european space technology harmonisation

45 years

50 YEARS OF INNOVATION AT ESA

ESA Technology Harmonisation and Technology Implementation through GSTP and TDE Activities

Giovanni Modugno

Giovanni.Modugno@ext.esa.int

Technology Coordination and Planning Office | TEC-RH

Nerea Socorro Morales

Nerea.Socorro@esa.int

Technology Programmes Office | TEC-RT

Software Product Assurance Conference (ESTEC), September 2025

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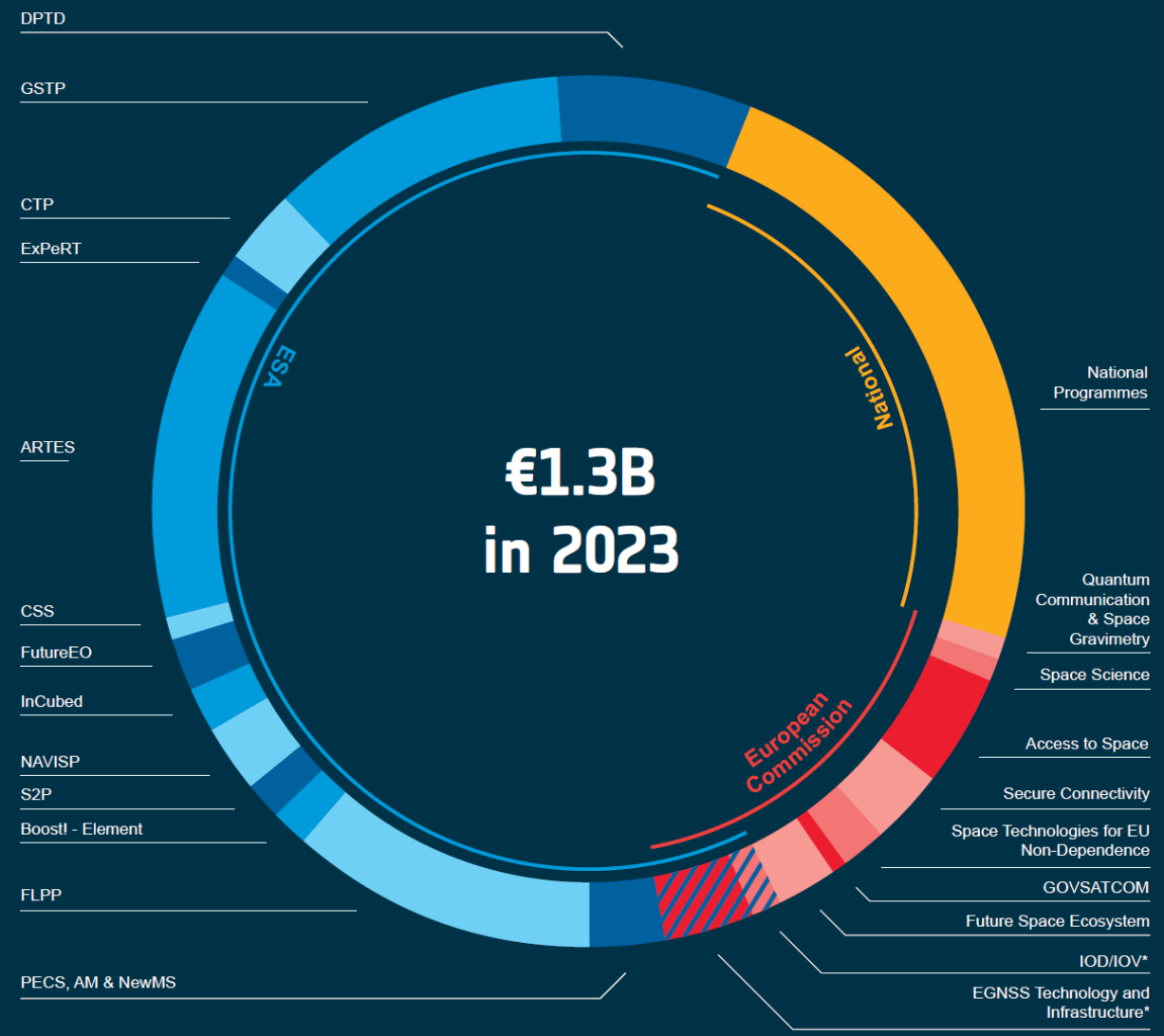
What is ESA Technology Harmonisation?

european
space technology
harmonisation

It is a structured process led by the European Space Agency (ESA) to coordinate and align technology development activities across Europe's space sector.

Its main goal is to ensure that investments in space technologies are efficient, non-duplicative, and address the real needs of European space missions and industry.

Institutional space technology civil R&D budgets in Europe



Institutional Space Technology civil R&D budgets in Europe reached **1.3 B€** in 2023:

- **760 M€** through ESA programmes
- **310 M€** in National programmes
- **230 M€** from European Commission

Reference: 2024 ESTMP

Key Objectives of Harmonisation

The European Space Technology Harmonisation is a European-wide collaboration to efficiently coordinate future R&D activities to:

IDENTIFY GAPS
(MISSING TECHNOLOGIES)
& OVERLAPS
(DUPLICATED EFFORT)

COORDINATE
TECHNOLOGY DEVELOPMENT AMONG ESA, NATIONAL AGENCIES AND INDUSTRY

SET COMMON PRIORITIES
FOR TECHNOLOGY DEVELOPMENT

PROMOTE COLLABORATION
AND INFORMATION SHARING

Harmonisation Organisation and Stakeholders

*Space Entities include Industry, R&D Organisation, Academia and Associations

Harmonisation Products

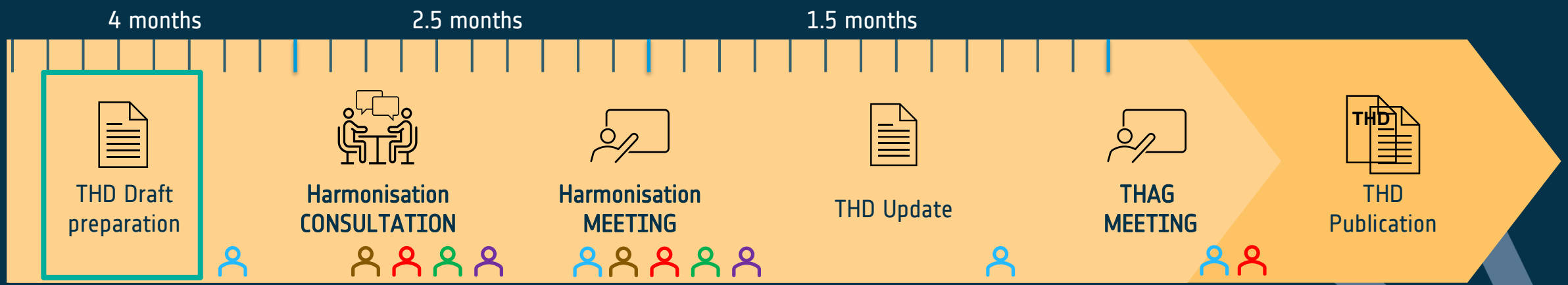
Technology Harmonisation Dossier

- 10 THDs published per year.
- Contains state of the art of the technology and Roadmaps.

European Space technology Master Plan

- 1 ESTMP published per year.
- Overview of the current state of space technology development.

Harmonisation Process



ESA Experts draft the Technology Harmonisation Dossiers (THD) that include high-level roadmaps.	All stakeholders may provide feedback on draft THDs.	Open and free meeting for all stakeholders to discuss feedback from the Consultation.	Based on feedback received, ESA Experts update the THDs.	Meeting between ESA and THAG to agree on final THDs before publication.

