THE EUROPEAN SPACE TECHNOLOGY HARMONISATION

INFORMATION NOTE (P. LIONNET - JC TREUET)

INTRODUCTION

The European Space Technology Harmonisation is designed to achieve better and more coordinated Space Technology Research and Development activities among all European Actors, having as major objective to "fill strategic gaps" and "minimise unnecessary duplications". The Technology Harmonisation takes into account the various European developments, capabilities and budgets to enhance the complementary roles of the various stakeholders in meeting common objectives, covering different situations of technology maturity, industrial competitiveness, funding needs and political interests.

The process is based on voluntary participation; it runs with two cycles per year, each articulated around Mapping and Roadmap meetings. The process is strongly supported by all stakeholders as a leading instrument for coordination of Space Technology in Europe.

Since its pilot launch in 2000, more than 50 technology areas have been harmonised, with the participation of all ESA Member States, EC, Industry, involving more than 1500 Professionals from more than 300 European Space Companies and research organisations.

THE HARMONISATION PROCESS IS A UNIQUE POSSIBILITY OFFERED TO ALL TECHNOLOGY STAKEHOLDERS TO DIRECTLY CONTRIBUTE TO THE DEFINITION OF EUROPEAN SPACE TECHNOLOGY DEVELOPMENT PLANS. THESE CONTRIBUTIONS ARE MANAGED BY EUROSPACE IN AN OPEN AND TRANSPARENT PROCESS WHERE ALL STAKEHOLDERS ARE CONSIDERED ON THE SAME FOOTING.

HARMONISATION OVERVIEW

HARMONISATION OBJECTIVES

The technology harmonization process aims at providing strategic guidance, in the form of **detailed technology development roadmaps, for space technology in Europe**.

The objectives are defined as below:

- "Fill strategic gaps" and "Minimise unnecessary duplications"
- Consolidate European Strategic capabilities
- Achieve a coordinated and committed European Space Technology Policy
- Contribute to ensuring* continuity and coherence between Technology and Industrial Policies

PRINCIPLES

- Optimise public fund investments in Space Technology and determine the R&D priorities to satisfy European Space ambitions, commensurate with available resources
- Play a proactive role in creating a balanced industrial landscape by specialising skills and strengthening industrial cooperation, considering appropriate geographical distribution while maintaining a competitive environment and ensuring a fair role to each player, irrespective to presence of national space programme and without discrimination for non-EU Member States
- Promote long-term agreements based on competitiveness
- Protect the role of Technology Innovation and advanced Research
- Consult actively Industry and National Delegations in definition of Technology programmes
- Stakeholders contribute on a voluntary basis
- Implement in all ESA Technology programmes and in ESA programmes containing Technology development, the Roadmaps and conclusions stemming from the Technology Harmonisation process
- Maximise the utilization of European Technology in ESA programmes with due consideration to programme risk
- Foster and promote the implementation of the Harmonisation recommendations in national and commercial programmes

HARMONISATION STAKEHOLDERS – THE PARTICIPANTS IN THE PROCESS

The Harmonisation process involves the following actors:

- **ESA**: ESA is a major driving force in the harmonization process, it provides process coordination and ensures the initial production of all documents required (the Technical Dossiers and the Technology Roadmaps). ESA hosts all Harmonisation meetings, for Mapping and Road mapping.
- **The European Commission**: since 2013 the EC is regularly invited to observe and contribute to the harmonisation process. It is expected to join the process as a full player with the aim of seamlessly integrating in the space RTD funding landscape the activities promoted by H2020/Space.
- **The THAG**: ESA Member states (represented by their National Agency when applicable): ESA Member states ultimately provide ESA its funding. They are involved in the harmonization process to support the technological landscape mapping (national input) and to approve the Technology Roadmaps. Member States' representatives in the harmonization process form the THAG (Technology Harmonisation Advisory Group). The THAG is the entity taking all decisions in the Harmonisation process.
- **The Eurospace THP**: Industry and all other technology and research suppliers (research laboratories, universities, other institutions…) are involved in the process through a Eurospace body called the **Technology Harmonisation Panel (THP)**. The consolidated THP input forms an important contribution at mapping and roadmap levels. Eurospace coordinates all THP activities, from document dissemination to the integration and consolidation of all viewpoints expressed.
    - Membership in the THP is open to all entities not represented in the THAG (excluding SMEs, represented by SME4Space)
    - Membership in the THP is free of charge
    - The THP takes all decisions by consensus
    - THP members are invited to attend Mapping meetings at ESTEC
    - The THP is co-chaired by Serge Flamenbaum (Airbus D&S) and Rolf Janovsky (OHB).

