# General Support Technology Programme

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Directorate of Technology, Engineering and Quality

Riga, Latvia, September 12, 2023

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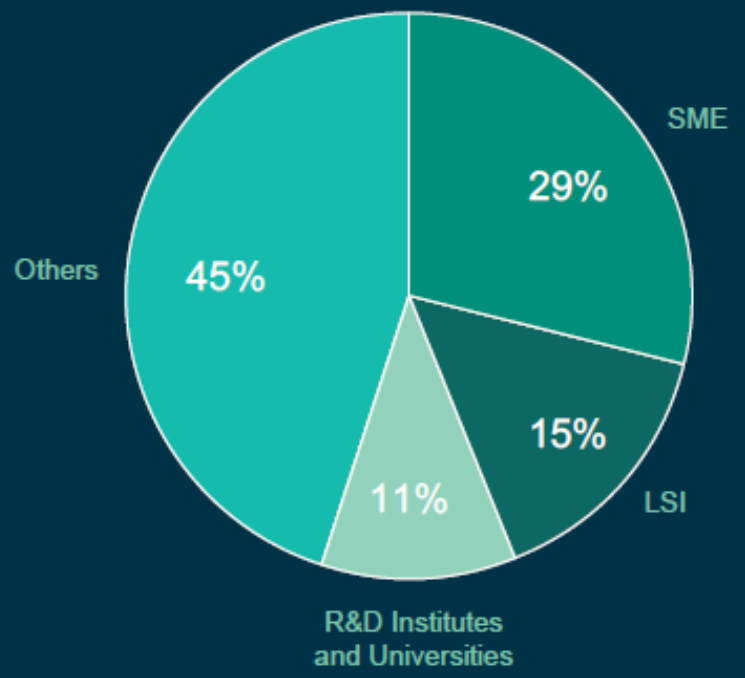
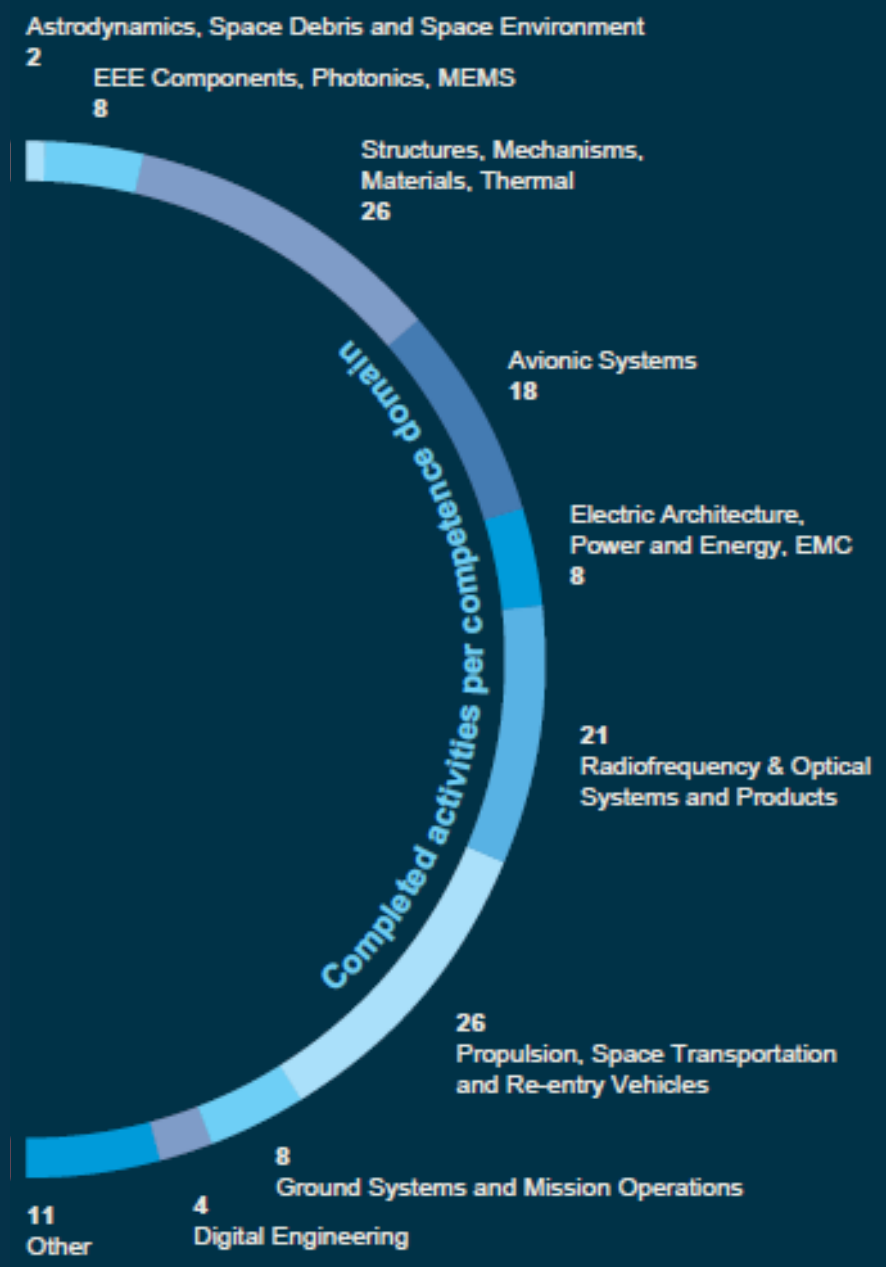
- Background / Overview of GSTP
- GSTP Element 1 Compendia and Workplan
- GSTP Element 1 Frameworks
- GSTP Element 2 Announcement of Opportunity
- GSTP Element 3 Technology Demonstration
- Conclusions

# GSTP's mission

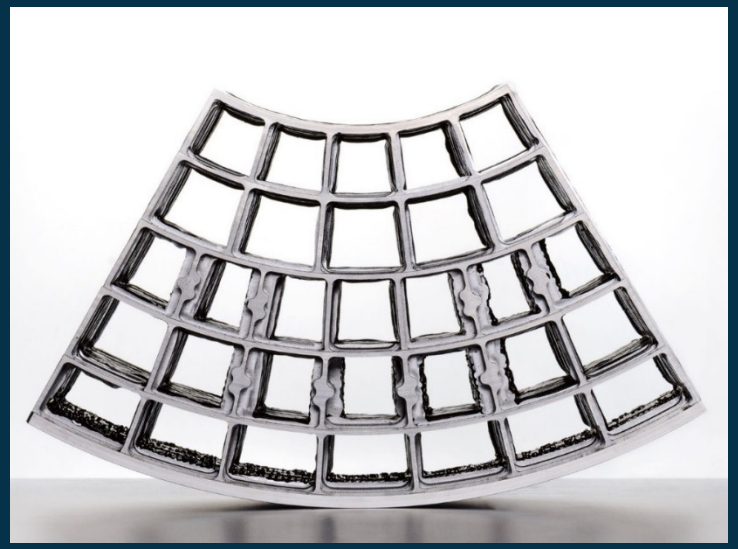



- For 30 years, GSTP has been developing leading-edge space technologies: enabling missions & supporting industry competitiveness
- GSTP allows companies of all sizes and research/academic organisations to perform technology developments and demonstrations
  - Building capacities and fostering innovation
  - Creating and improving products and services
- GSTP is an optional ESA programme with the participation of all ESA Member, Associate and Co-operating States
  - 27 Participating States in total