ESA · THAG · Spaces Entities · European Commission · European Defence Agency

Active Harmonisation topics

Micro And Nano Tech. - MEMS Pressure Sensors, MOEMS and RF-MEMS
Optical Detectors
Photonics

Actuators Building Blocks for Mechanisms
Additive Manufacturing
Coatings
Composite Materials
Cryogenics and Focal Plane Cooling
Deployable Booms & Inflatable Structures
Heat Transport Equipment and Systems
Printed Circuit Boards and Electronic Assembly Technologies
Pyrotechnic Devices
Solar Array Drive Mechanisms
Technologies for Hold Down, Release, Separation and Deployment Mechanisms

AOCS and GNC Systems
Avionics Embedded Systems
On-Board Computers, Data Handling Systems and Microelectronics
On-Board Software
On-Board Radio Navigation Receivers
TT&C Transponders and Payload Data Transmitters

Electromagnetic Compatibility
Electrochemical Energy Storage
Power Management and Distribution
Solar Generators and Solar Cells

Array Antennas and Periodic Structures
Critical Active RF Technologies
Frequency and Time Generation and Distribution (Space & Ground)
Microwave Passive Hardware
Lidar Critical Subsystems
Optical Communications for Space
Power RF Measurements & Modelling
Reflector Antennas
Technologies for Optical Passive Instruments (Stable & Lightweight Structures, Mirrors)
Technologies for Passive Millimetre & Submillimetre Wave Instruments

Automation and Robotics
Life Support Technologies

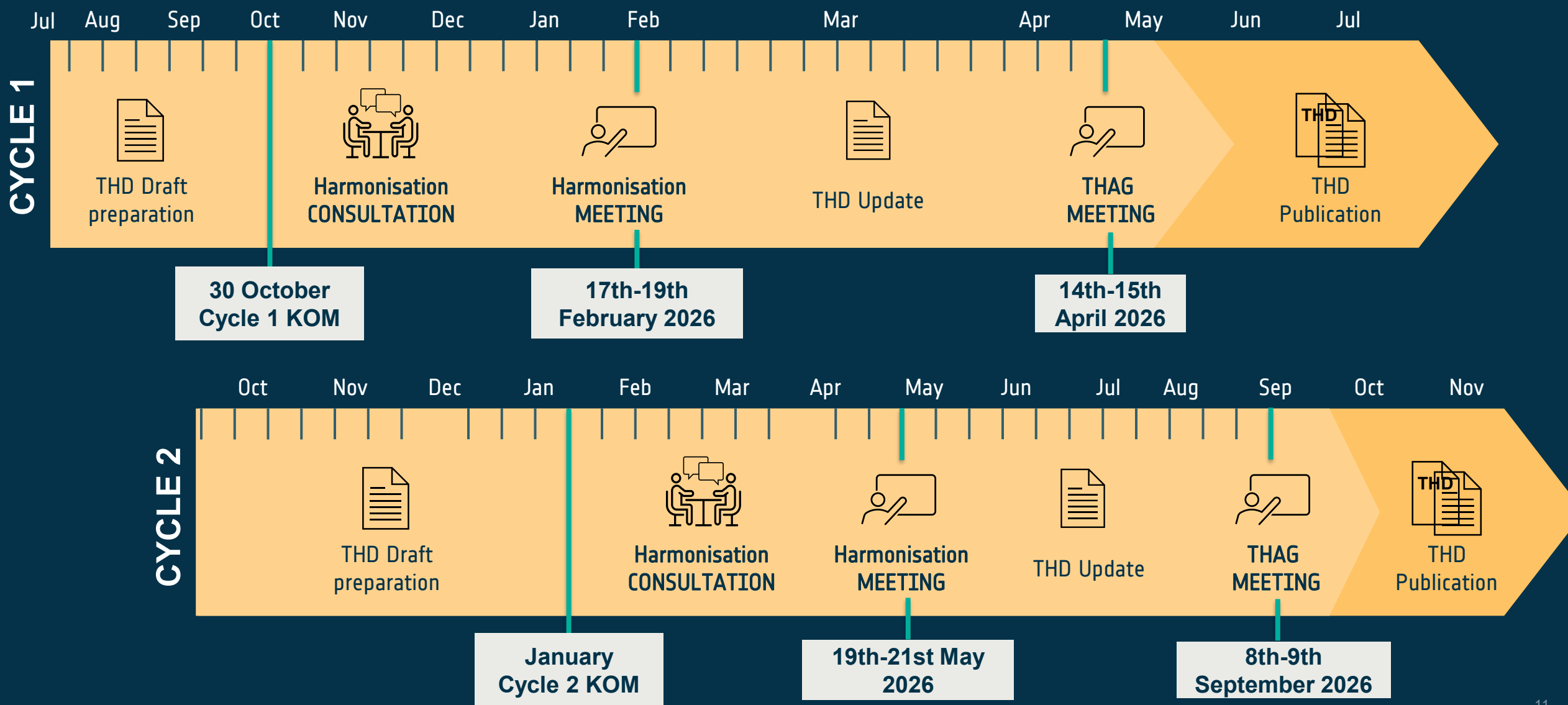
CubeSat Propulsion
Chemical Propulsion - Components (including Tanks)
Electric Propulsion Technologies
Technologies for Fluid Mechanics

Functional Verification and Missions Operations Systems
Ground Station Technology

Big Data from Space
Enabling Artificial Intelligence for Space System Applications
Model Based for System Engineering
System Modelling and Simulation Tools

De-orbiting Technologies
Radiation Environments & Effects

2026 Timeline



2026 Harmonisation Topics

CYCLE 1

- Actuators Building Blocks for Mechanisms
- Pyrotechnic Devices (within release mechanisms)
- Printed Circuit Boards and Electronic Assembly Technologies
- Additive Manufacturing
- Micro and Nano Technologies – MEMS Pressure Sensors, MOEMS and RF-MEMS

CYCLE 2

- Ground Station Technology
- On-Board Computers, Data Handling Systems and Microelectronics
- Avionics Embedded Systems
- On-Board Software
- Radiation Environment and Effects

Content of the Dossiers

CONTENT OF THE DOSSIER

- **STATE OF ART IN EUROPE,** KEY ISSUES, COMPETITIVENESS AND BENCHMARKING
- **TECHNOLOGY TRENDS**, SYNERGIES AND TRANSFER OPPORTUNITIES
- MISSION NEEDS, **MARKET PERSPECTIVES** AND EUROPEAN STRATEGIC INTERESTS
- **R&D FUNDED ACTIVITIES** RELEVANT TO THE TOPIC AT EUROPEAN AND NATIONAL LEVEL
- **STRATEGIC ROADMAPS** AND R&D LINES RECOMMENDED FOR THE FUTURE YEARS

Benefits for Space Entities

WHY TO PARTICIPATE IN EUROPEAN SPACE TECHNOLOGY HARMONISATION ?

Your contribution to the Harmonisation products:

TECHNOLOGY HARMONISATION DOSSIERS AND STRATEGIC ROADMAPS

Gives you

MARKET INTELLIGENCE

A comprehensive analysis of technologies' state-of-the-art, benchmarking and trends.

OPPORTUNITIES

Insight into tech transfer opportunities.
Insight into future needs and priorities.

VISIBILITY

Networking across various key space stakeholders.
Direct access to ESA experts.

STRATEGIC ROADMAPS

Early-access to European-wide roadmaps.
Alignment with Harmonisation strategic objectives.

INFLUENCE

A voice in shaping the future developments.

Implementation of the Harmonisation

FROM HARMONISATION TO STRATEGIC ROADMAPS

- Defined priorities & future needs through Strategic Objectives
- Involvement of ESA Experts + National Delegates

FROM ROADMAPS TO ACTIVITIES

- Strategic Proposed activities in GSTP and TDE
- Inspiration taken from Strategic Roadmaps

FROM ACTIVITIES TO IMPLEMENTATION

- Entities manifest interest
- Activities are voted by IPC and ITTs issued
- For GSTP, Letters of support from Delegates are necessary to participate

esa esa-star Publication

OSIP OPEN SPACE INNOVATION PLATFORM

The same experts often shape both roadmaps and activity proposals.

Delegates act as **advocates** for roadmap priorities and are also part of Harmonisation process.

Harmonisation from Entities' Perspective

Step-by-step view of Harmonisation process.

KICK-OFF MEETING

Online session introducing topics for this year.

REGISTER TO ESA-STAR

ESA's system for registration and tendering, which serves as a single access point.

JOIN THE CONSULTATION

THD's review of version 0 through a dedicated Sharepoint.

ATTEND HARMO MEETING

Online or onsite (usually in ESTEC, NL) with Experts' topics presentations.

GET ACCESS TO THDs

Contact *harmo@esa.int* from a corporate email to get access to the ESA Harmonisation Database

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Esa-Star Registration

Esa-star is the European Space Agency's system for registration and tendering, which serves as a single access point for your activities with ESA.

TECHNOLOGY CAPABILITIES

Add and update your technology capabilities to ensure that you are considered for Harmonisation topics which match your expertise.