THE HARMONISATION PROCESS

HARMONISATION PROCESS ORGANISATION

THE HARMONISATION PROCESS INVOLVES TECHNOLOGY FUNDING ENTITIES (MEMBERS STATES, ESA, THE EC) AND TECHNOLOGY SUPPLIER ENTITIES (THE EUROSPACE- THP MEMBERS) WITH A VIEW TO ASSESSING THE FULL SCOPE OF CAPABILITIES AND NEEDS ALONG A GIVEN TECHNOLOGY DOMAIN (THE MAPPING), AND DETERMINE THE DEVELOPMENT REQUIRED IN THE FUTURE WITH ASSOCIATED ROADMAPS.

TWO CYCLES PER YEAR – TWO PHASES PER CYCLE

The harmonization process is organised in two cycles per year, each cycle is organised in two phases, called **MAPPING** and **ROADMAP**. During each cycle 4 to 6 technology areas are addressed (see here the full list of technology areas concerned).

THE MAPPING PHASE

The Mapping phase aims at **collecting all information relevant to the technological capabilities of the European space sector** on the technology areas concerned, and at identifying all relevant technology developments needs (trends, strategic interest etc.).

THP members are invited to express their views during the mapping phase. The Eurospace process to collect these views is organised in two steps with 4 document generations. The two steps are separated by a plenary meeting in which all stakeholders are invited to review the comments received and prepare converging views.

THE ROADMAP PHASE

The Roadmap phase aims at defining and agreeing the full scope of technology developments required for each technological area. The roadmap is a very detailed document complete with activity description, budget needs, target programme and urgency/criticality assessment.

The Eurospace process in the Roadmap phase is organised in two steps, with 3 document generations. A plenary meeting in which all stakeholders are invited to review the comments already received and prepare converging views separates the two steps.

Each roadmap prefigures the technology development programmes of the years to come within a technology area. It is associated to the description of activities and budget requirements. Once a roadmap has been approved at THAG, its contents become a reference for decision at the IPC (i.e. a technology development proposed at ESA IPC for funding should be supported by a corresponding Roadmap).

The technology roadmaps are a unique opportunity offered to technology suppliers (the industrial sector, the research sector, academia and labs) to shape future technology programmes in the European framework. Eurospace supports stakeholders contributions to the process in a fully transparent and coordinated way.

HARMONISATION WORKPLAN

The schedule for these events (Workschedule), along with the subjects proposed to be harmonised in the upcoming year and a preliminary list for the subsequent 2 years is published each year in a Workplan document, approved by ESA IPC. As an example, the "'Proposed Workplan for 2015" provides the Workschedule for 2015, the list of technology subjects to be harmonised in 2015 and a preliminary list of technologies for 2016-2017.

Eurospace THP members are invited to review and comment the draft workplan prepared by ESA before it is submitted to IPC approval.

INDUSTRY CAPABILITIES MAPPING

Since the Technology Harmonisation process started in 2000 ESA has thrived on establishing and maintaining a complete landscape of European capabilities in space technology.

This activity is organized with the direct collection of information with entities participating in the Technology Harmonisation process through Eurospace. Participants in the process are thus invited to complete an excel file with two types of informations:

- **Space Technology capabilities**, organized by domain and subdomain alongside ESA Technology Tree classification (the SU-TT excel sheet). Each participant in the process is asked to identify its capabilities by checking the appropriate fields of the technology tree.
- **Space products**, organized alongside the ESA generic product tree (the SU-GPT excel sheet): Each participant is asked to list its space products (relevant to the subject harmonized) by creating an appropriate entry in the SU-GPT sheet. For each product a few key parameters (mass, power, etc.) are required to complete the information.

