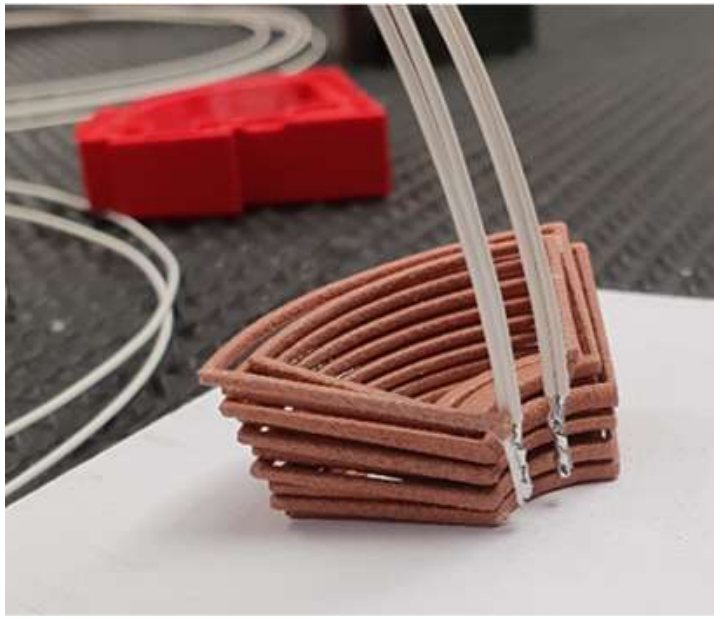
Examples of products supported in GSTP

Reconfigurable Telemetry Transmitter



Optical system modelling software

ADEO space brake sail



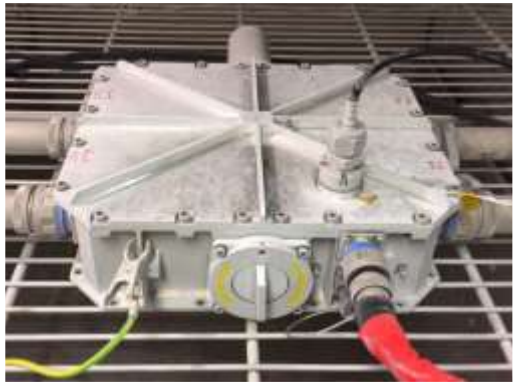
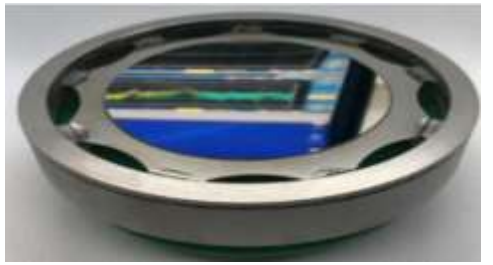
Additive manufacturing of copper (magnetic) coils