- Go to the **esa-match** module
- Navigate to My Entity Profile and access the **Competences & Capabilities** section
- Edit your capabilities according to the ESA **Technology Tree***

CONTACT INFORMATION

Add and update your points of contact to let us know who to contact to participate to the Harmonisation Consultations.

- Go to the esa-star **Registration module**
- Navigate to the **Contacts** part of the registration sections menu
- Edit your Harmonisation contacts with the role **Entity Capability Responsible***

* The capabilities and contact email are used for all matters related to Harmonisation including matching to a topic, invitation to consultations and meetings, announcements, and links to the published Harmonisation outcomes. For more information on the roles and responsibilities in esa-star modules please consult the esa-star registration user manual: https://esastar-emr.sso.esa.int/Account/DownloadFile

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Space Entities Consultation Summary

CONSULTATION WORKFLOW

CONSULTATION HIGHLIGHTS

The 2026 Cycle 1 Harmonisation consultation will be launched **November 2025** and closed in **January 2026**

The 2026 Cycle 2 Harmonisation consultation will be launched **February 2026** and closed in **April 2026**

Harmonisation from Entities' Perspective

Step-by-step view of Harmonisation process.

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GET ACCESS TO THDs

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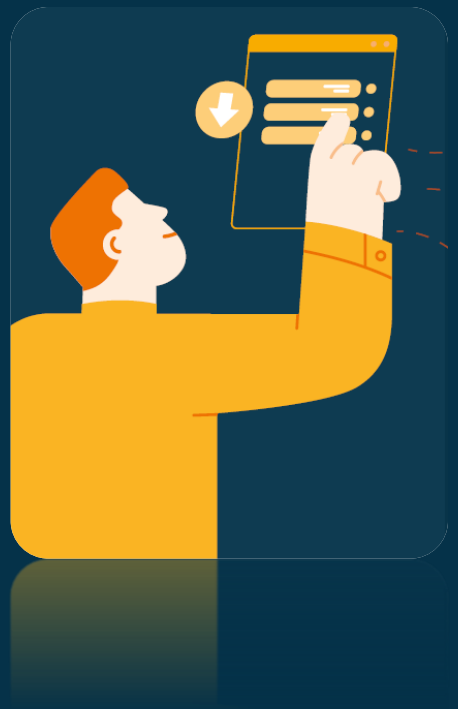
Access to Harmonisation Database opened to European or Canadian space entities only.

How to access THDs and ESTMP

Contact harmo@esa.int from a corporate email address stating your affiliation and request access to the Harmonisation database HDMS on Polaris platform.

https://tec-polaris.esa.int/eclipse



Get access to:

- 48+ Technology Harmonisation Dossiers (THD)
- 48+ Harmonisation Roadmaps
- European Space Technology Masterplan (ESTMP)

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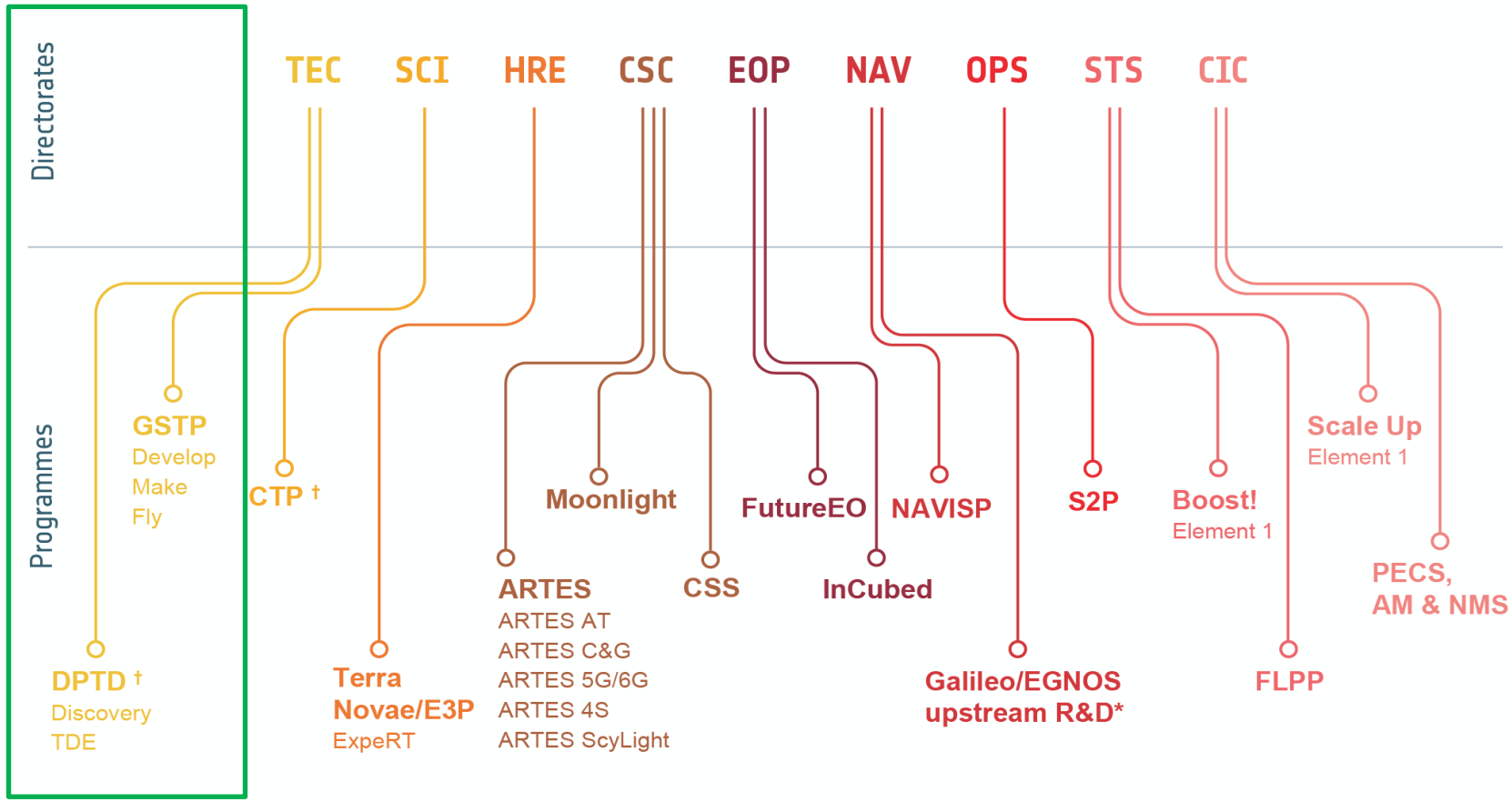
Technology Development Element (TDE) of ESA Basic Activities

General Support Technology Programme (GSTP)

ESA Directorates & Technology Programmes



TEC Technology, Engineering and Quality

SCI Science

HRE Human and Robotic Exploration

CSC Connectivity and Secure Communications

EOP Earth Observation Programmes

NAV Navigation

OPS Operations

STS Space Transportation

CIC Commercialisation, Industry and Competitiveness.

Research And Development

Disruptive Ideas

- Taking risks
- Low budget
- Fast and Open
- Novelty driven
- Commercialisation
- Research, studies and tech.dev.
- Outside driven (OSIP)
- Open competitive

Discovery

Future Missions

- Solid baselines
- For all domains
- (Pre-)Phase A
- MBSE, ODebris, LCA
- Commercialisation

- ESA-driven
- Open competitive

Preparation

Technology Raising

TDE	GSTP
• Low TRL • All ESA applications • Enabling missions • 2yr work plans • ESA driven • Open competition	• Higher TRL • Support Competitiveness • Enabling missions • Work plans and industry-driven proposals • SME focus • Delegation support • 3 Elements

