

# European Space Technology

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# Harmonisation and Strategy

## – From Concept to Master Plan

The process of harmonizing and developing a future strategy for European space technology was initiated in 2000 in response to the adoption of a Resolution titled ‘Shaping the Future of Europe in Space’ at the ESA Ministerial Council in May 1999. This Resolution notes that

*“...the new and demanding challenges of the 21st Century call for a concerted European effort, so that Europe achieves its fullest potential international cooperation and world competition”.*

The Technology Harmonisation and Strategy Initiative has therefore been developed to achieve better coordinated Research and Development (R&D) activities among all European space sector players, and to establish a strong technology base as a key to the worldwide competitiveness of European Industry and the success of future space missions. The strategy involves establishing a coordinated *European Space Technology Policy* and preparing a *Technology Master Plan* through a process of concertation, coordination, harmonisation and agreement between ESA’s Member States, the European Commission, European Industry and ESA itself.

*The ‘European Strategy for Space Technology Workshop’ in Seville, Spain, in May 2000*



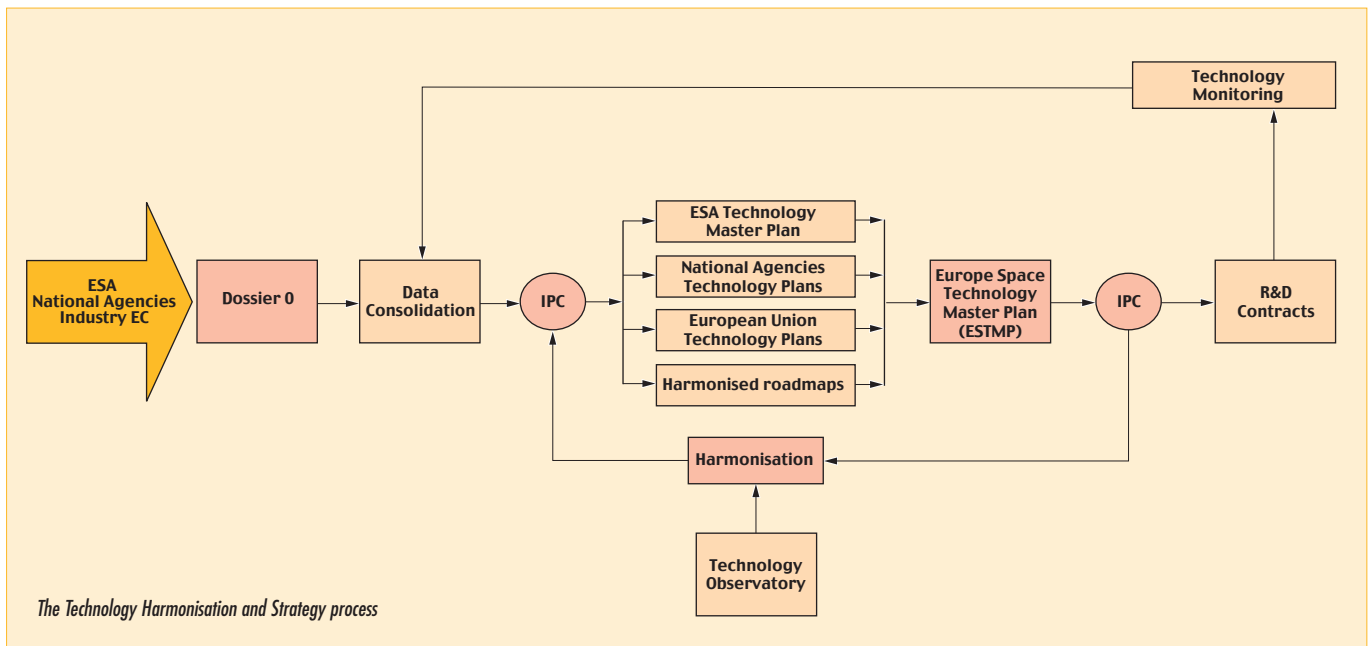
A Workshop was organized in Spain in May 2000, by ESA’s Technology Programmes Department in cooperation with the European Commission (EC), Spain’s ‘Centro para el Desarrollo Tecnológico e Industrial’ (CDTI) and Eurospace (representing the European space industry), to present to Delegations and Industry ESA’s approach to the implementation of the May 1999 Council mandate on technology and to solicit their opinions. The participants at this Seville

Workshop agreed that Europe had indeed to unify and coordinate its space-technology activities via a coherent European policy.