GSTP Element 1

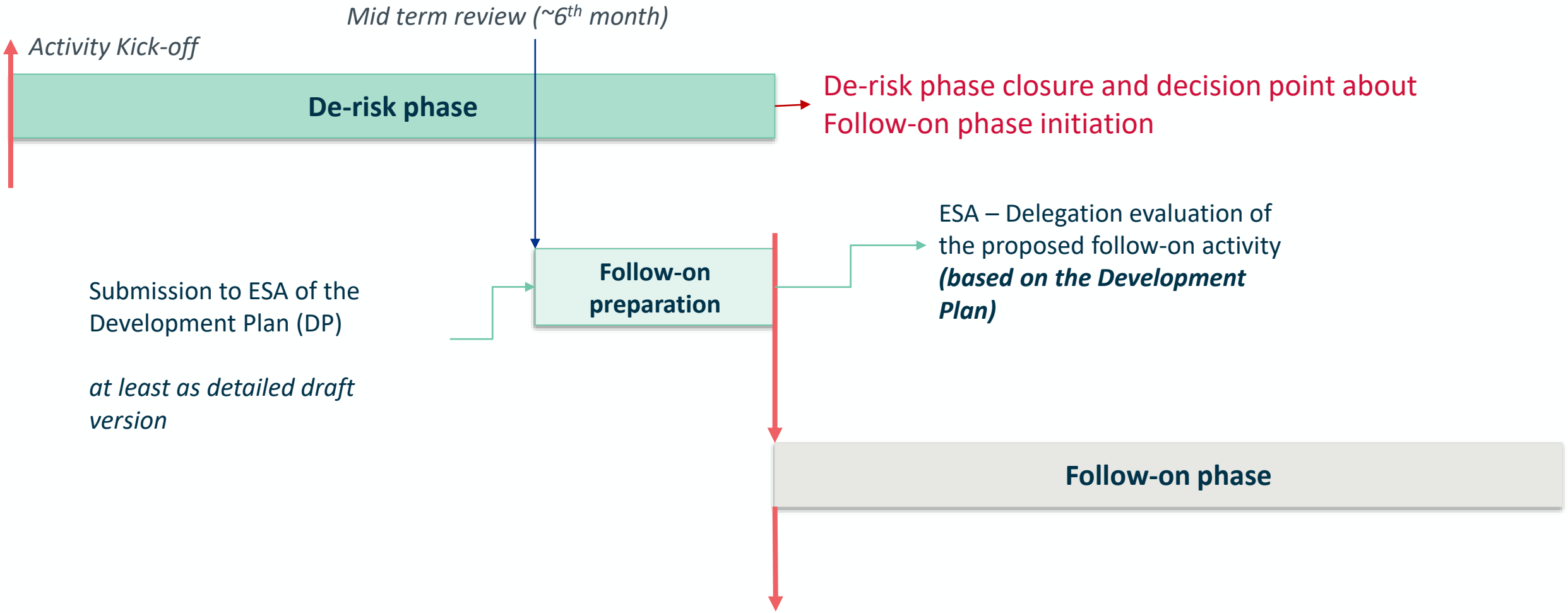
COMPENDIA

- **Published every 3 years with ~150 activities**.
- It covers all technology domains and selected specific areas.
- Activity proposals and selection of activities made by representatives of the technical and application domains and internally coordinated. **For specific areas industry validates the activities.**
- Source for the GSTP Work Plan. Procurement in Competition.
- **The objective of the Compendia:**
  - **To trigger discussions among industry and Delegations of the GSTP Participating States.**
    Activities supported are included within the GSTP WP.
    Source for targeted activities.



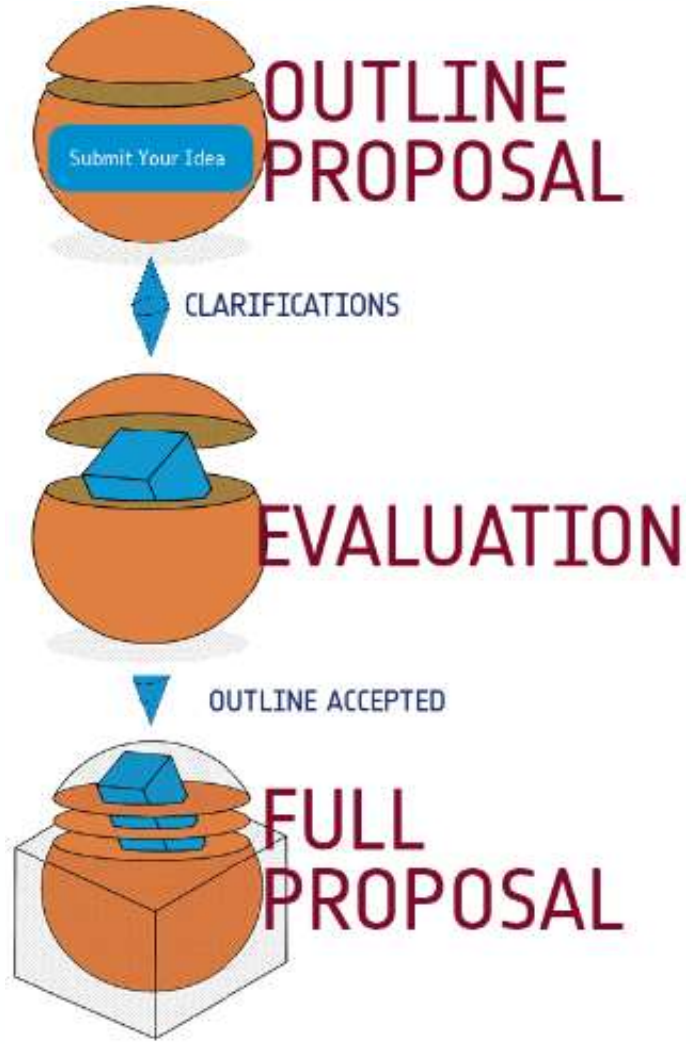




De-risk Framework – Element 1



Any Follow-on must be approved by IPC – 5 IPCs every year (~2 months)