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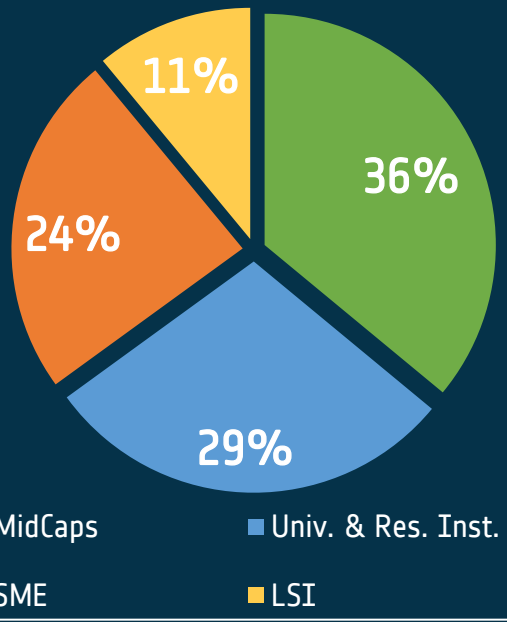
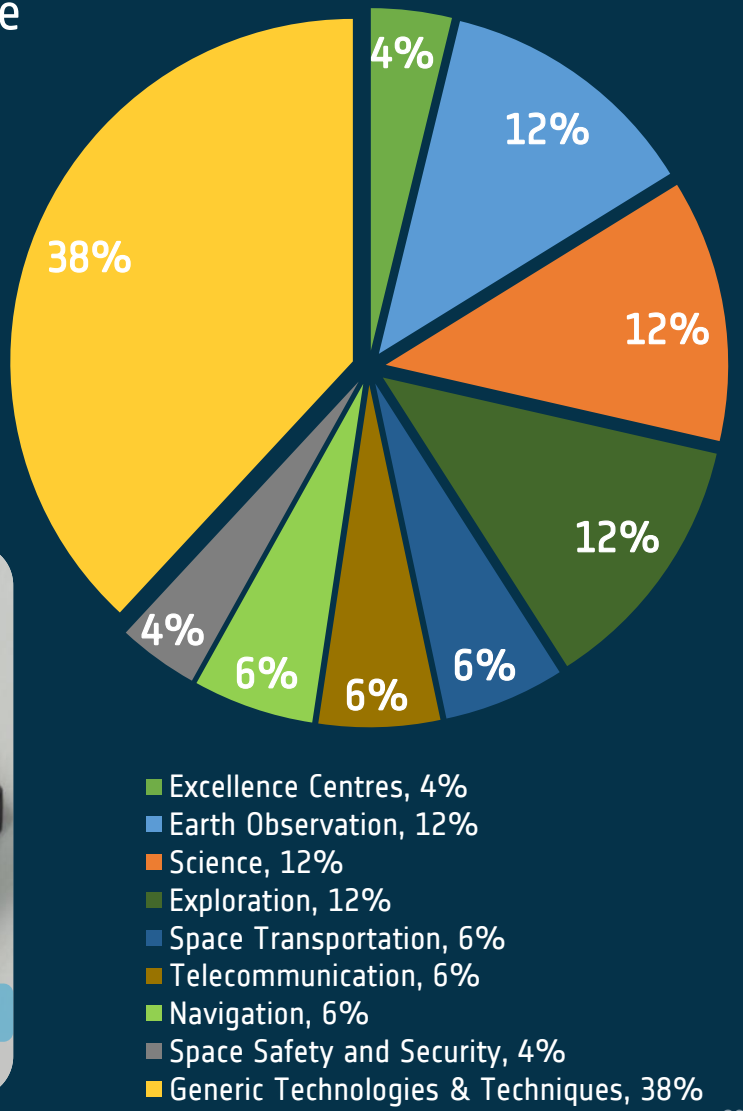
- Support Competitiveness
- Enabling missions
- Work plans and industry-driven proposals
- SME focus
- Delegation support
- 3 Elements

GSTP

TDE overview

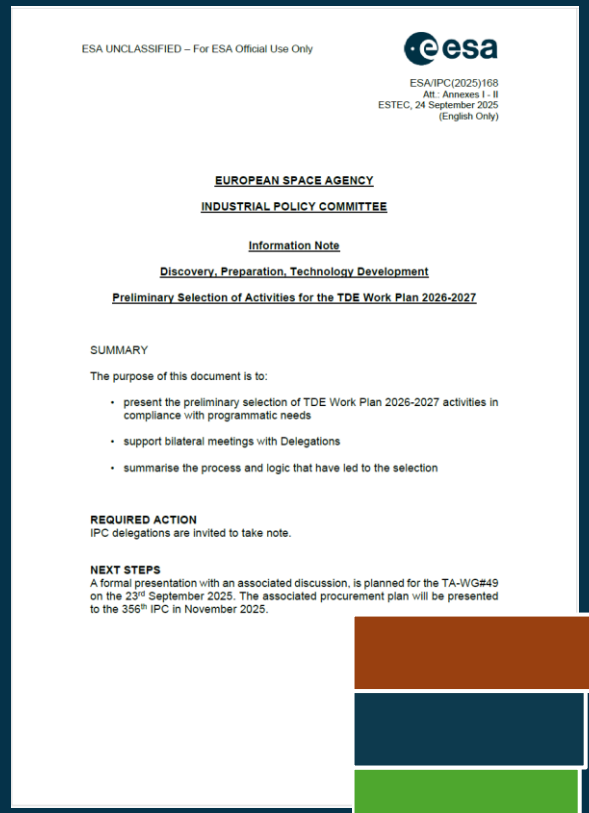
- Part of ESA's Mandatory Basic Activities, All ESA Member States contribute
- Covers all applications and technology domains
- First step for the implementation of ESA Technology Strategy
- Relies on European Space Technology Harmonisation Roadmaps
- Based on 2-year work plans, with yearly updates, TRL 1 - 4
- 94% of all activities in open competition
- Around 50% of the contracts are awarded to SME or R&D Institutes





TDE Workplan 2026 - 2027

- Objectives:
  - In line with ESA Strategy 2040
  - 5 goals:
    - Protect our Planet and Climate
    - Explore and Discover
    - Strengthen European Autonomy and Resilience
    - Boost Growth and Competitiveness
    - Inspire Europe
- Streamlined R&D definition process
- ~189 activities for ~ 100 M€ (+ 16 M€ Science)
- All ESA's Application Domains
- Generic Technologies:
  - ESA Technology Vision 2040
  - Critical Technologies for European autonomy
  - Sustainable Space
  - Mid-size LEO Satellites Industrialisation & Competitiveness



ESA UNCLASSIFIED – For ESA Official Use Only

ESA/IPC(2025)168
Att.: Annexes I - II
ESTEC, 24 September 2025
(English Only)

EUROPEAN SPACE AGENCY

INDUSTRIAL POLICY COMMITTEE

Information Note

Discovery, Preparation, Technology Development

Preliminary Selection of Activities for the TDE Work Plan 2026-2027

SUMMARY

The purpose of this document is to:

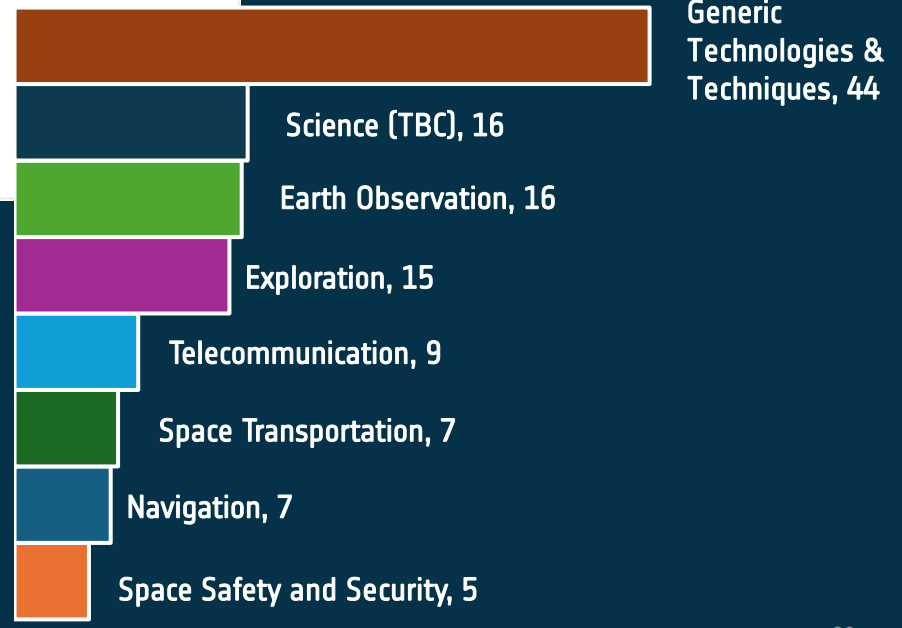
- present the preliminary selection of TDE Work Plan 2026-2027 activities in compliance with programmatic needs
- support bilateral meetings with Delegations
- summarise the process and logic that have led to the selection

REQUIRED ACTION
IPC delegations are invited to take note.