The complete database of space industry capabilities and products can be consulted online (registered users only) at: https://harmostrat.esa.int/pls/adm/weblogin.login (chose ICMDB on the left menu)

PRACTICAL ASPECTS

EUROSPACE DOCUMENT DISTRIBUTION SYSTEM

The complete Eurospace document generation process is organized through a secure online document distribution system. All THP members are entitled to log into that system and access for review and information purposes all documents generated throughout the consultation organized by Eurospace.

- The site is available at: http://www.eurospace-members.org
- Credentials requests: jean-charles.treuet@eurospace.org

ESA DOCUMENT DISTRIBUTION SYSTEM - HDMS

All official documents associated to the harmonization process are available from as secure online document distribution system. This includes all ESA generations of documents (Technical Dossiers and Roadmaps) as well as all documents presented at the mapping meetings (including Eurospace and all member states'). THP members are entitled to access the document database.

The site also provides access to the ICM Database, with the possibility to search organisations by technology and product.

- The site is available at: https://harmostrat.esa.int/pls/adm/weblogin.login
- Credentials requests: harmo@esa.int

ATTENDING THE MAPPING MEETING AT ESTEC

THP members are invited by Eurospace to attend the mapping meetings at ESTEC.

Prior each mapping Eurospace circulates to al stakeholders a registration form in Excel for those willing to attend the Mapping meeting in ESTEC. Complete information on participants is required to abide to security requirements of ESTEC and to provide each participant with credentials to connect to ESA visitors network via Wi-Fi. Please make sure that you return the data in line with the timeline requirements for ESA to be able to process the information. Mapping meetings can gather as much as 100 people.

Only presentations form agreed stakeholders are accepted, i.e. ESA, the EC, the Member states, and Eurospace/THP. Experts are invited to join in the discussions and to raise questions and issues.

ATTENDING EUROSPACE THP MEETINGS FOR MAPPING AND ROADMAP PREPARATION

THP members are invited to attend mapping and roadmap preparation meetings.

All THP meetings are held in Paris at Eurospace premises. THP members are invited to participate in these meetings free of charge. An agenda is distributed prior the meeting with an indicative timeline for each topic to be addressed. Usually a mapping preparation meeting will be organised across 1.5 or 2 days (depending on the number and size of the dossiers, but also depending on the quantity of comments received). Eurospace provides limited support for participating via teleconference.

BECOMING THP MEMBERS

All European entities active in space technology research and development are entitled to joining the THP (with the exception of those already members of the THAG, i.e. the national agencies and government bodies

representing the member states at ESA). Interested parties shall contact Eurospace and nominate representatives to the THP. Each representative shall express a technological interest by checking the appropriate dossiers in a list. The mailings are organised by dossier, i.e. THP members are only contacted for the dossiers they have expressed interest in.

USEFUL CONTACTS

Eurospace (+33-1-44420070)
Pierre LIONNET - Head
Pierre.lionnet@eurospace.org
Jean-Charles TREUET - Process Manager
Jean-charles.treuet@eurospace.org

ESA-ESTEC (+31-71-5656565)
Edmund WILLIAMS - Head
Edmund Williams@esa.int
Marco FREIRE - Process Manager
Marco.Freire@esa.int
Alain PRADIER - Process Manager
Alain.pradier@esa.int