The necessity to identify needs, to map European capabilities and to define common European roadmaps for future developments was outlined and an overall process was established based on:

- Identification of technology needs for European programmes, strategic areas for European independent capabilities and leadership, and the competitiveness of European industry in both the short and long term.
- Acquisition of a complete overview of all relevant technology-development activities in Europe and the relevant skills, specifically at European and national level, including industry and academia.
- Definition of implementation guidelines and funding for the necessary technology R&D activities, harmonised in a coherent and co-ordinated Master Plan.

***Under the overall co-ordination of ESA, the European space sector is elaborating a technology strategy based on top-level needs (Dossier 0), on the mapping and harmonisation of European development and competences, and on a co-ordinated European Space Technology Master Plan (ESTMP). This plan embraces today’s technology needs, current and future European developments, industry capabilities and budgets to enhance the complementary role of the various partners in meeting common objectives. The whole effort is based on a voluntary process, transparency and the free exchange of information.***



The process starts with the elaboration of a ‘European Space Technology Requirements Document’ (Dossier 0) in which all European missions and technology requirements are gathered from all ESA Directorates, National Delegations, Industry and Operators. These requirements are then analysed, and synthesized.

The second cornerstone of the process is the ‘European Space Technology Master Plan’ (ESTMP), which constitutes a complete overview of planned institutional space-technology programmes in Europe and includes harmonised roadmaps. The analysis of these planned European R&D activities with regard to technology requirements forms the basis for conducting the technology-harmonisation activities with the European stakeholders.

A further strategic element is the ‘Technology Observatory’. Its function is to support the harmonisation process with specialized inputs at critical points along the way.

The Technology Monitoring activities close the process loop by providing the feedback needed to measure the performance of the process, and to support continuous improvement.

The actual implementation of the R&D contracts is carried out through the various existing ESA or national programmes.

These principles and guidelines agreed in Seville were endorsed by ESA’s Industrial Policy Committee (IPC) in May 2000. The ESA Ministerial Council, at its meeting in Edinburgh in November 2001, reaffirmed ESA’s central role in the coordination and harmonisation of the European strategy and policy for space technology and invited the Agency and

its Member States to pursue, together with the other players in the space sector, the programmatic coordination and harmonisation of technology programmes in Europe. The accompanying Ministerial Council Resolution confirmed the vision embodied in the joint ESA-EC Strategy for Space for strengthening the foundations of Europe’s space activities.

### The Edinburgh Ministerial Council:

1. REAFFIRMS the need for a strong technology base as the key to the worldwide competitiveness of European industry and the success of future space missions.
2. REAFFIRMS the central role of the Agency in the coordination and harmonisation of European strategy and policy for space technology and WELCOMES the good progress demonstrated in pilot cases.
3. INVITES the Director General and Member States, together with other players in the space sector, to:
  - a) pursue the programmatic coordination and harmonisation of technology programmes in Europe and prepare the European Space Technology Master Plan as a further step to the recently developed ESA Technology Master Plan;
  - b) define road-maps and harmonised implementation schemes for the development of critical technologies, involving industrial funding as appropriate; and
  - c) define appropriate measures to ensure consistency between the European Space Technology Master Plan and ESA’s industrial policy.



## The European Space Technology Requirements Document

### Dossier 0

The European Space Technology Requirements Document is intended to collect in a single text, and provide a complete overview at European level of, all the envisaged future missions and their associated technology requirements, including those related to 'technology push'. This document is the starting point for and a key element of the global technology strategy developed by ESA, which extends from the collection of the technology requirements, through to the implementation of the actual technology-development activities. Moreover, Dossier 0 is an important tool for the generation of the individual ESA, European Commission and national space-technology plans. Inputs are provided by all ESA Technical and Programme Directorates, by the national Delegations, the European Commission, and by European Industry through Eurospace and European Prime Contractors and by other interested parties.

The first version of the Dossier 0, issued in 1999 and widely circulated to Industry and Member State Delegations, was well received, confirming its importance within the overall European technology strategy. With the March 2002 issue, an effort has been made to improve the traceability of the inputs, the structure and the content of document, and its coverage.

### The consolidation process

The data collected in Dossier 0 have been further processed in the Consolidated Dossier 0 (Dossier 0-C) with the aims of improving the document's overall legibility and completeness, and of providing a consolidated view of the technology requirements in order to better identify synergies and commonalities.