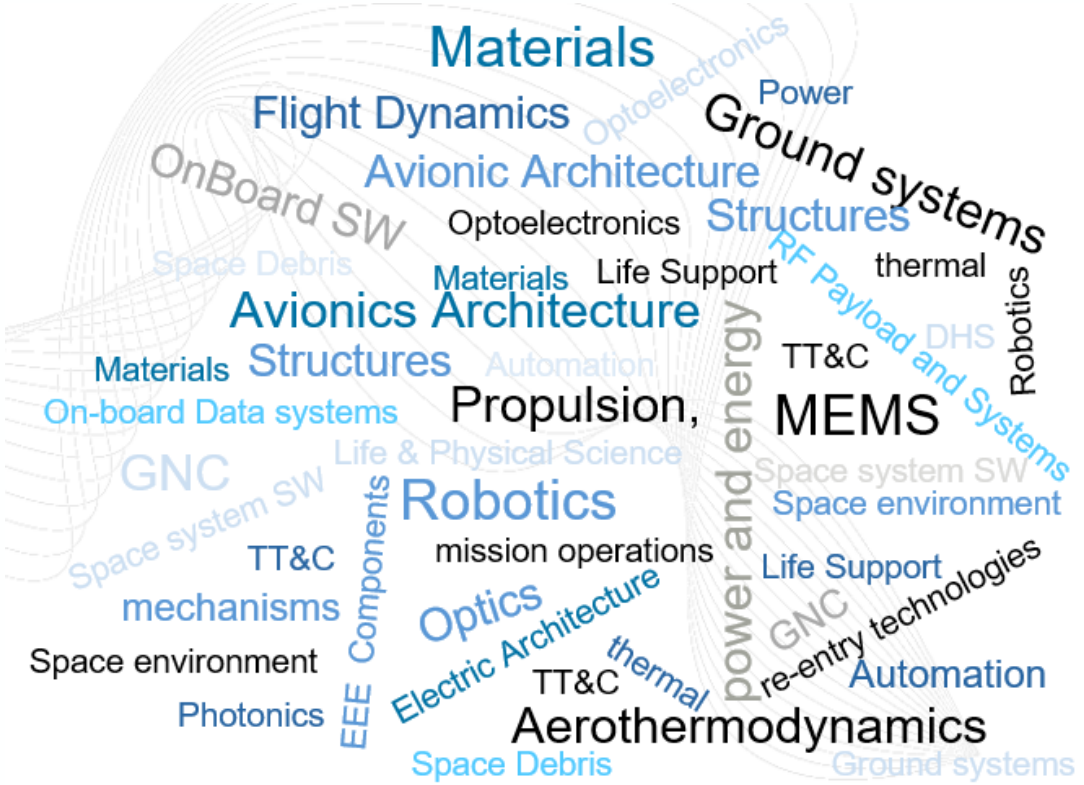
# GSTP: 2022 at a glance

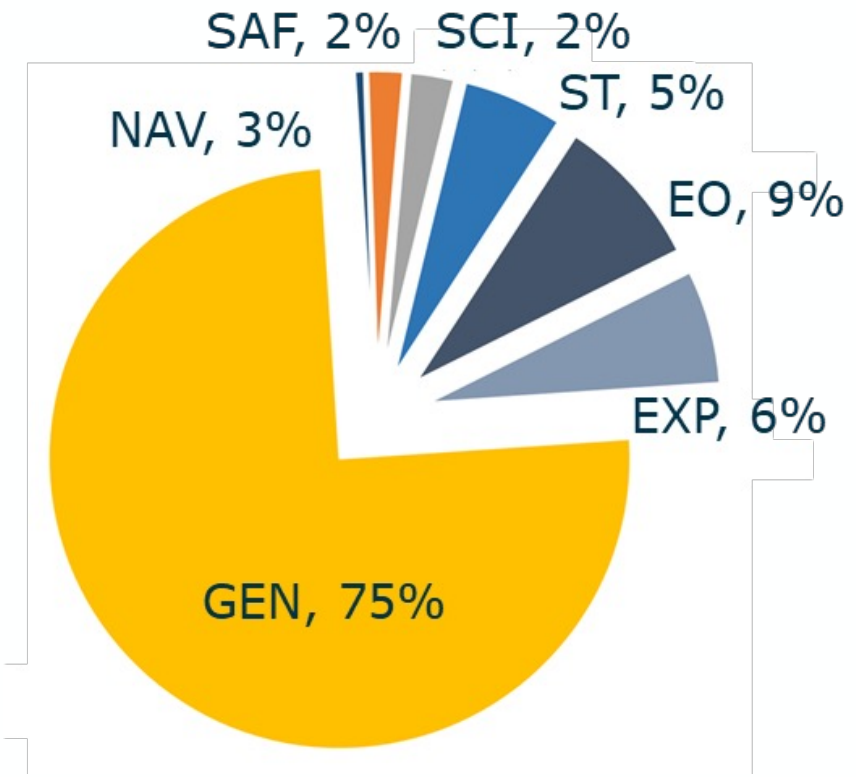



- Over 500 running activities
- 140 activities completed
- 130 technology development and demonstration activities initiated, representing over 100 MEuro in contracts



# GSTP Technology and Application Areas




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 Subscriptions

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

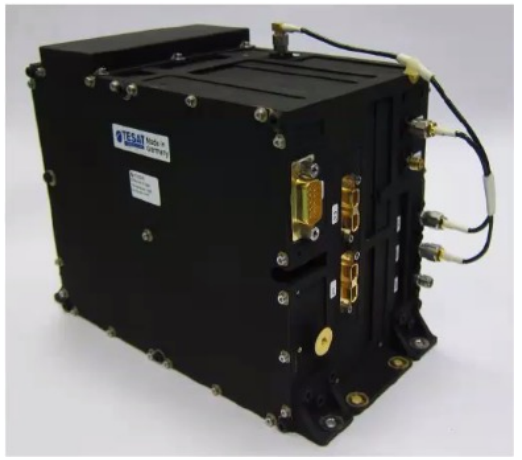
It is possible to propose activities and to bid for activities with partners from these States