GSTP E2 Make: Implementation



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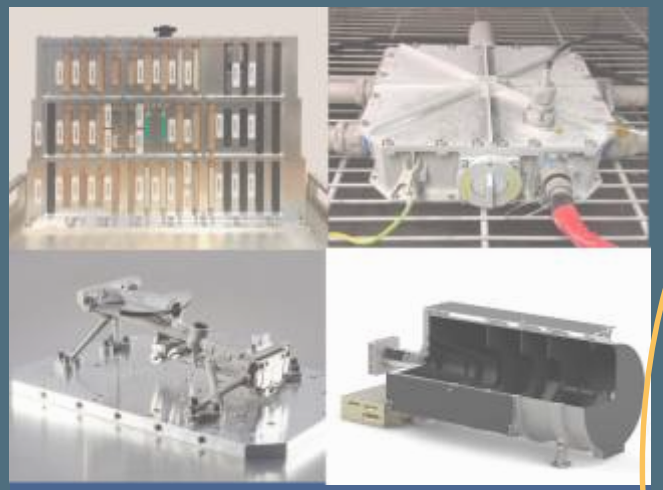
OUTLINE PROPOSAL EVALUATION CRITERIA

- Clarity and credibility of the business opportunity and market context (for segment 1) or the strategic opportunity and market context (for segment 2)
- Credibility and quality of the technical requirements, technical solutions versus activity objectives
- Credibility and quality of the proposed development plan, deliverables and schedule
- Credibility and quality of the bidder's background, experience and facilities
- Credibility and quality of the cost breakdown

GSTP - How to participate for technology developments

	Objective	Type of Procurement	Max Budget	Max Duration	Co-fund	First Step	Main Proc Doc
GSTP E1 Workplan	To develop space technologies up to qualification. Mainly ESA coordinated. Compendium and continuation of framework activities.	Competition and Direct Negotiation	No limit	No limit	Not Mandatory	ESA Star	SoW / DP
GSTP E1 BB fr.	Develop enabling capabilities and the associated building blocks for space related systems and the associated sub-systems	Direct Negotiation	1,000 k€	24 months	Not Mandatory	OSIP	Template
GSTP E1 De-risk fr.	To reduce funding and technical risks linked with new technologies/applications and to facilitate collaboration with new industrial players	Direct Negotiation	250 k€	9 months	Not Mandatory	OSIP	Template
GSTP E2	Industry initiated and driven, co-funded activities to strengthen competitiveness	Direct Negotiation	No limit	No limit	Mandatory	OSIP	Template

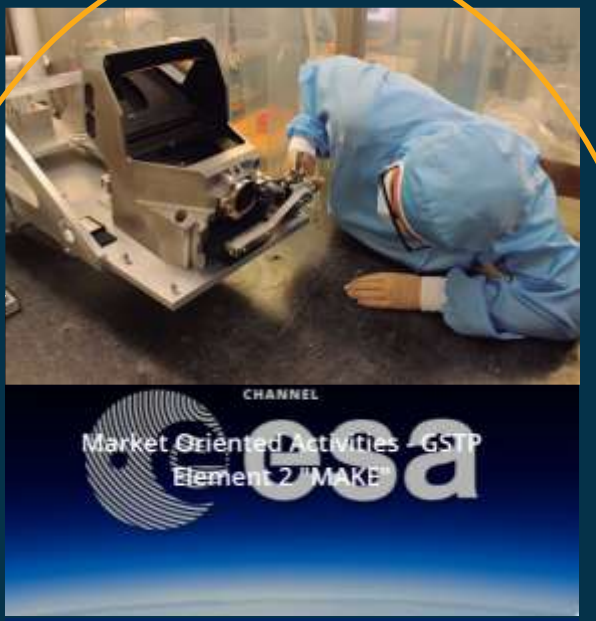
GSTP STRUCTURE



ELEMENT 1: DEVELOP

Supports technology developments up to qualification, capacity building & ESA technology aims.