The consolidation process was strongly supported by all ESA Directorates, in particular the Directorate of Technical and Operational Support and, when needed, by



*The 2002 update of Dossier 0 on CD-ROM*

Industry, Eurospace and the national Delegations. The Dossier 0 data was reviewed by 25 panels of ESA experts to:

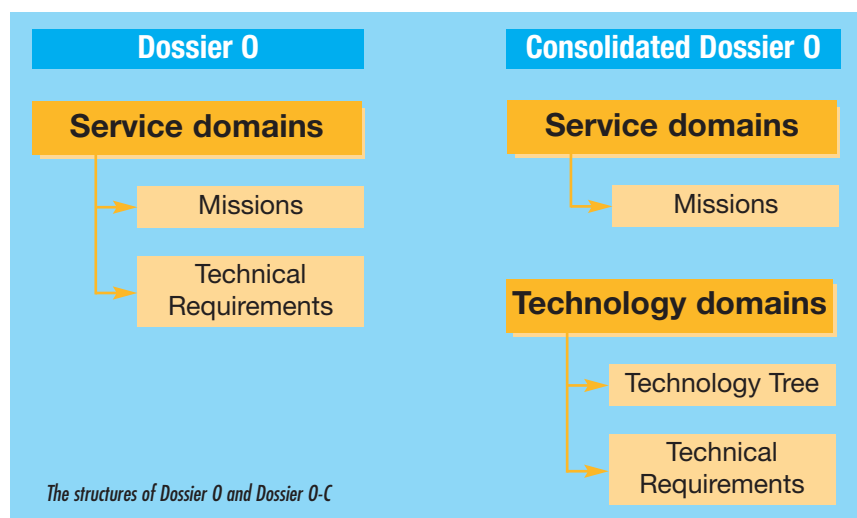
- (i) establish the 'Technology Tree' (which provides a detailed classification in terms of technology domains, sub-domains and groups of technological know-how required in space activities; and
- (ii) carry out a thorough analysis to ensure the coherence, completeness and correct classification of the various requirements within the Technology Tree.

Although the contents of the Dossier 0 and Dossier 0-C are similar, the document structures differ significantly.

The Dossier 0 data are organised into service and application domains, while in the consolidated document all missions are grouped together and the technology requirements are organised into technology domains. In practical terms, this allows a technology expert to find all of the technology requirements pertaining to his/her field of technical expertise grouped independently of the application. This helps considerably in identifying synergies and commonalities across various applications.

### The evolution process

Dossiers 0 and 0-C are already playing a valuable role in European space-technology strategy. As they evolve further, more contributors will be included, thereby providing ever-growing benefits to the European space community. Subsequent yearly updates will increase both their validity and completeness. Web-based informatics tools are being developed to facilitate participation in the voluntary contribution process and to speed up the updating process.



### The Space Technology Harmonisation

The harmonisation initiative is based on two assumptions: firstly that the resources for basic space R&D need to be better coordinated and prioritized; and secondly that dedicated public budgets for space-technology developments in Europe will continue to be constrained, and consequently R&D should be increasingly financed through co-funding, partnership, cooperation and concertation schemes, and space agency / EC / industry agreements.

The technology-harmonisation process takes into account the various European developments, capabilities and budgets to enhance the complementary roles of the various partners in meeting common objectives. Success relies first and foremost on exchanging information on future plans and on results from on-going developments between participating stakeholders, and on the interest and willingness of these stakeholders to discuss and agree on a common and concerted approach for the benefit of both Europe's industry and its space programmes. ESA is playing a central role

in this process, facilitating – through coordination, documentation, recommendation and synthesis – a fruitful dialogue between the ESA Directorates, the national Delegations, the European Commission and Industry.