GLOSSARY AND DEFINITIONS

- **TD - Technical Dossier** - The document prepared by ESA Technical teams to start the harmonization process. It includes the key information on technology (background, state of the art, strategic interests etc.). The TD is completed and expanded after each step of the harmonization, in particular, after the mapping it is updated to include all comments expressed by delegations and Eurospace (on behalf of the THP). At the very end of the process the TD is updated with the Roadmap approved by the THAG
- **THAG** - Technology Harmonisation Advisory Group - the THAG is the main body in charge of al harmonization decisions, it approves the roadmaps (complete with budget and prioritisation) and defines the harmonization work plan (i.e. the topics that will be harmonized in the future). The THAG is composed of representatives of the ESA member states. The EC is invited as observer.
- **Roadmap** - This is the most critical phase of the harmonisation process. In this phase detailed development plans are proposed by ESA and discussed with all stakeholders. The roadmap shall include the rational for development, the detailed activity description with associated budget requests and destination programmes. When a roadmap is available from a previous harmonisation exercise, the new roadmap includes a status of implementation of the previous one.
- **Mapping meeting** - The main event marking the end of the first phase of the harmonization cycle. This 2/3 days meeting is open to all stakeholders (ESA, Delegations and THP members).
- **ESA-Eurospace Roadmap meeting** - Since industry/Eurospace is not allowed to join in the THAG, a dedicated restricted meeting is organised by ESA to review the THP comments to the roadmap. In this restricted session the THP comments/additions to the roadmap are discussed with the ESA technical teams (the authors of the TD). The comments can then be agreed or not with ESA technical teams. The redlined roadmap document (highlighting points of agreement and disagreement with ESA technical teams) is then presented to the THAG during the THAG Roadmap meeting.
- **THP - Technology Harmonisation Panel** - The Eurospace entity supporting the harmonization process. This group is open to all stakeholders (i.e. technology suppliers and research entities)
- **ICMDB - industry capabilities database** - a data repository for all space units information on capabilities and products
- **SU-TT - Space Unit TT** - a data repository for space units' information on capabilities, a Space Unit is a space technology supplier (company, research, lab) identified within the perimeter of a single country
- **SU-GPT - Space Unit GPT** - a data repository for space units information on products, a Space Unit is a space technology supplier (company, research, lab) identified within the perimeter of a single country
- **GPT** - ESA Generic Product Tree
- **TT** - ESA Technology Tree
- **HDMS** - Harmonisation Document management system

FULL LIST OF HARMONISATION DOSSIERS/TOPICS

Communications Systems	Array Antennas
	Optical Communications for Space
	Reflector Antennas for Telecommunications
Computer Hardware & Robotics	Automation and Robotics
	Data Systems and On-Board Computers
	OBCDS Microprocessors and Microelectronics
	On-Board Payload Data Processing
Electronic Equipment	CMOS-APS Sensors
	Critical RF Payload Technologies
	Lidar Critical Solid-State Components
	Microelectronics: ASIC and FPGA
	Optical Detectors, IR Range
	Optical Detectors, Visible Range
	RF Metamaterials and Metasurfaces
Ground Systems	Frequency and Time Generation and Distribution - Ground
	Functional Verification & Mission Operations Systems
	Ground Station Technology
	Radiation Environment Models, In-Orbit Monitors, Test Facilities and Engineering Tools
	System Data Repository
Materials, Structures, and Mechanical Systems	Additive Layer Manufacturing
	Composite Materials
	Deployable Booms & Inflatable Structures
	Electrical Motors
	Position Sensors
	Pyrotechnic Devices
	Solar Array Drive Mechanisms
	Technologies for Hold Down, Release, Separation and Deployment Systems
	Two-Phase Heat Transport Systems
Navigation & Control	AOCS Sensors and Actuators
	On-Board Radio Navigation Receivers
	TT-C Transponders and Payload Data Transmitters
Non Dependence	Critical Technologies for European Non Dependence
Payload Instruments & Measurement Tools	Frequency and Time Generation and Distribution - Space
	Lidar Critical Subsystems
	Microwave Passive Hardware
	Power RF Measurements and Modelling
	Technologies for Optical Passive Instruments - Stable and Lightweight Structures, Mirrors
	Technologies for Optical Remote Passive Instruments - Detectors
	Technologies for Passive Millimetre and Submillimetre Wave Instruments
Power Sources & Energy Storage	Electrochemical Energy Storage
	Power Management and Distribution Units
	Solar Generators and Solar Cells
Propulsion Systems & Fuels	Chemical Propulsion - Components (including Tanks)

	Chemical Propulsion - Green Propellants
	Chemical Propulsion - Micropropulsion
	Electric Propulsion - Power Supply and Control Electronics
	Electric Propulsion Pointing Mechanisms
	Electric Propulsion Technologies
Research & Development	Aerothermodynamic Tools
	Big Data from Space
	Micro-Nano Technologies - RF MEMS & MOEMS
	Microwave Power Breakdown modelling and Characterisation
	Multibody Dynamic Simulation
	Upper Stage Propulsion
Software	Avionics Embedded Systems
	Formation Flying Technology
	Ground System Software
	On-Board Software
	System Modelling and Simulation Tools
	Thermal and Space Environment Software Tools and Interfaces
Space Survivability, Environmental Control/Monitoring, and Life Support	Cryogenics and Focal Plane Cooling
	De-Orbiting technologies