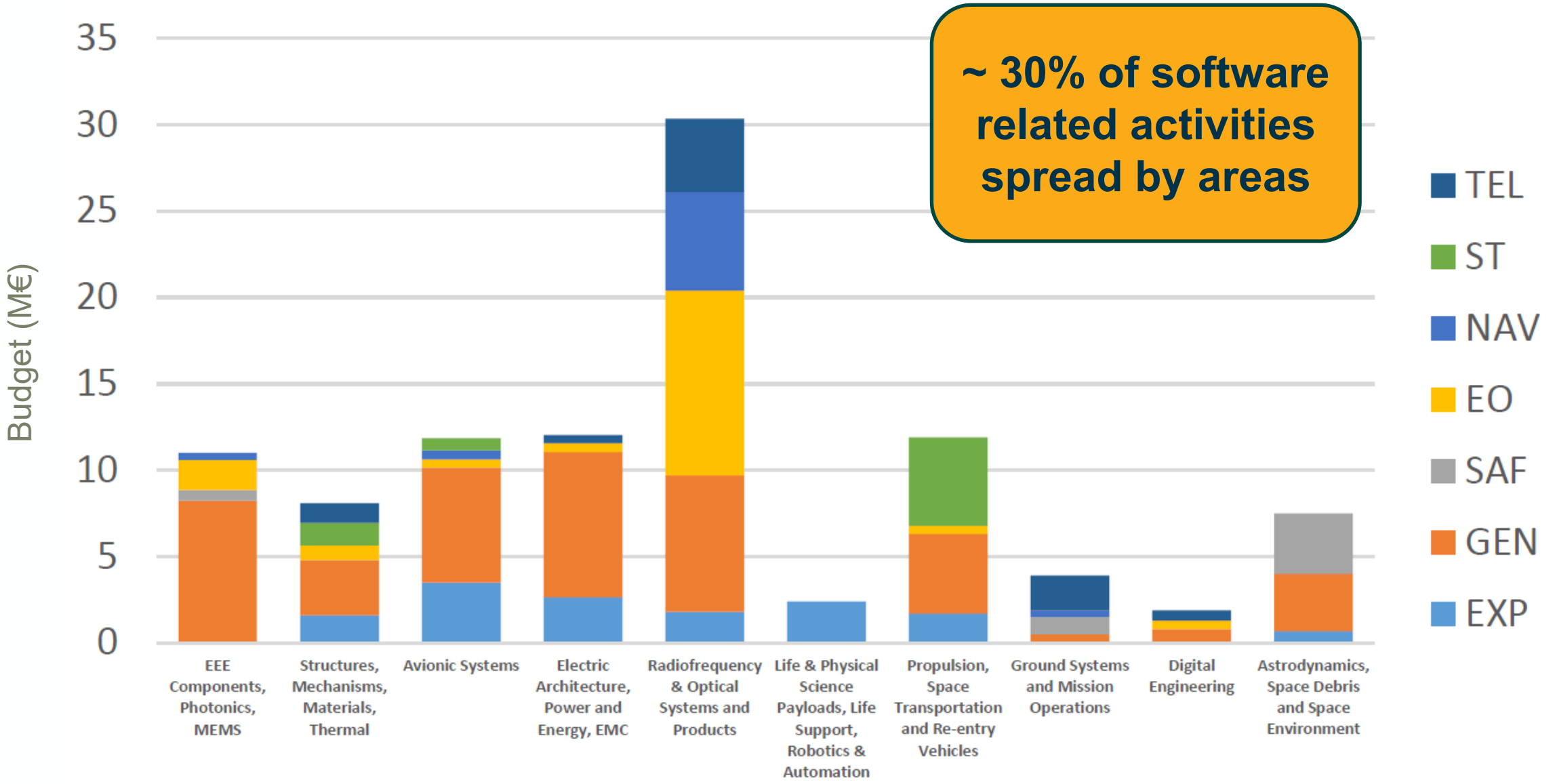
NEXT STEPS
A formal presentation with an associated discussion, is planned for the TA-WG#49 on the 23rd September 2025. The associated procurement plan will be presented to the 356th IPC in November 2025.

Esa-star Publication by end of November!

Budget per Application Domain(M€)



TDE Workplan 2026 - 2027



TDE - Raising Low Technology Maturity

ESA identified technology needs

- ESA published 2-year TDE work plans
- Based on future mission needs, strategic decisions
- Across all domains
- Implementation of TDE WP 2026 – 2027 from Q1

esa-star Publication

- ITT on esa-star Publication
- Partnerships
- Proposal answering ESA statement of work

TDE Contract

- Following competitive evaluation
- TRL 1 - 4 raising technical activity
- ~ 500k€ per activity.
- Parallel contract

Research And Development

Disruptive Ideas

- Taking risks
- Low budget
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Discovery

Future Missions

- Solid baselines
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Preparation

Technology Raising

- Low TRL
- All ESA applications
- Enabling missions
- 2yr work plans

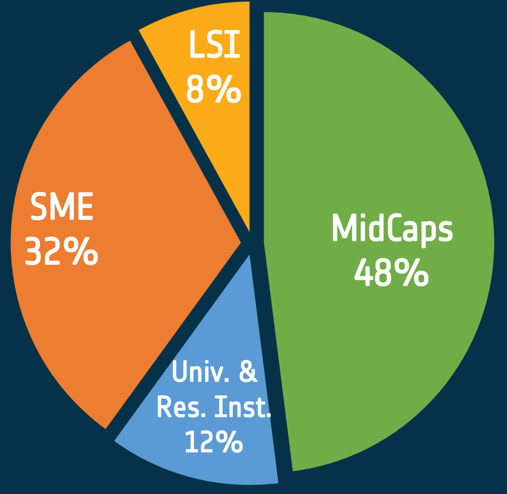
- ESA driven
- Open competition

TDE

- Higher TRL
- Support Competitiveness
- Enabling missions
- Work plans and industry-driven proposals
- SME focus
- Delegation support
- 3 Elements

GSTP

Overall GSTP actors



GSTP's mission

→ For more **than 30 years**, the GSTP has been developing leading-edge space technologies to

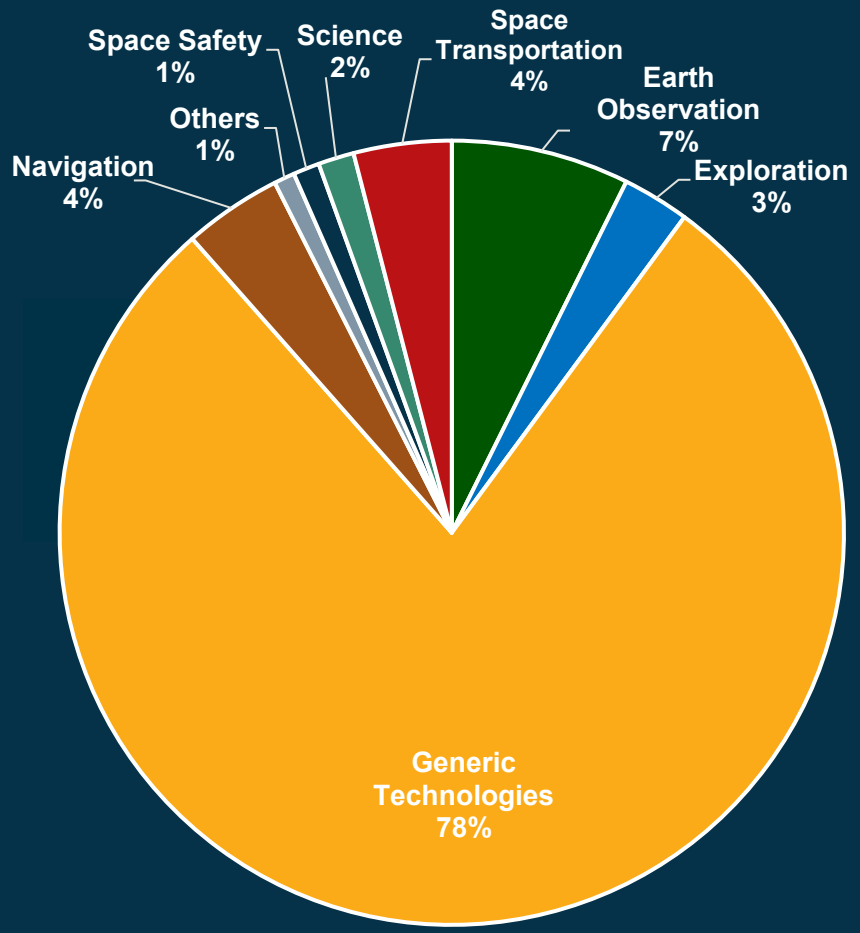
- enable future missions
- support the competitiveness of European industry