Given the novelty and wide-ranging scope of the harmonisation process, a methodology was tested on pilot cases in 2000 and 2001, covering different situations in terms of technology maturity, industrial competitiveness, funding needs and political interest. The pilot cases

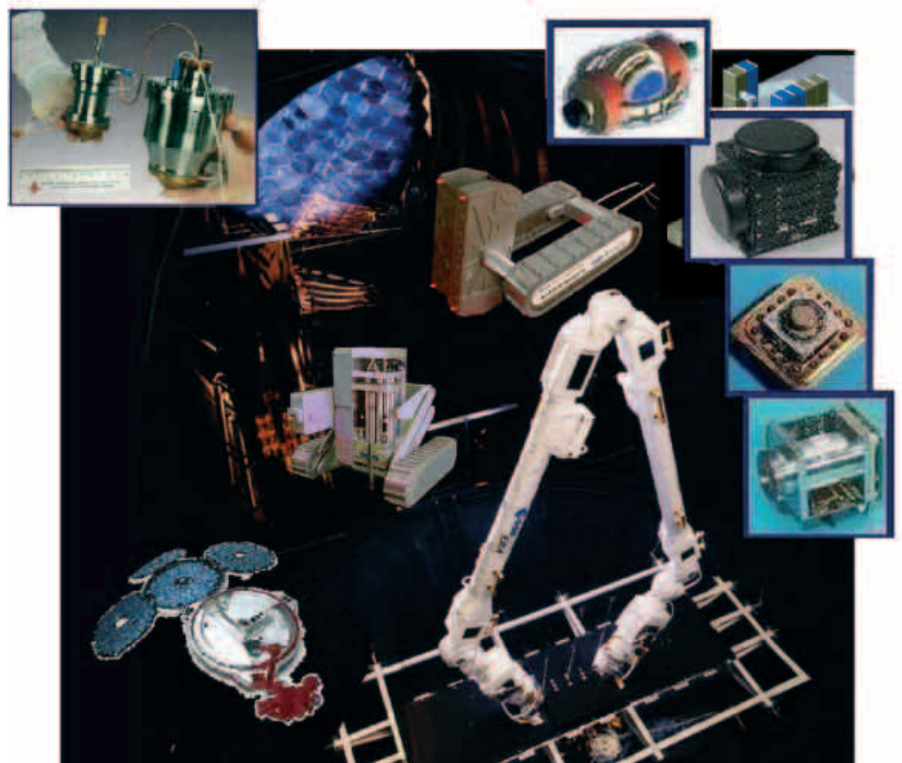
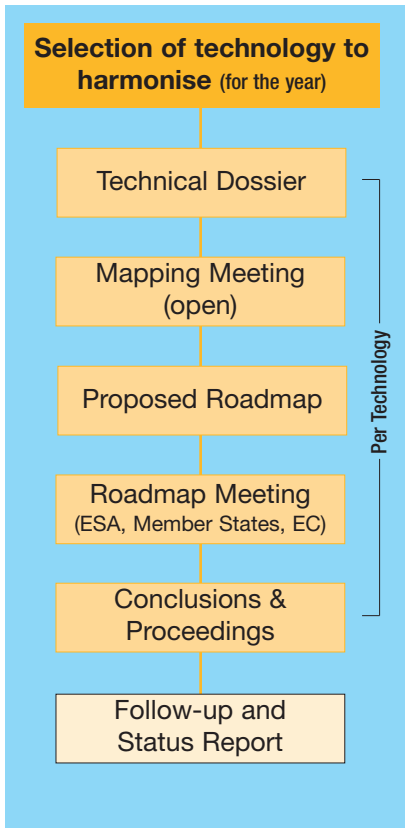
selected were: solar arrays, electric propulsion, and synthetic-aperture radars in 2000; and cryogenics, attitude and orbit control system sensors and robotics in 2001.

The methodology followed is based on two meetings per technology. The first is open to all players (Industry, National Agencies and Delegations, Operators, EC and ESA's Programme and Support Directorates). Its objective is to achieve as complete a mapping as possible of the technology in question. ESA introduces

### Technology Harmonisation

The major objectives of the harmonisation process are to:

- optimise public investments in space-technology R&D
- fill strategic gaps and reduce unnecessary duplication
- ensure a fair role for each player
- specialise skills and strengthen industrial cooperation
- determine the R&D priorities to satisfy European space ambitions, commensurate with the available resources
- arrive at a coordinated and committed European Space Technology Policy and R&D programme.



the future mission and market needs, the worldwide technology trends, the European state of the art, competitiveness and strategic interest. National Delegations present their on-going activities, industrial expertise and plans. Eurospace presents the space-industry-coordinated capabilities, needs, and recommendations.

The second meeting is restricted to the funding parties (Delegations, EC, ESA). Its purpose is to discuss and agree on road-maps for future R&D activities, covering all programmatic aspects. Items for discussion and decision include what needs to be developed and by when, and the identification of sources of finance and possibilities for sharing skills, expertise, capacities and resources with potential partners. Issues such as maturity, target readiness, and competitive impact and position are also assessed.