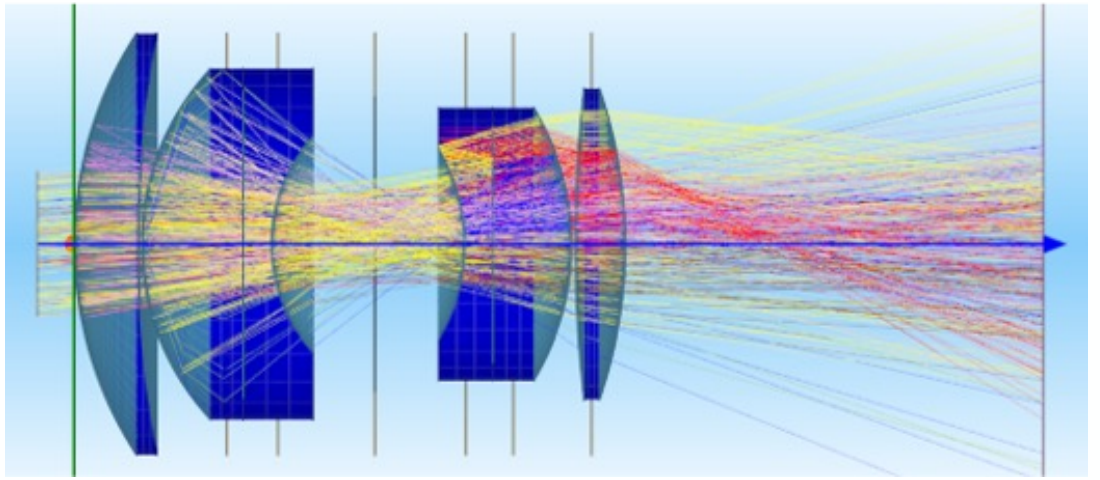
Latvian total subscription: 3 MEuro

4 activities are being implemented so far

# Examples of products supported in GSTP

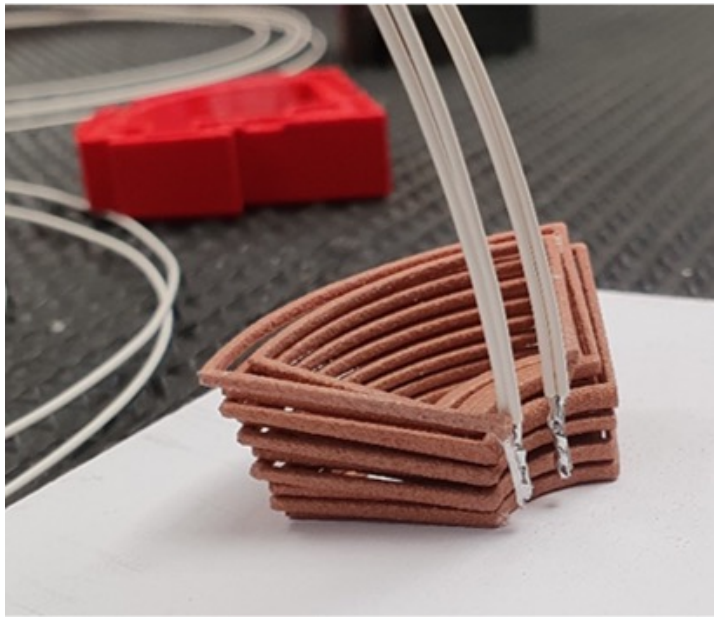
Reconfigurable Telemetry Transmitter





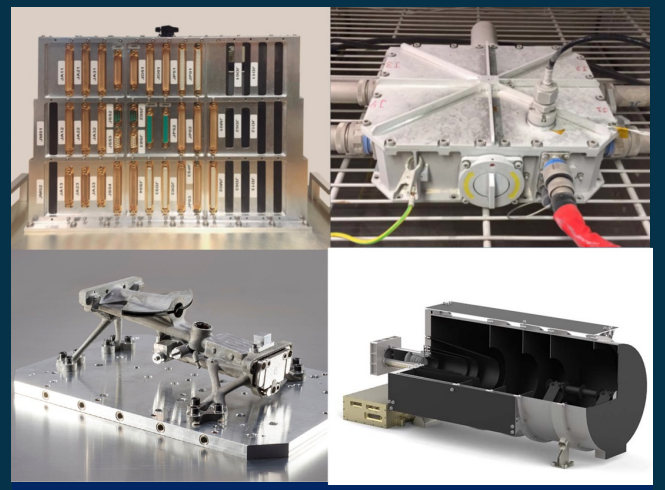
Optical system modelling software

ADEO space brake sail



Additive manufacturing of copper (magnetic) coils

# 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

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implements phases C/D/E of the PROBA-3 mission

## ELEMENT 3: FLY

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**Specific Areas in Element 1:** Cyber Security and Space-Based Solar Power
**Two additional Components introduced in the context of CM-22:**
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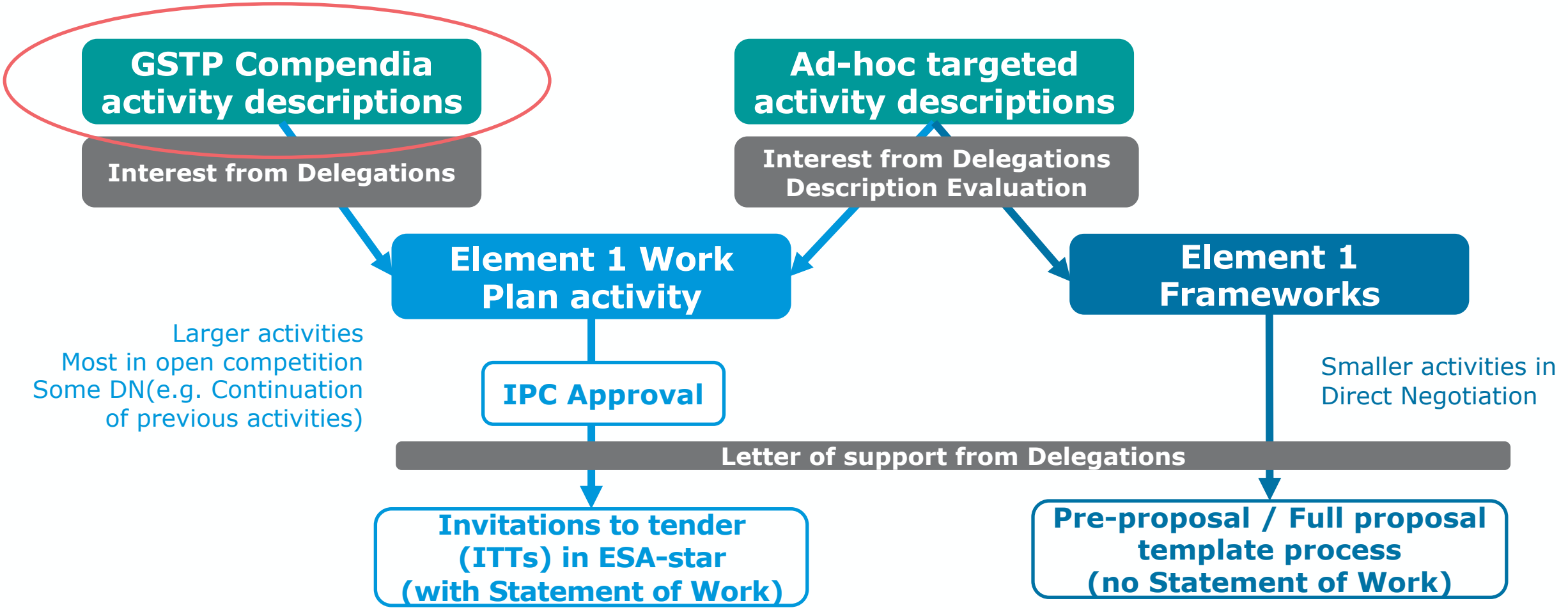
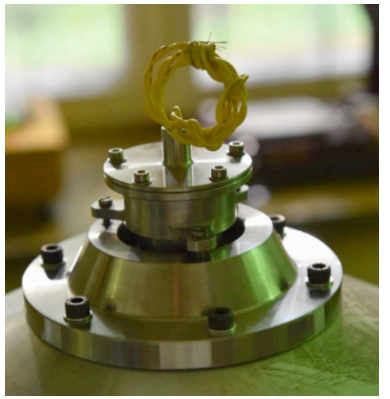
# GSTP Element 1

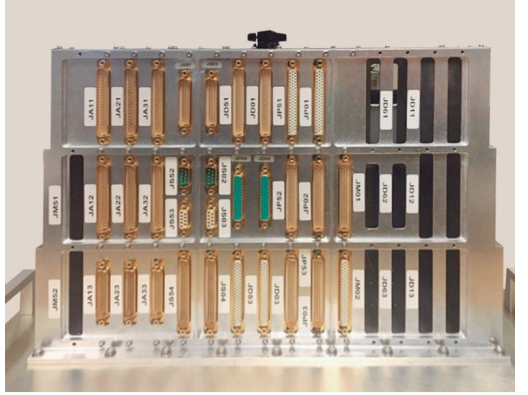


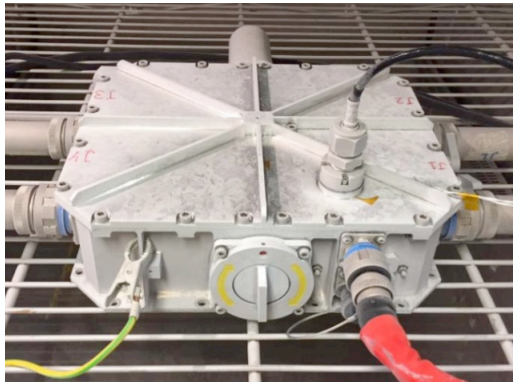
# GSTP Element 1

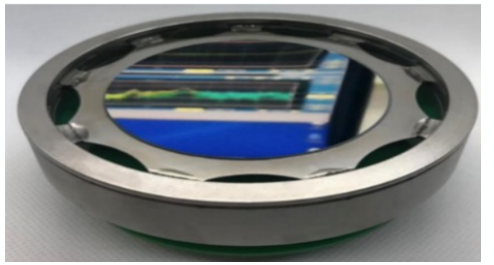
## COMPENDIA

- **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.