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

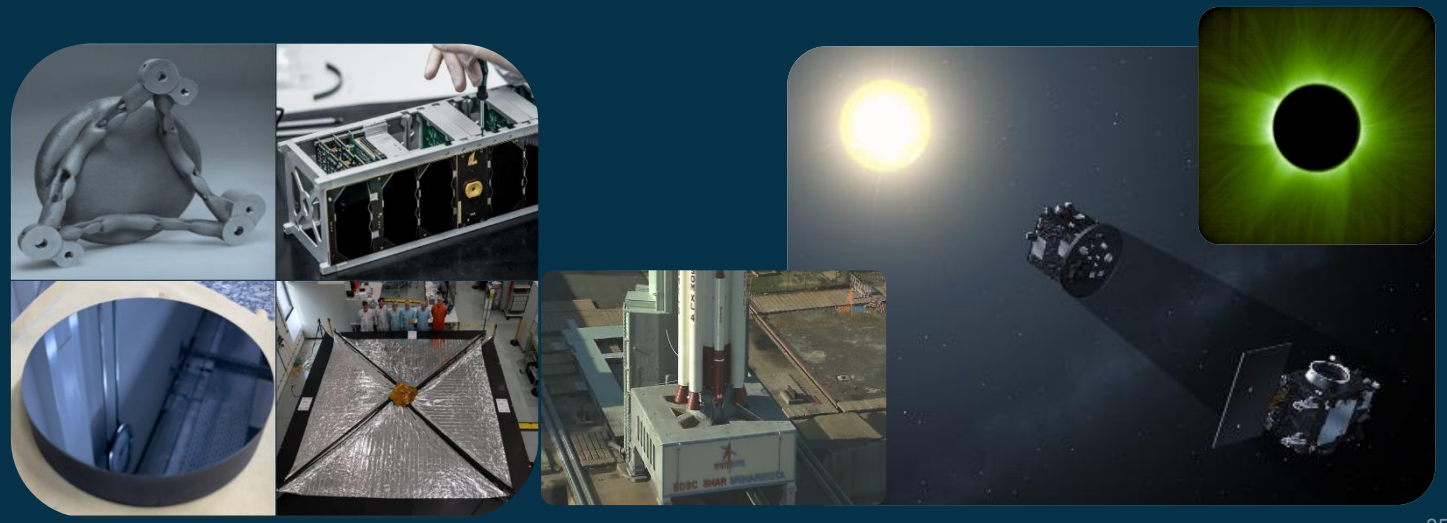
- building capacities,
- fostering innovation and
- creating and improving products and services

→ GSTP is an optional ESA programme with the participation of all ESA Member, Associate and Co-operating States: **27 Participating States**

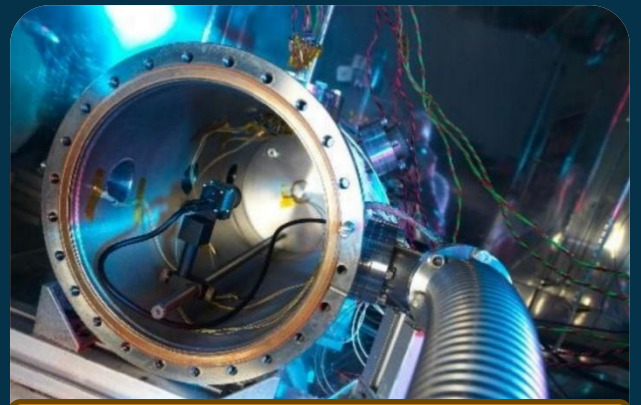
GSTP: 2024 at a glance



- Around 600 running activities
- 130 activities completed
- 180 technology development and demonstration activities initiated, representing over 230 M€ in contracts
- Launch of Precise Formation Flying PROBA-3 and HERA



GSTP Structure

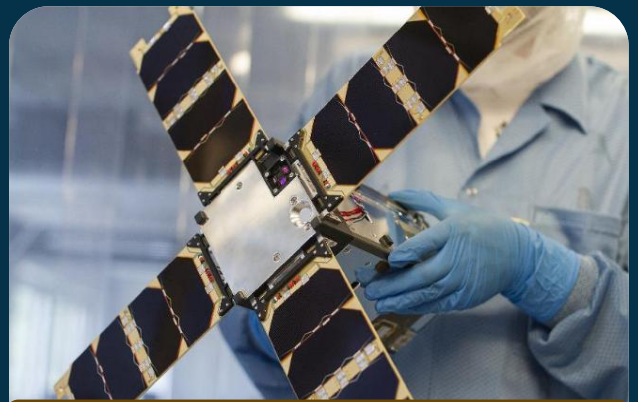


Element 1: Develop

ESA and Industry driven developments (Work Plan, Frameworks)

Element 2: Make

Industry driven developments to strengthen competitiveness



Element 3: Fly

In Orbit Demonstrations (Competitiveness, Innovation, Capacity Building)

EEE Sovereignty

Space Component Sovereignty for Europe

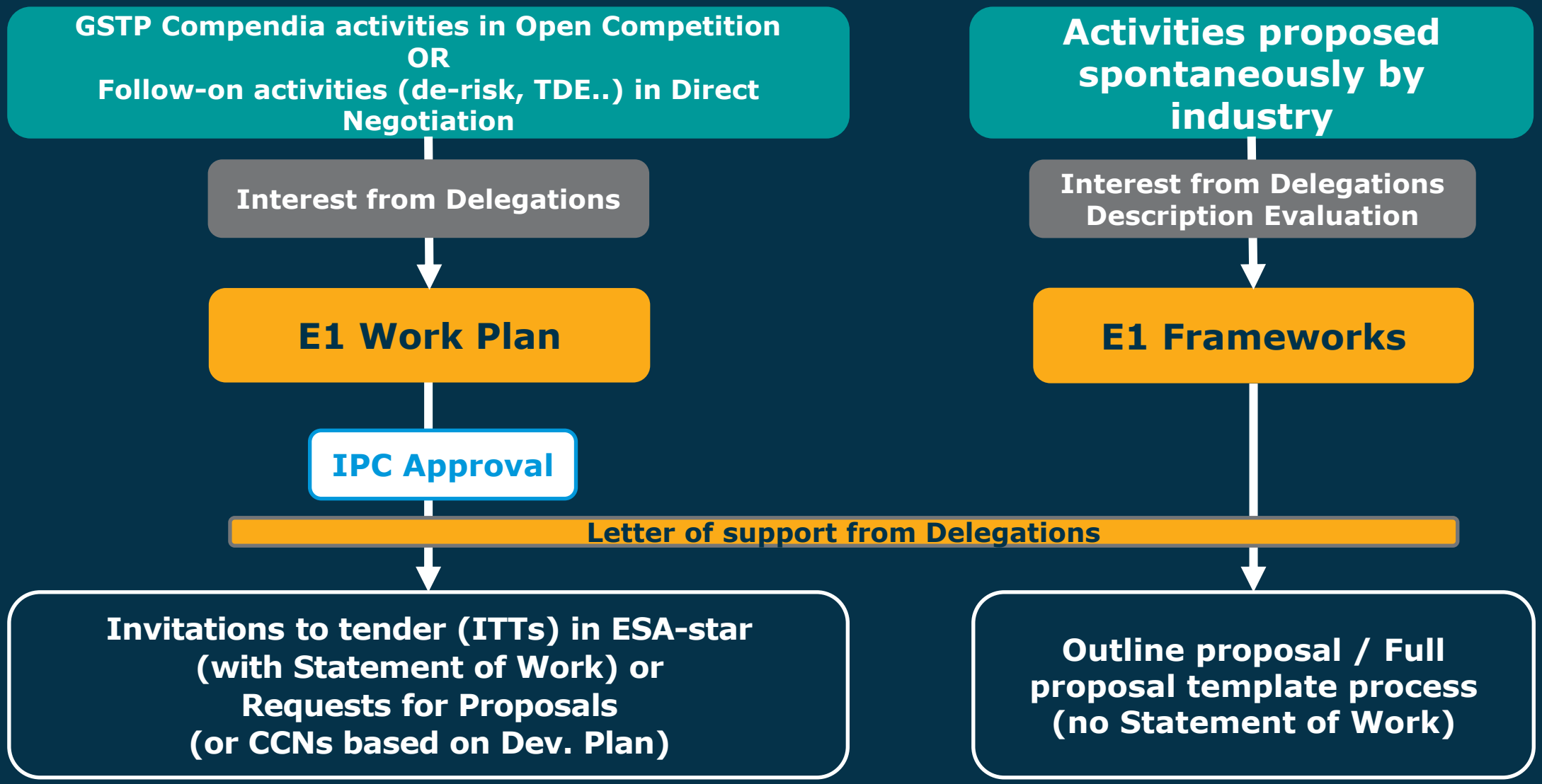
ENDURE Component

EuropeaN Devices Using Radioisotopes

Proba-3 Component

Precise Formation Flying Component

GSTP Element 1 – 2 Mechanisms



GSTP Element 1 – Workplan

GSTP Compendia activities in Open Competition
OR
Follow-on activities (de-risk, TDE..) in Direct Negotiation