Feedback on the pilot phase from all participants has been very positive. The mapping meetings and the supporting documentation have provided increased visibility of the opportunities and challenges related to specific technologies and market segments. The agreed road-maps have guided the various players in planning their R&D efforts in the corresponding technology areas.

The benefits obtained from harmonisation can therefore be summarised as:

- Increased visibility of the European situation for the technologies covered.
- Identification of inefficiencies.
- Contributions to skills specialisation and the strengthening of cooperation between companies across Europe.
- Helping in establishing and improving contacts and developing partnerships.
- Facilitating the adoption of strategic decisions by Delegations, which may reorient their national plans and help their industry to improve its competitive position.
- Constituting an essential step towards the optimisation of public investments and the achievement of a European Space Technology Master Plan.

The November 2001 harmonisation meeting concluded the pilot phase, and included a discussion with Delegations about lessons learnt and the way forward.

### Harmonised Technologies

2000	2001	2002
<ul style="list-style-type: none"> <li>• Solar Arrays</li> <li>• Electric Propulsion</li> <li>• Synthetic-Aperture Radar</li> </ul>	<ul style="list-style-type: none"> <li>• Cryogenics</li> <li>• AOCS sensors</li> <li>• Robotics</li> </ul>	<ul style="list-style-type: none"> <li>• Aerothermodynamics</li> <li>• On-board Radio Navigation Receivers</li> <li>• Thermal and Space Environment Software Tools and Interfaces</li> <li>• Energy Storage (Batteries)</li> <li>• Onboard Computers and Data Systems</li> <li>• Mechanisms and Motors</li> <li>• Chemical Propulsion</li> <li>• Ground-System Software</li> </ul>

It was agreed to:

- Conduct technology harmonisation on a routine basis.
- Identify and plan harmonisation meetings well in advance.
- Retain the two-meeting approach.
- Increase the number of cases handled every year, with a target of two cycles/year (4 meetings and 8 cases per year).
- Revisit each case on a regular basis (every 2 to 3 years), to assess results and update the road-map.
- Prepare and distribute relevant documents (technical dossier, tentative road-map) to participants before each meeting.
- Provide annual feedback to Delegations and Industry regarding progress in harmonisation.

The harmonisation process proper started in January 2002 with the discussion and approval by ESA's Industrial Policy Committee (IPC) of the cases to be handled this year. The first four technologies were harmonised during the first quarter, and harmonisation of the second set will be completed by December.

### The European Space Technology Master Plan (ESTMP)

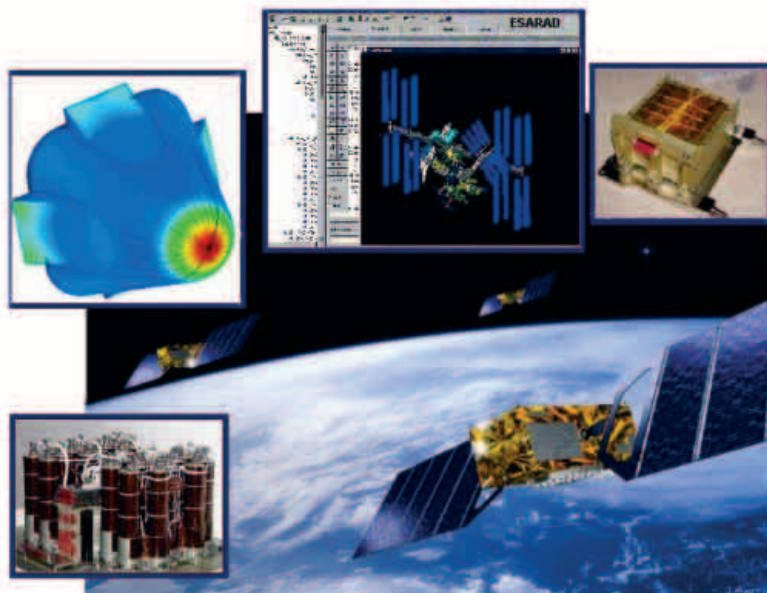
The ESTMP has its roots in the Technology Plans of the Member States of the EC and of ESA, which are synthesised in a manner comparable with the high-level requirements retained in ESA Dossier 0. It supports the on-going harmonisation process by identifying any gaps and overlaps. The ESTMP will

increasingly be established based on technology road-maps agreed at European level, giving the European stakeholders an overall view of planned European institutional technology activities. It will provide a reference for the next iteration of Technology Work Plans for ESA as well as its European partners, thus becoming a common tool to define technology strategy and policy at both national and European level.