# GSTP Element 1

## Compendia 2022

**ESA Driven:**

- Generic Technologies

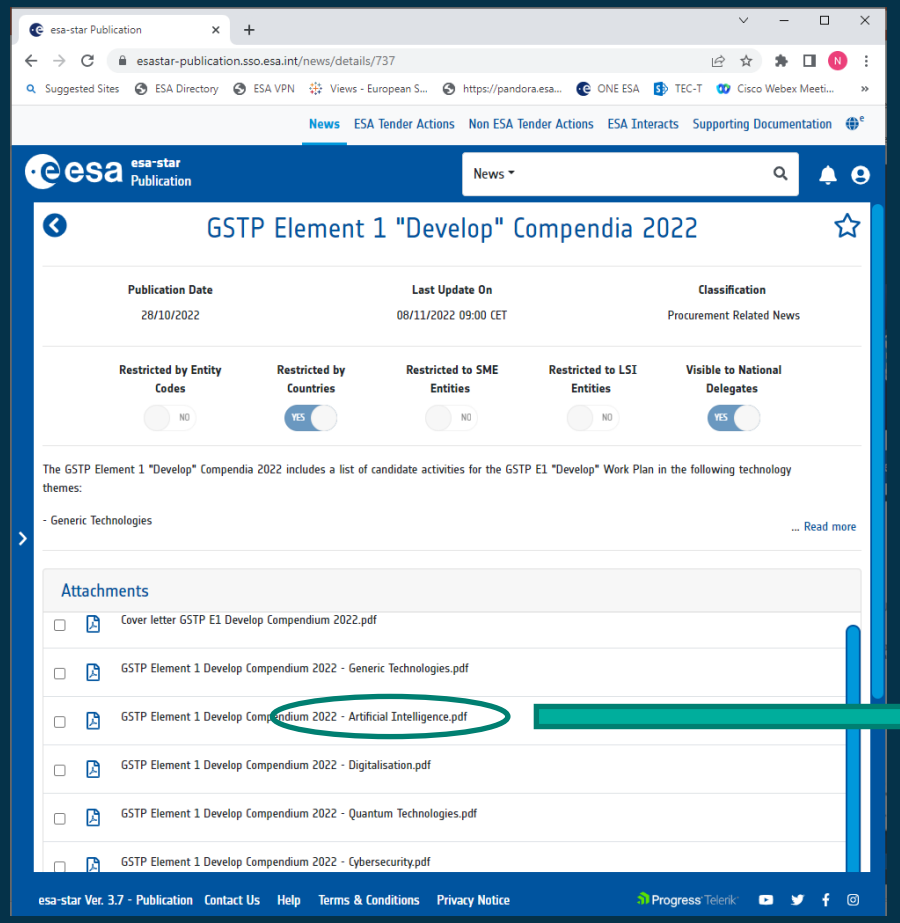
**Industry Driven:**

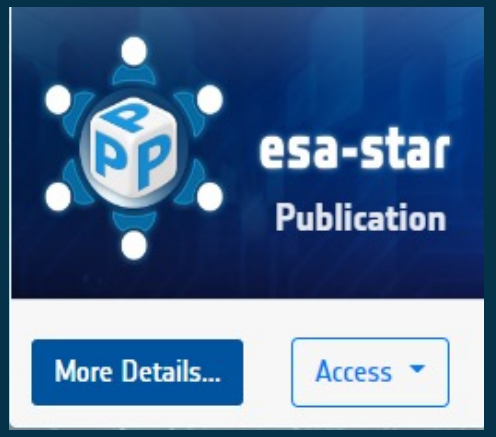
- Artificial Intelligence - Edge/AI on Board, GNC, Mission Operations
- Digitalisation - Data Management, MBSE, Simulation, Digital Twin
- Quantum Technologies – Quantum Sensing, Atom interferometers, Atomic frequency standards, Quantum Computing, Quantum Memories…
- Cybersecurity

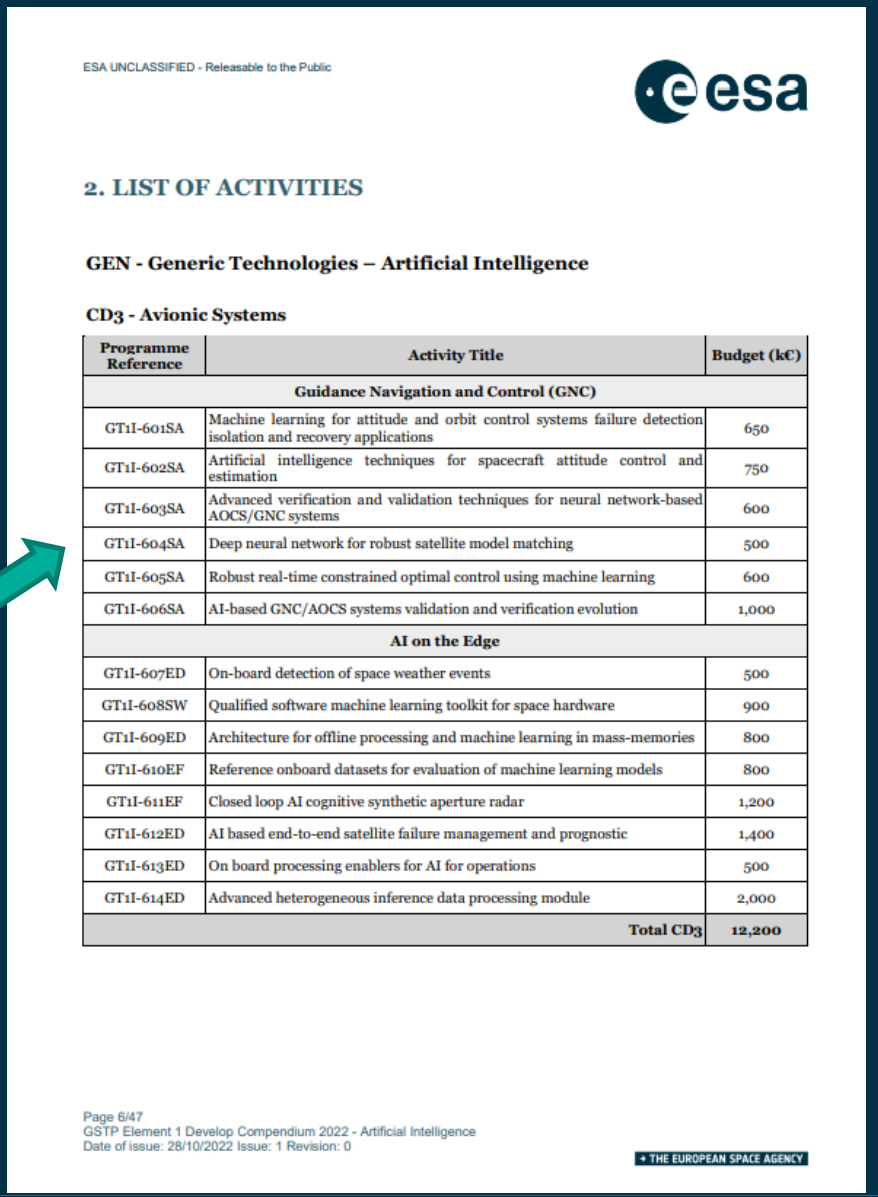
esa-star Publication

- Publication in November 2022
- First activities in WP Feb 2023
- Implementation over 2023/25