Interest from Delegations

E1 Work Plan

IPC Approval

Letter of support from Delegations

Invitations to tender (ITTs) in ESA-star (with Statement of Work) or Requests for Proposals (or CCNs based on Dev. Plan)

Activities proposed spontaneously by industry

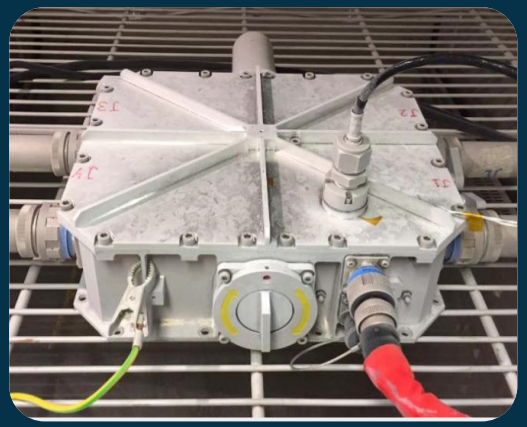
Interest from Delegations Description Evaluation

E1 Frameworks

Outline proposal / Full proposal template process (no Statement of Work)

GSTP Element 1 - Workplan

- Maturing technology from proof of concept to qualification
- ESA driven Technologies for space and ground segment payload, platform, ground equipment, engineering tools
- Activities drawn from the **Compendia (Open Competition (C))** or **continuation** of previous activities **(Direct Negotiation (DN))**
- 100% funded but co-funding possible for DN activities.
- Letter of support from delegation required
- Invitation to tender (ITTs) published in esastar.

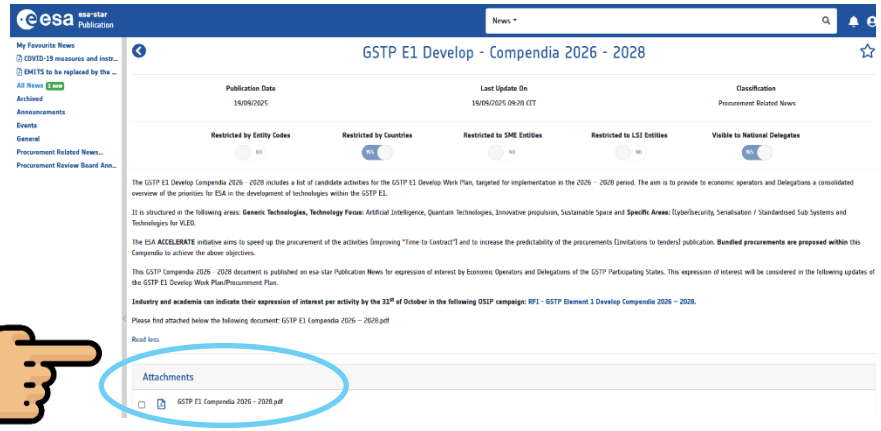


GSTP E1 Compendia 2026-2028 – Published on esa-star!

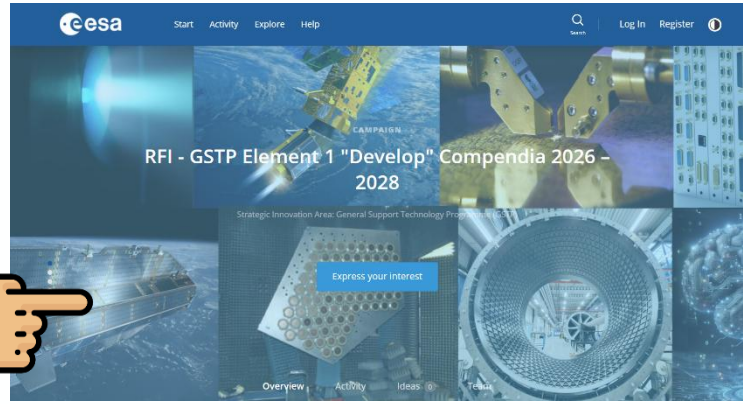
GSTP Element 1 - Workplan - Compendia

- ESA priorities for implementation in the short / medium timeframe
- 202 (~280M€) activities structured in 3 areas:
  - Generic Technology Areas
  - Technology Focus Areas
    - Artificial Intelligence
    - Quantum Technologies
    - Innovative propulsion
    - Sustainable Space
  - Specific Areas:
    - (Cyber)security
    - Serialisation / Standardised Sub-Systems
    - Technologies for VLEO
- Industry and academia can indicate **expression of interest per activity**

Published on esa-star:



OSIP Campaign:



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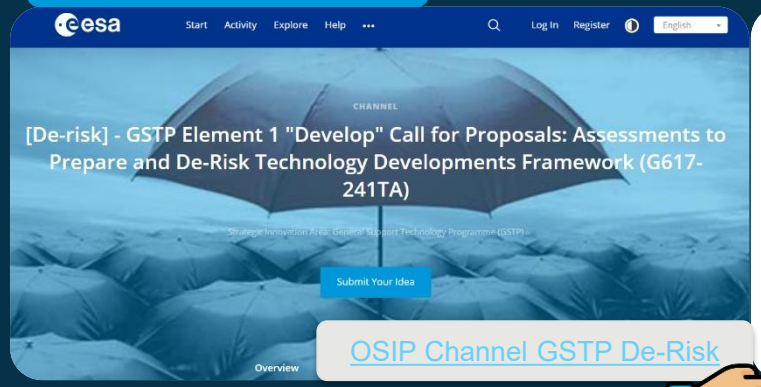
GSTP Element 1 - Frameworks

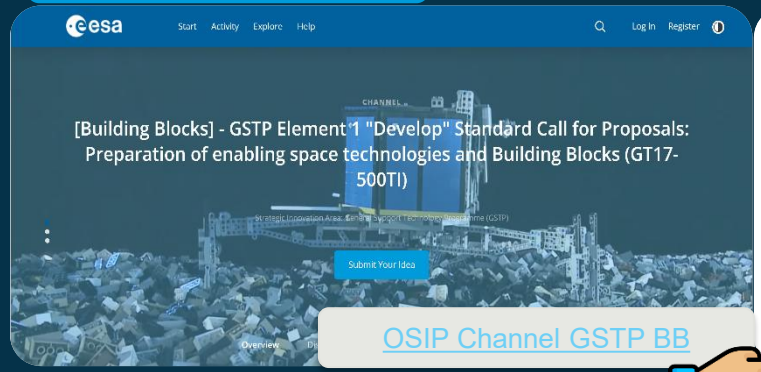
De-Risk



OSIP Channel GSTP De-Risk

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

Building Blocks



OSIP Channel GSTP BB

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

Outline Proposal → Clarifications → Evaluation → Outline accepted → Full Proposal

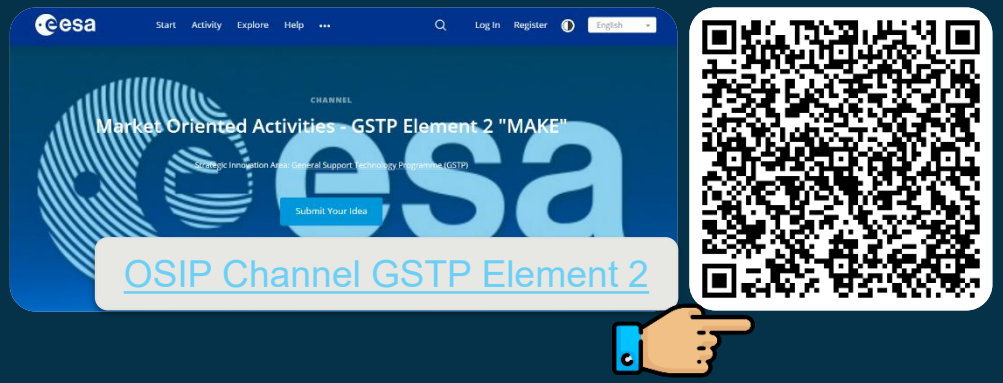
OSIP OPEN SPACE INNOVATION PLATFORM

esa esa-star Publication

GSTP Element 2

Announcement Of Opportunity

- GSTP Element 2 is dedicated towards industry driven co-funded activities enabling the development of technologies and products for market competitiveness and sustainability.
- Industry is invited to submit proposals addressing one of the 3 technology and product development segments:
  - Market Oriented Opportunities,
  - Strategic Opportunities and
  - Implementation of National Priorities.