In addition to providing an overview of how the contributing national, ESA and EC technology authorities are structured and their programmes are funded, the ESTMP describes the various technology programmes and lists the key contact persons for the technology development activities in ESA, National Delegations, EC, and Industry within the Member States and sometimes beyond.

Generation of the ESTMP was initiated back in March 2002 with a letter to the Delegations and to the key ESA players, announcing the ESTMP activities and describing the process milestones. Most Member State Delegations have subsequently been briefed by key ESA Technology Programme staff regarding the Agency's approach to the ESTMP, to facilitate their participation. Similar contacts with EC representatives have become part of the ESA/EC Joint Task Force technology Working Group.

Strong support and interest was expressed by both ESA Delegations and ESA Programme Directorates for this common tool.



The first issue of the ESTMP (1.0) was presented to the Agency's Industrial Policy Committee (IPC) on 27 November. The IPC warmly welcomed the document and its associated database and recommended its extensive use at national and European level. The ESTMP will be presented to the ESA Council in December 2002.

### Technology Monitoring

One of the essential components in formulating and implementing an effective technology strategy is knowledge of the results of past activities and their overall coherence with the strategies and policies of ESA and its Member States. ESA has therefore initiated a Technology Monitoring Study to develop a framework for assessing the impact of ESA R&D activities on European Industry.

As a validation exercise, a pilot study has already been run, selecting a limited set of past technology-development activities. A detailed questionnaire identifying the outputs of the R&D activities in terms of generation of patent applications, publications, etc. has been compiled with the help of the industries involved. The study is now in its final phase and the preliminary results are promising.

### The Technology Observatory

The watch on key activities related to technology developments both inside and outside Europe is a further element of the technology strategy being developed by

ESA. Within the remit of the 'Technology Observatory', therefore, information is being gathered concerning:

- European Industrial R&D capability mapping, including the identification of best practices.
- Identification of technology-dependence issues.
- Space-technology watch outside Europe.
- Non-space-technology watch within Europe.

The envisaged output from these Technology Observatory activities is a series of reports, which ESA will be making available to the National Delegations and the technology strategy units of European Industry. The first issues are planned by end of 2002.

### Conclusions

ESA's central role in defining a European strategy and policy for space-technology R&D, coordinating the corresponding programmes and harmonising the activities resulting from their implementation, was reaffirmed at the Ministerial Council in November 2001. Space-technology research, development and demonstration must ensure effective technological preparation for future space programmes, leadership in some selected areas, and support the worldwide competitiveness of European space industry. ESA has therefore developed a comprehensive process for ensuring the implementation of these challenging

strategic goals:

- Dossier 0 (now in its second edition) compiles at European level future missions and the technologies they require along with technology 'push'.
- The European space-technology harmonisation process, which is voluntary and transparent, is very strongly supported by Delegations and Industry, and this is key to its success. After the pilot phase in 2000 - 2001, the process is now in a 'running' phase that will result in 14 technology areas being harmonised by the end of 2002, with better-coordinated R&D plans and well-targeted industrial activities.
- The European Space Technology Master Plan documents the European R&D activity and guides its implementation. The ESTMP is a frame document that identifies, incorporates and analyses the European technology developments that are institutionally funded. As they are established, discussed and agreed, the harmonised road-maps will constitute the core of this Master Plan.

The process of defining a European strategy and policy for space-technology research, development and demonstration is highly dynamic, with active feedback throughout its various phases and frequent interactions with all parties involved. Dossier 0 and the ESTMP will be updated on a yearly basis, the harmonisation being a more continuous process with the objective of revisiting the technology road-maps on a 2 to 3 year basis.

### Acknowledgement

The authors would like to thank the National Delegates, Industry and Eurospace for their strong and continuous support, to highlight the substantial contributions of the ESA Directorates and in particular the Directorate of Technical and Operational Support, and to acknowledge the work performed by A. Atzei, M. Novara and P. Cordero-Perez who initiated this whole effort. Special thanks also go to Dr. H. Kappler and N. Jensen for their encouragement and leadership.