# GSTP Element 1





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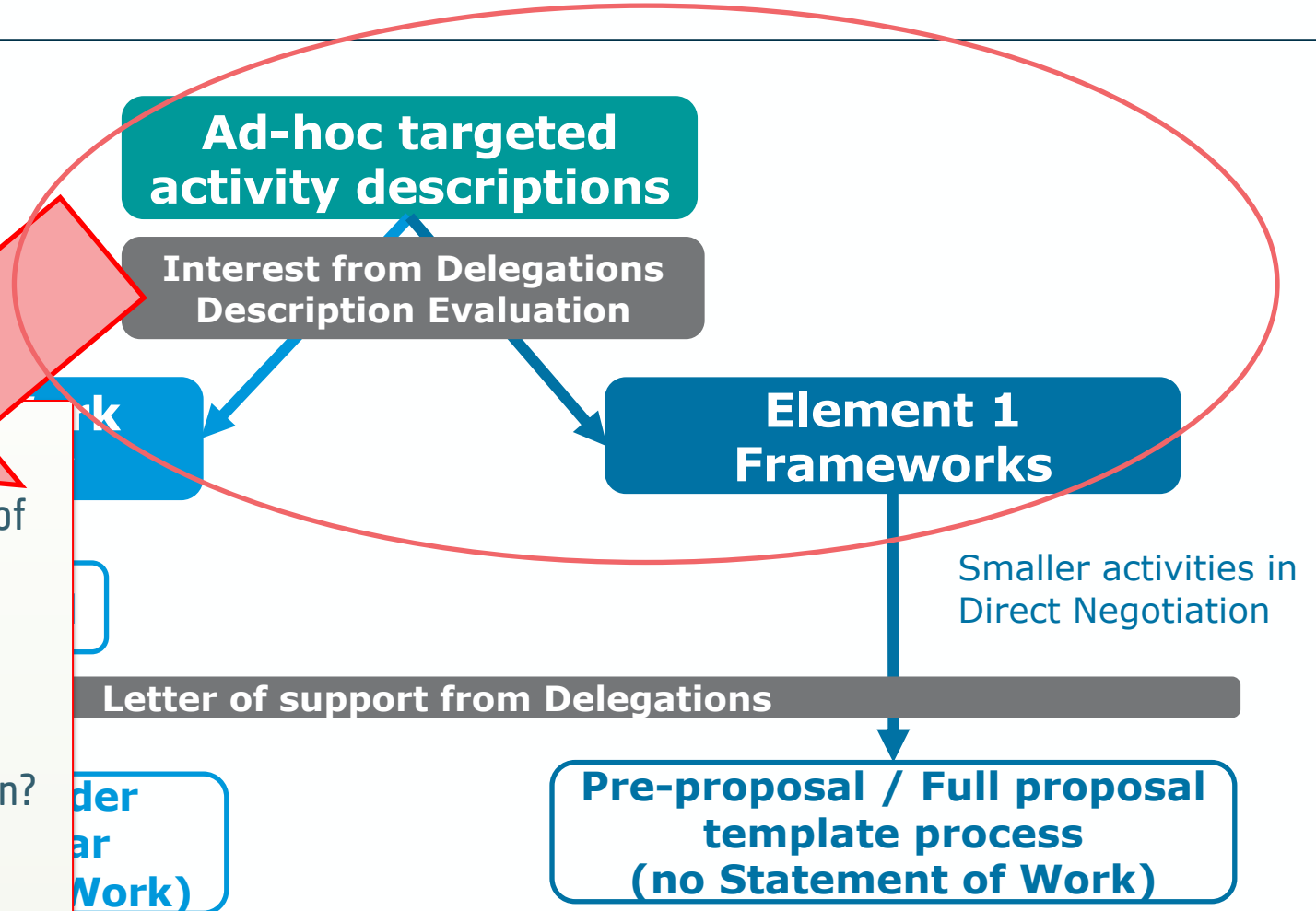
GSTP Element 1 Develop Compendium 2022 - Artificial Intelligence
Date of issue: 28/10/2022 Issue: 1 Revision: 0

THE EUROPEAN SPACE AGENCY

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

# GSTP Element 1



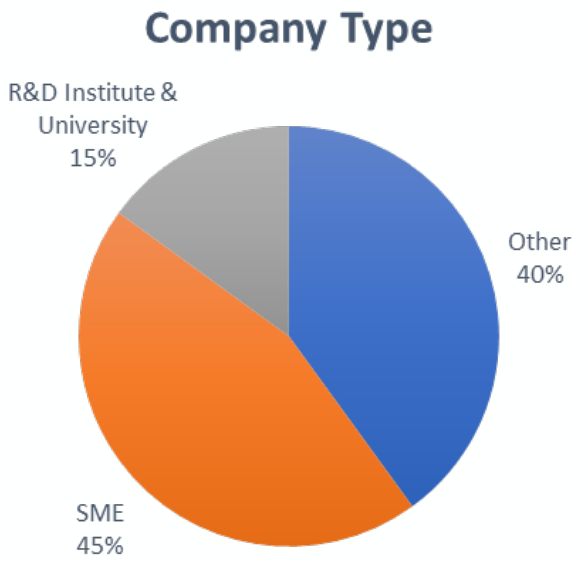

GSTP Criteria – Description Evaluation:

- 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

# De-risk Framework – Element 1

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

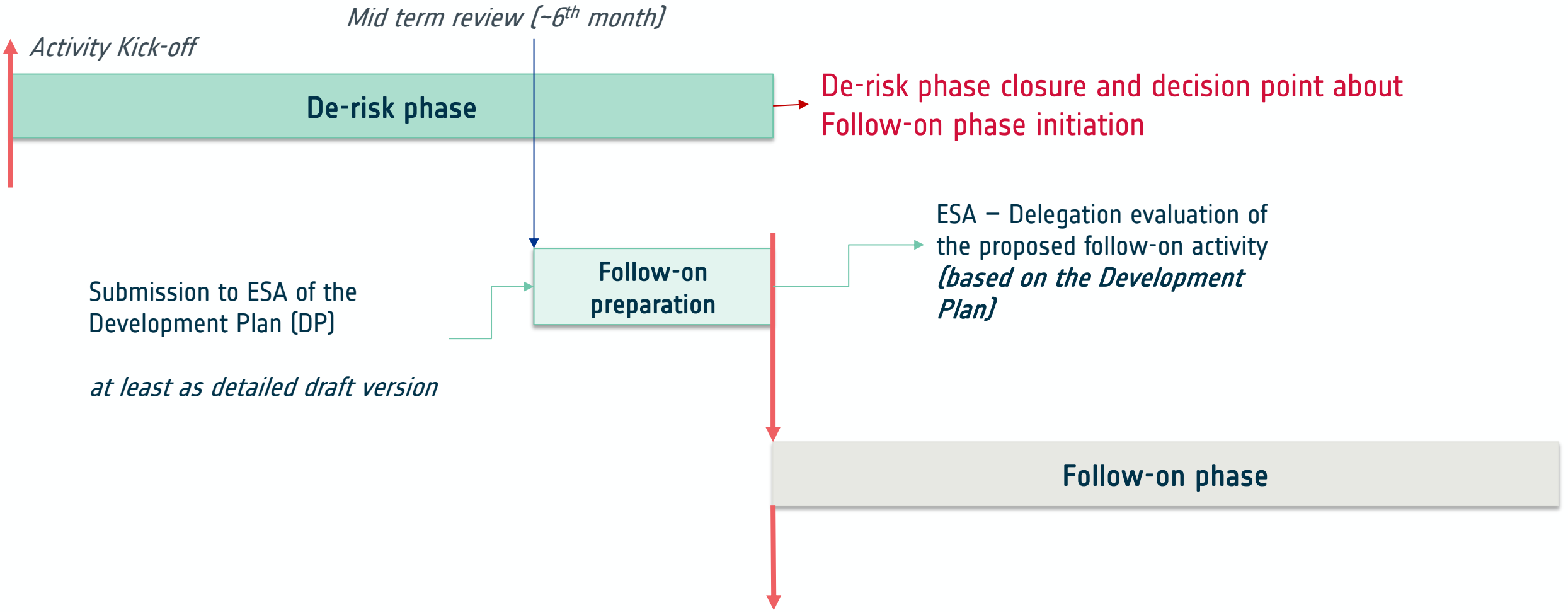
**Approved by IPC in November 2016 "…to allow for assessments that will help prepare and de-risk potential development activities".**