→ **Compendia, Work Plan,** Frameworks



ELEMENT 2: MAKE

→ Industry initiated and driven, co-funded activities to strengthen competitiveness

COMPONENTS

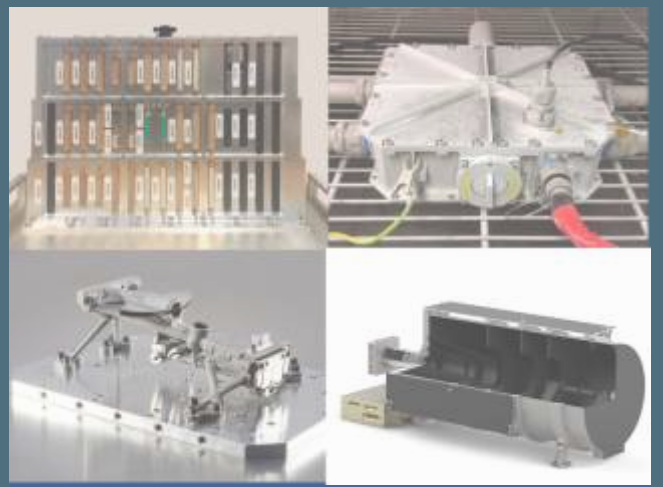
PRECISE FORMATION FLYING COMPONENT
implements phases C/D/E of the PROBA-3 mission

ELEMENT 3: FLY

On-ground and in-orbit demonstrations of technologies in need of acquiring in-orbit validation.

Specific Areas in Element 1: Cyber Security and Space-Based Solar Power
Two additional Components introduced in the context of CM-22:
EEE Space Component Sovereignty for Europe and EuropeaN Devices Using Radioisotope Energy (ENDURE)

GSTP STRUCTURE



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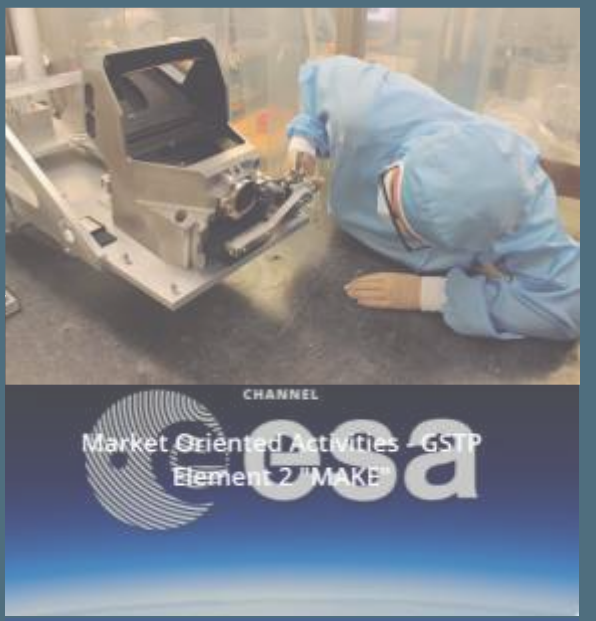