25 - 30 activities committed per year

(30m€ - 35m€)

Outline Proposal → Clarifications → Evaluation → Outline accepted → Full Proposal

esa-star Publication

GSTP Element 3

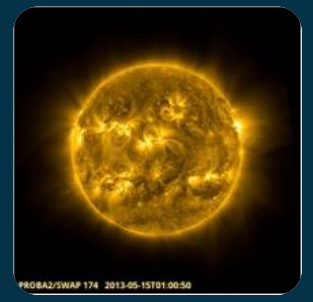
Facilitate Technology Demonstrations

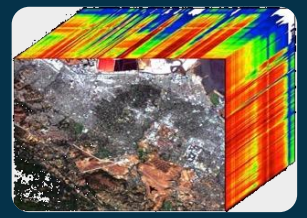
The main objectives related to Element 3 are to:

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

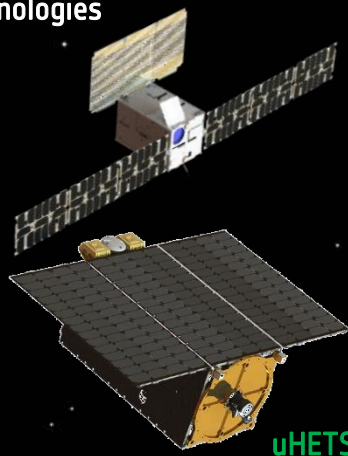


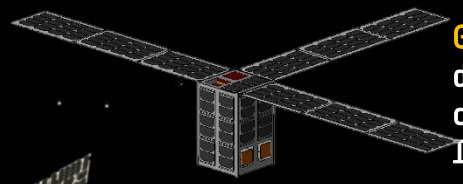


Workplan and Cubesat framework

Definition
Implementation
Launched

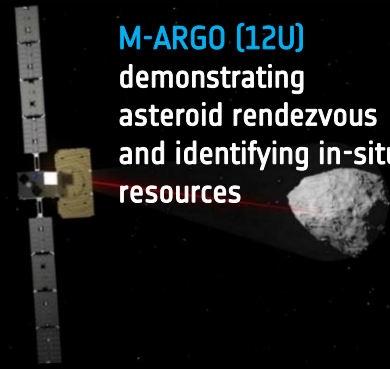
GOMX-5 (12U)
demonstrating
technologies





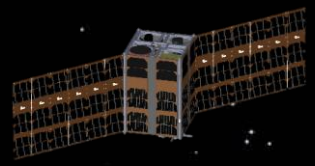
GENA-OT (12U)
demonstrating
commercial
IOD/IOV services

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

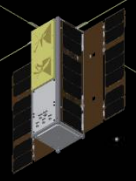


CubeSpec (6U)
stellar
spectroscopy
from space

AOS-P and AOS-D
Precusor and
Demonstrator for
Arctic Ocean
Surveillance

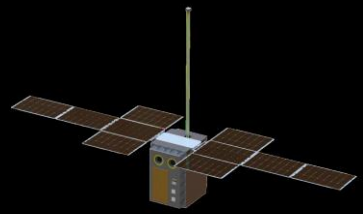


uHETSat
electric
propulsion



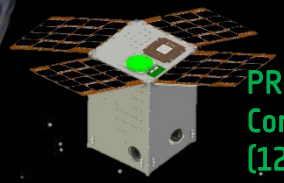
PRETTY (3U)
demonstrating GNSS
reflectometry

e.Inspector (12U)
demonstrating
debris inspection



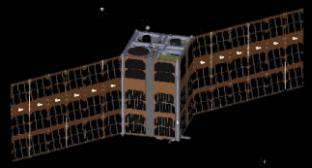
HENON (12U)
space weather
monitoring from
Distant
Retrograde Orbit

Juventas & Milani
(2x6U)
observing asteroid
deflection assessme
funded by S2P (Hera



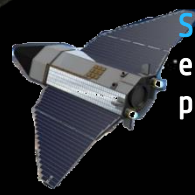
PROBA-V
Companion
(12U)
Imaging
Vegetation

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



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

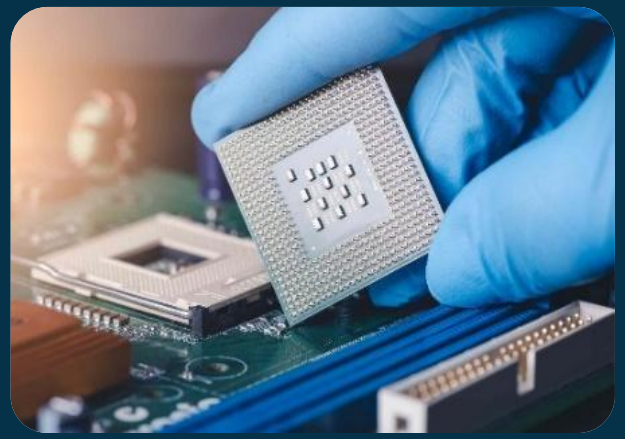
LUMIO
measuring lunar
surface impact
hazards



SkimSat (VLEO)
electric
propulsion

Funded in GSTP Fly unless otherwise stated

GSTP EEE Space Component Sovereignty for Europe



- EEE aims to build a sustainable European supply-chain for state-of-the-art, high-value European EEE components
- It follows GSTP Element 1 workplan process
- 9 activities (almost 70 MEuro) initiated in the following lines:
  - Ultra-Deep Sub Micron (UDSM), preparing future microprocessors and FPGAs (signed in January)
  - Wide-band gap technologies (GaN, SiC), preparing for power and RF applications
  - New Test Facility capabilities

Useful links and contact points

esa esa-star Publication

- Registration of new companies.
- Invitations to tenders.
- News/Procurement related announcements: TDE WP, GSTP Compendia Publication.

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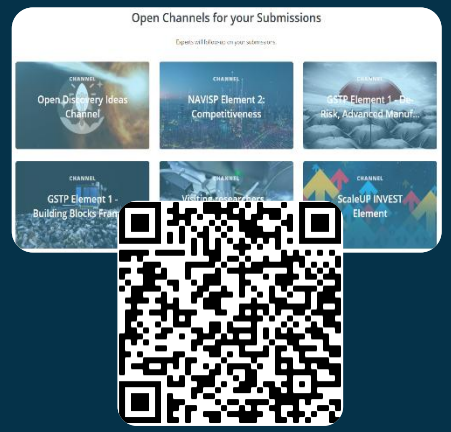
- Channel and Campaign.
- Submission of outline proposals for GSTP.



ENABLING & SUPPORT shaping the future

- TDE/GSTP information.
- TDE/GSTP achievements summary.
- Annual reports and highlights.

Nebula Public Library

The knowledge bank of ESA's R&D programmes

- Closed TDE and GSTP activities with public deliverables

THANK YOU FOR YOUR ATTENTION!

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european space technology harmonisation

5 years

50 YEARS OF INNOVATION AT ESA

Contacts

Harmonisation Team: *harmo@esa.int*

European Space Technology Master Plan: *estmp@esa.int*

Website
https://technology.esa.int/page/harmonisation

Contacts

TDE management: *TDE@esa.int*
Eike.Kircher@esa.int, *Olivier.Perat@esa.int*

GSTP management: *GSTP.management@esa.int*
Matthew.Bullock@esa.int , *Noelia.Peinado@esa.int*