| Procurement using a template | Follow-on procurement <u>based on template</u> | ~40 de-risk initiated every year |
|---|---|---|
| • Max budget 200k€<br>• Max Duration 9 months | • No budget limit<br>• No duration limit<br>• ~ 35% de-risk are continued | • >200 de-risk so far<br>• ~ 35 M€ overall budget |

Permanent Open Call in ESA-Star

# De-risk Framework – Element 1



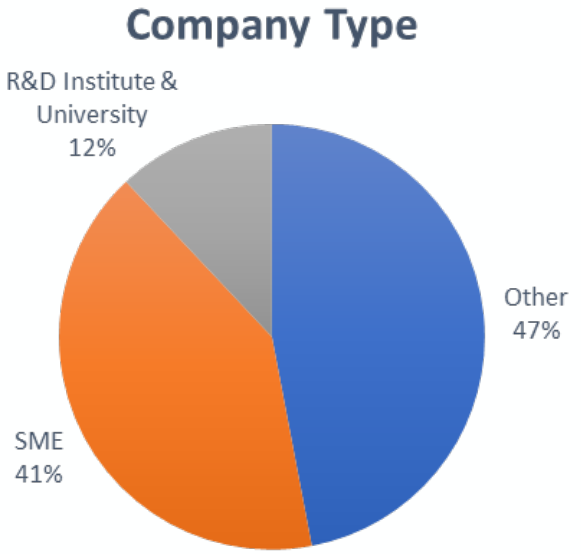

Any Follow-on must be approved by IPC – 5 IPCs every year (~2 months)

# Building Block Framework – Element 1

## 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**

- Max budget 1M€
- Max Duration 24 months

**~20 activities initiated every year**

- 100 activities so far
- ~ 45 M€ overall budget

Permanent Open Call in ESA-Star

# Framework procurement process

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

**Not-Official ESA procurement**

*Communications allowed with ESA Technical Officer and GSTP*

*Outline Proposal in OSIP*

*Outline Proposal evaluation*

*Activity scope refinement*

**Official ESA procurement**

*Communications allowed only through ESA assigned Contract Officer*

Proposal submission using ESA-Star

TEB & Negotiation

**Commitment**

# Framework procurement process

Outline Proposal → Evaluation → Proposal

ideas.esa.int

ESA-star

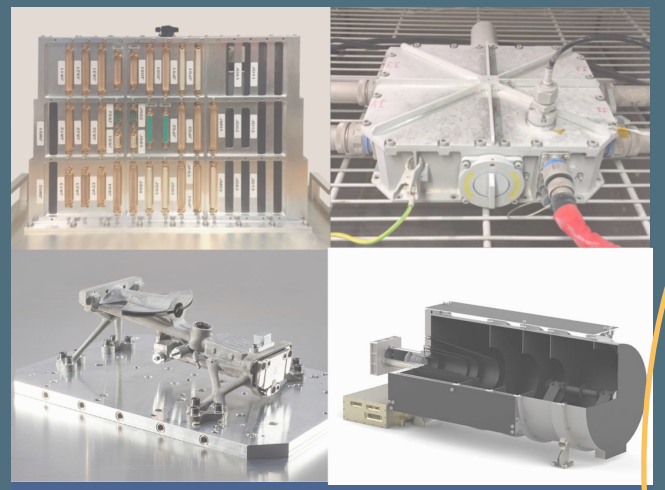
[Building Blocks] - GSTP Element 1 "Develop"

[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 STRUCTURE



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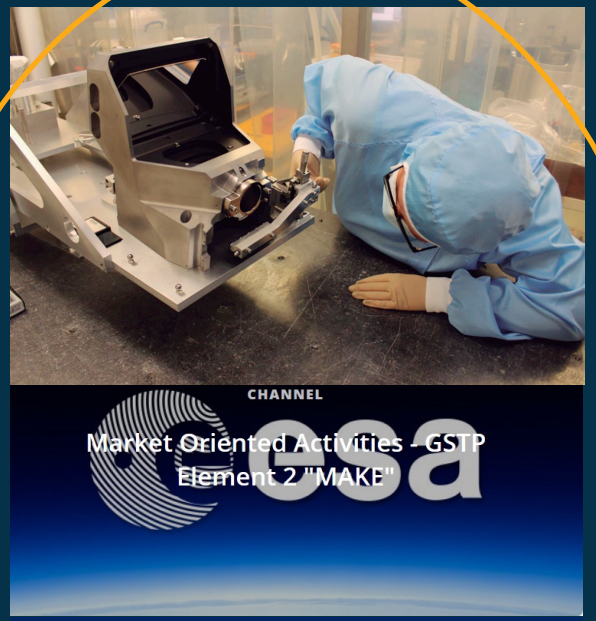


## ELEMENT 2: MAKE

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

## COMPONENTS

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implements phases C/D/E of the PROBA-3 mission

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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
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# GSTP Element 2 Make

## ANNOUNCEMENT OF OPPORTUNITY

2020: First full year with the current structure

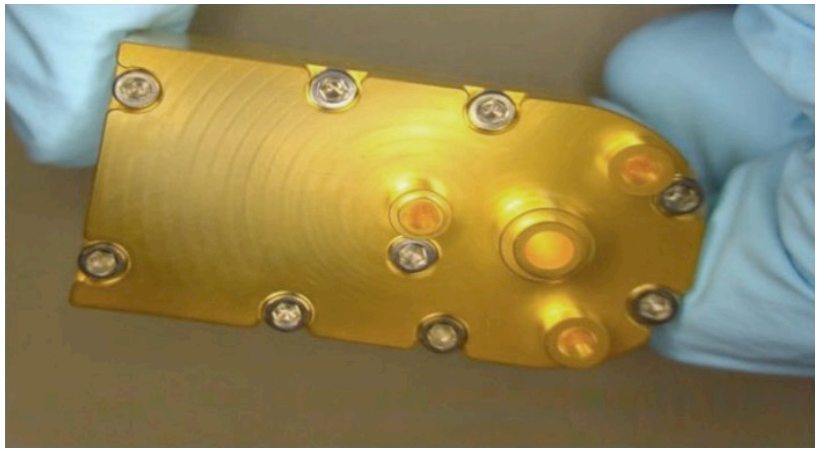
3 segments:

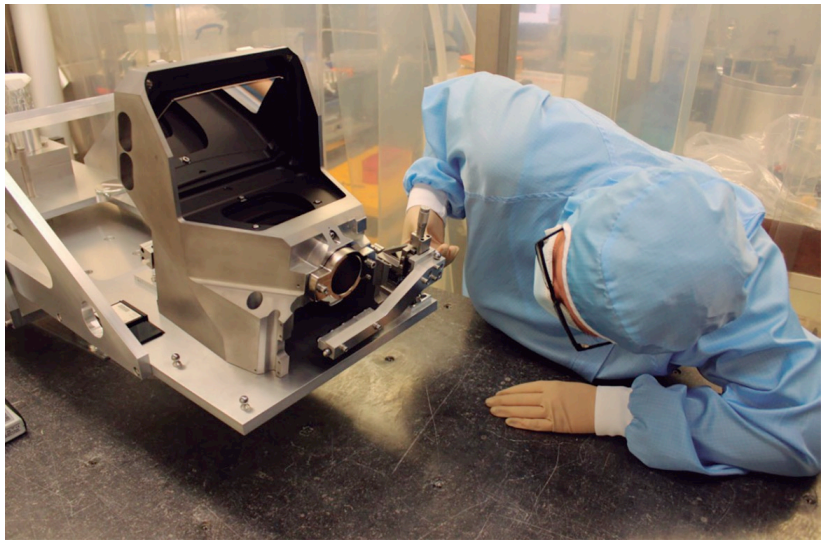
- Market Oriented Opportunities,
- Strategic Opportunities and
- Implementation of National Priorities

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

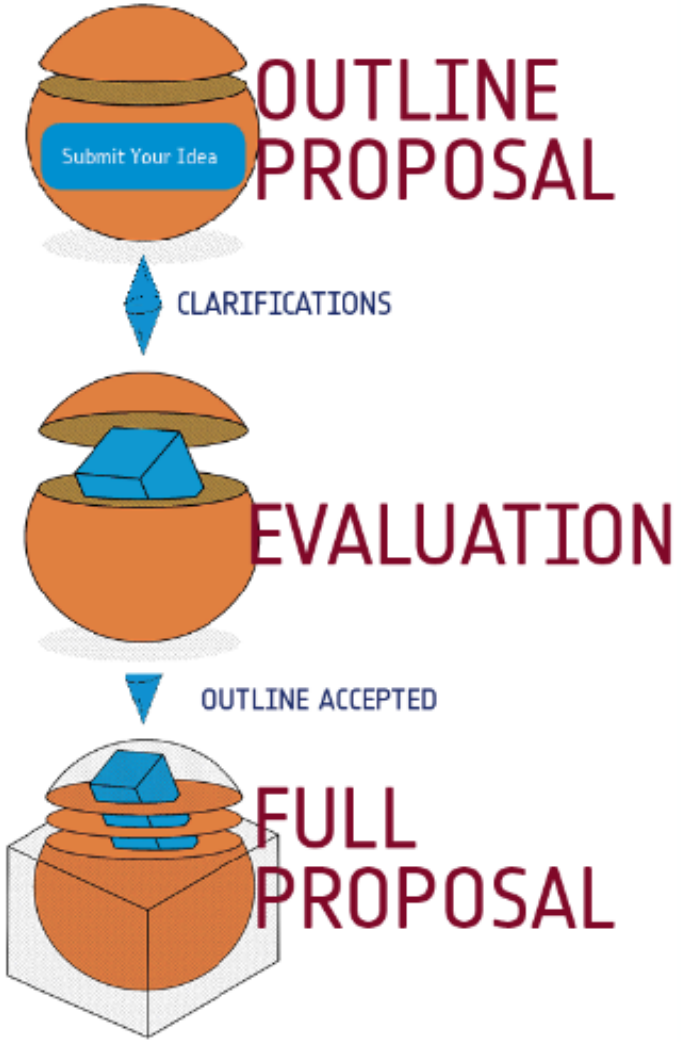
2020-2022: significant increase in proposals received

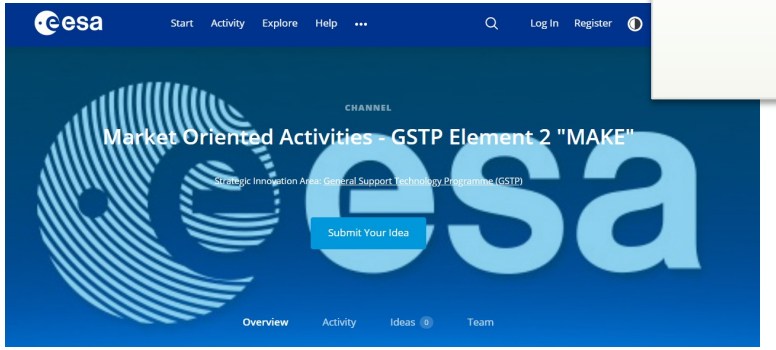
25-30 activities committed per year (30-35 MEuro)





# GSTP E2 Make: Implementation

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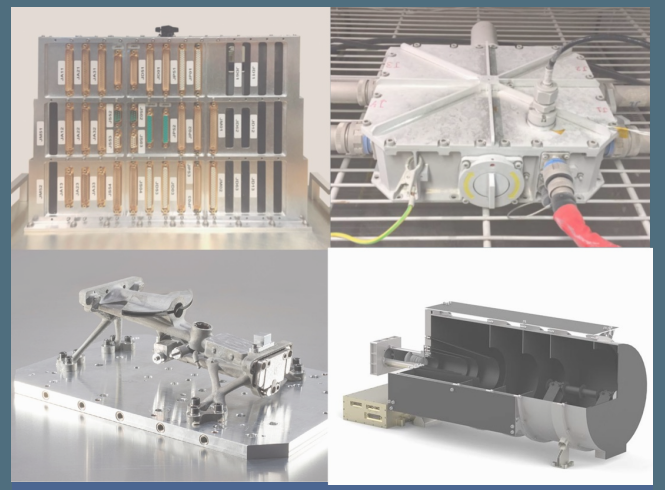
## OUTLINE PROPOSAL EVALUATION CRITERIA

- 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 | 200 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



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# GSTP Element 3

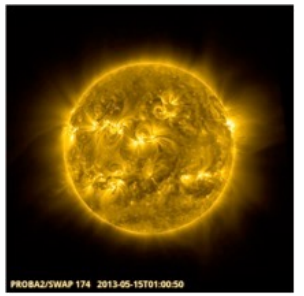
## Facilitate Technology Demonstrations

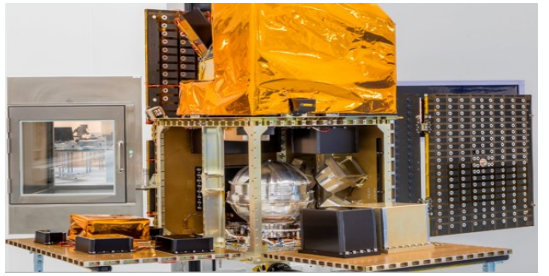
### The main objectives related to Element 3 are to

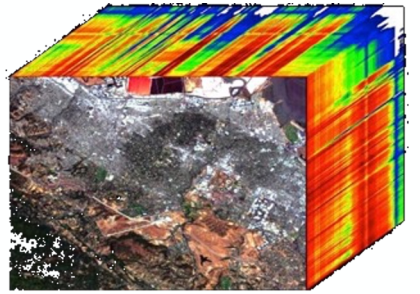
- ensure the successful implementation of the **Missions** and **In-Orbit Demonstrations** currently in preparation
- identify/prepare new mission/IOD opportunities and
- expand and enhance the demonstration approach