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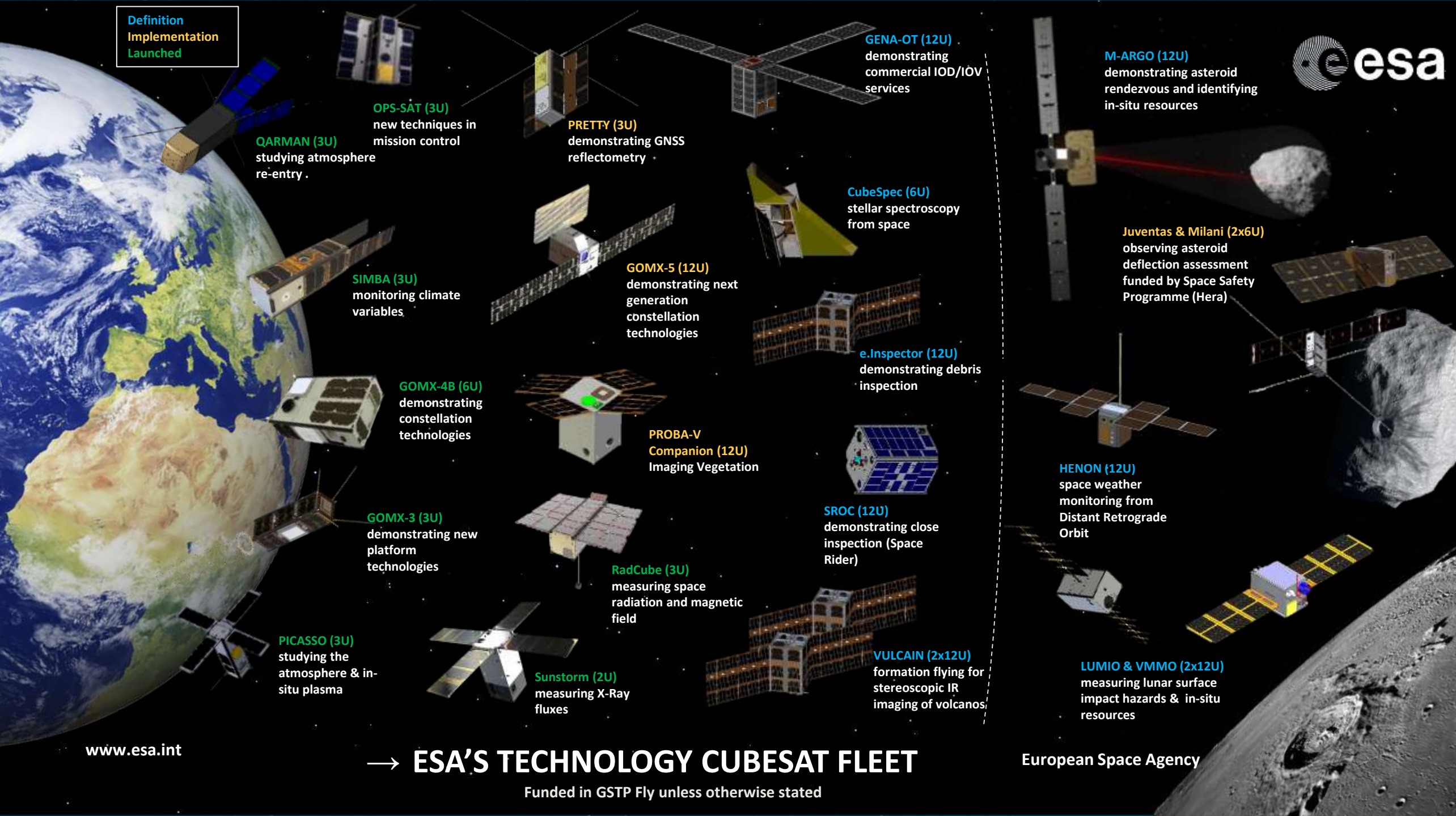
Definition
Implementation
Launched



OPS-SAT (3U)
new techniques in mission control

QARMAN (3U)
studying atmosphere re-entry .

PRETTY (3U)
demonstrating GNSS reflectometry

GENA-OT (12U)
demonstrating commercial IOD/IOV services

CubeSpec (6U)
stellar spectroscopy from space

SIMBA (3U)
monitoring climate variables

GOMX-5 (12U)
demonstrating next generation constellation technologies

e.Inspector (12U)
demonstrating debris inspection

GOMX-4B (6U)
demonstrating constellation technologies

PROBA-V Companion (12U)
Imaging Vegetation

SROC (12U)
demonstrating close inspection (Space Rider)

GOMX-3 (3U)
demonstrating new platform technologies

RadCube (3U)
measuring space radiation and magnetic field

PICASSO (3U)
studying the atmosphere & in-situ plasma

Sunstorm (2U)
measuring X-Ray fluxes

VULCAIN (2x12U)
formation flying for stereoscopic IR imaging of volcanos

M-ARGO (12U)
demonstrating asteroid rendezvous and identifying in-situ resources

Juventas & Milani (2x6U)
observing asteroid deflection assessment funded by Space Safety Programme (Hera)

HENON (12U)
space weather monitoring from Distant Retrograde Orbit

LUMIO & VMMO (2x12U)
measuring lunar surface impact hazards & in-situ resources

www.esa.int

→ ESA'S TECHNOLOGY CUBESAT FLEET

Funded in GSTP Fly unless otherwise stated

European Space Agency

Components: EEE Space Component Sovereignty & ENDURE

- Ultra Deep Sub-Micron
- Wide Band-Gap Power and RF
- Photonics
- Solar Cells
- Packaging, PCB and Electronic Assembly
- Test Facilities

EEE Aims: facilitate a sustainable **European supply-chain** for state-of-the-art, high-value European EEE Components in a timely manner and implement an **end-to-end plan** for each **Technology Line**.

To be implemented in **strong synergy** with European Space Component Coordination/Component Technology Board and ESA Harmonisation roadmaps. **Synergies and coordination** with ESA Member State national programmes and European Commission (EC) activities will be pursued

ENDURE Phase 1 Objectives: **Establish an operational Am-241 fuel production capability and mature radioisotope power system technologies** (Radioisotope Heating Unit, Radioisotope Thermal Generator)

RPS Launch capabilities (Launch safety authorisation, launch site and launcher upgrades) are being addressed in the STS programmes