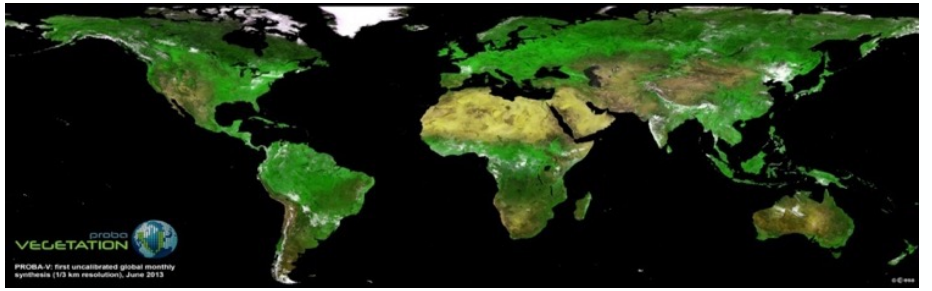
### Opportunities cover:

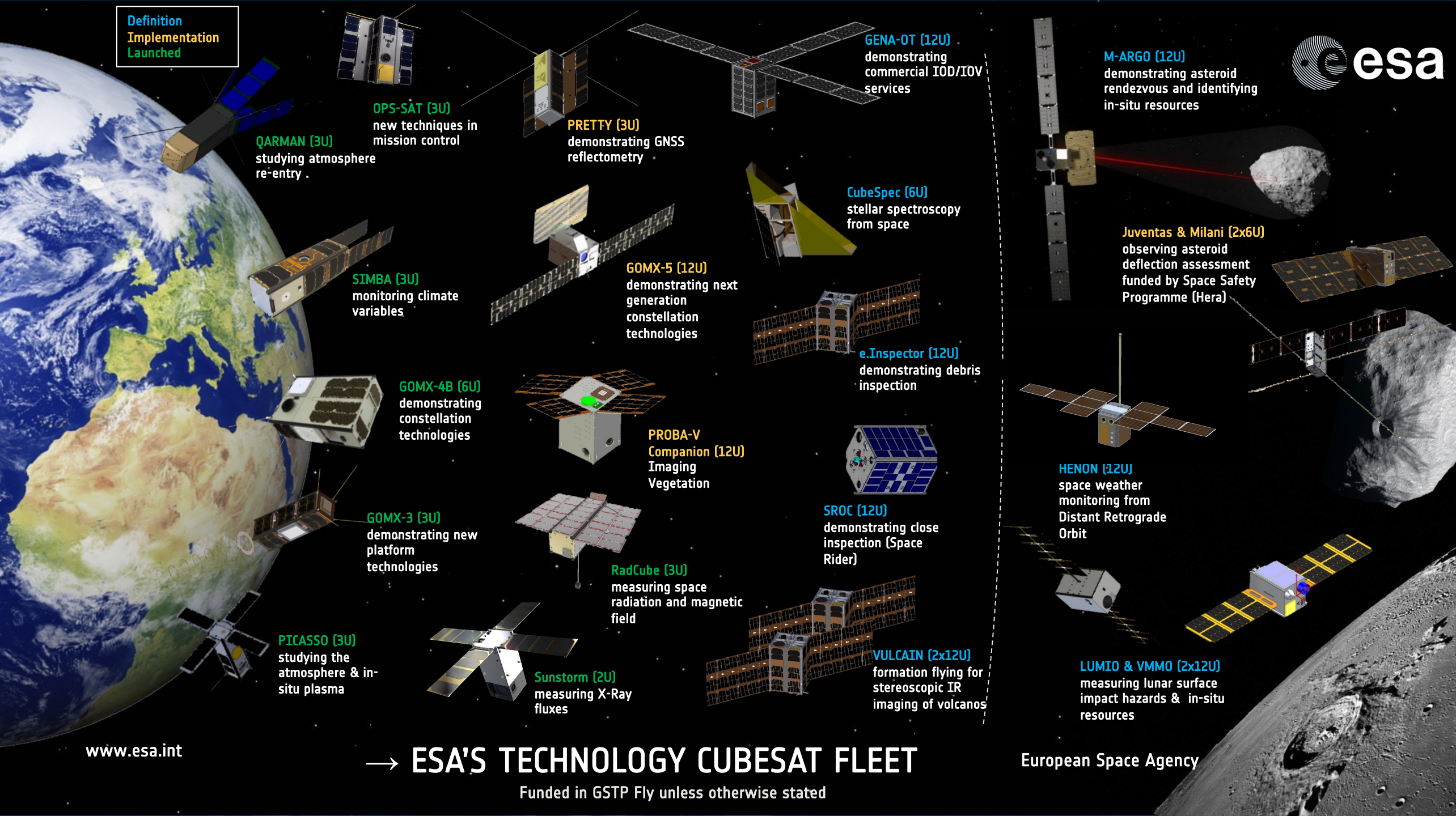
- Demonstration of technology (e.g. platform units, Li-ion batteries)
- Demonstration of techniques (e.g. ADS-B, hyper-spectral, …)
- First demonstrations of potential capabilities








Definition
Implementation
Launched
QARMAN (3U)
studying atmosphere re-entry .
OPS-SAT (3U)
new techniques in mission control
PRETTY (3U)
demonstrating GNSS reflectometry
GENA-OT (12U)
demonstrating commercial IOD/IOV services
M-ARGO (12U)
demonstrating asteroid rendezvous and identifying in-situ resources
CubeSpec (6U)
stellar spectroscopy from space
SIMBA (3U)
monitoring climate variables
GOMX-5 (12U)
demonstrating next generation constellation technologies
Juventas & Milani (2x6U)
observing asteroid deflection assessment funded by Space Safety Programme (Hera)
e.Inspector (12U)
demonstrating debris inspection
GOMX-4B (6U)
demonstrating constellation technologies
PROBA-V Companion (12U)
Imaging Vegetation
HENON (12U)
space weather monitoring from Distant Retrograde Orbit
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
LUMIO & VMMO (2x12U)
measuring lunar surface impact hazards & in-situ resources
esa
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

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

# Some Links / Events

EVENTS:

GSTP 30 years Event – Gdansk (PL) 26th/27th September 2023

www.esa.int/Enabling_Support/Space_Engineering_Technology/Shaping_the_Future

esastar-publication.sso.esa.int

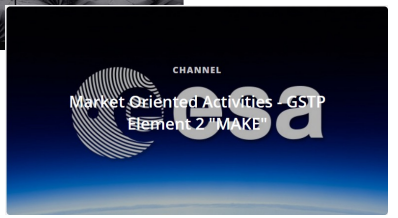
The procurement portal is a source for:

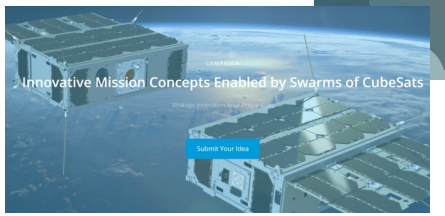
- Registration of new companies to do business with ESA
- Invitations to tender
- News/Procurement related announcements: GSTP Compendia Publication

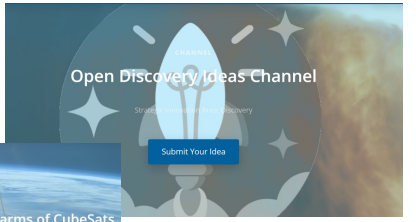
ideas.esa.int

Open Space Innovation Platform

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



# Thank You