Technology

Programmes

Basic Technology Research Programme (TRP)

As exciting as it was challenging, the StarTiger project (Space Technology Advancements by Resourceful, Targeted and Innovative Groups of Experts and Researchers) conducted within the TRP in 2002 had the twofold objective of: developing a new and promising technology, and conducting R&D in a novel and innovative way. It proved very successful, illustrating ESA's policy of innovation as well as its overall policy of striving to serve Europe's citizens. The rationale behind the StarTiger approach is to demonstrate quickly the feasibility of a new and promising technology, by bringing together a small group of highly motivated researchers and specialists, granting them full access to laboratory/production facilities, removing all administrative distractions, and letting them work intensively for a few months.

A suitable programmatic carrier was already in place for such a pioneering undertaking, thanks to the thrust for innovation set for the TRP by the ESA Technology Master Plan (TMP). ESA's Industrial Policy Committee (IPC) had approved the StarTiger pilot project in October 2001. The challenging technology goal set was to produce a compact terahertz imager within four months.

Technology-wise, StarTiger emerged from ESA-led research into Photonic Band Gap (PBG) technology in the late 1990s. By the end of the decade, this had resulted in the development of one of the first PBG antennas operating at submillimetre wavelengths. The StarTiger pilot project was also able to draw upon such innovative space technologies as planar antennas and detectors, and miniaturised back-end electronics.

A multi-disciplinary team of eleven scientists and specialists from seven European countries – the United Kingdom, Ireland, Italy, Germany, France, the Netherlands, and Spain – were handpicked in April 2002 both for their expertise and ability to work together. Scheduled to last four months, the R&D 'race'

The advanced imager in operation, with the terahertz image of the hand captured on the laptop's screen

The StarTiger team together at ESTEC in Noordwijk (NL) on 25 October

began on 5 June at RAL (UK), under the technical supervision of ESTEC's Electromagnetics Division. The project was officially inaugurated on the 24 June by Lord Sainsbury, the UK's Minister for Science and Innovation.

Criteria had been defined for measuring the expected success of the project and for providing a clear and simple way of assessing the outcome. The final goal was to capture a passive terahertz image of a human hand. The strategy chosen was to split the task into two phases. Initially a system would be built using conventional mechanical scanning technology to enable an early demonstration and uncover any underlying problems. This system was dubbed the 'conservative approach'. Whilst this system was being designed and built, the team would in parallel study possible options for the final 'advanced approach'. Work was also performed on photonic band-gap electronics, bolometer arrays and novel fabrication technologies.

In September, after four months of intense work, the StarTiger team succeeded in making a pioneering breakthrough, when a two-colour picture of a human hand was captured at 0.25 and 0.3 THz using the advanced demonstrator.

The unique properties of terahertz waves can undoubtedly pave the way for numerous, as yet unforeseen research and applications opportunities in both the space and non-space fields, stemming from the colour-imaging capability. They include cosmology, Earth environmental monitoring, planetary and cometary imaging, medical and dental diagnosis (obtaining an X-ray-like image without the use of harmful radiation), antipersonnel-mine detection, airport security and aircraft monitoring in poor weather conditions.

Looking ahead, the next step would be to develop an electronically scanned array, for which the key component – the phase shifter – was demonstrated by StarTiger. Although not the first priority, the intrinsic network building capability of StarTiger is also very interesting. ESA is therefore now working on continuing StarTiger through other projects.

General Support Technology Programme (GSTP)

The GSTP continued to be a key element within ESA for supporting the pre-development and qualification of space technologies required to meet the demands of both ESA projects and European industry's competitiveness. This is clearly reflected by the fact that the programme's financial envelope was increased by nearly 50% in 2002.

Thanks to the programme's flexibility, the GSTP could moreover be used as the implementation tool for interim-phase activities on Reusable Space Transportation and Atmospheric Re-entry Technologies (aimed at the preparation of future reusable launchers and manned re-entry systems), and also for the generic technology development activities related to the second opportunity mission within the Earth Observation Envelope Programme, SMOS (Soil Moisture and Ocean Salinity Mission).

The revision of the GSTP Programme Declaration during the year allowed the introduction of an initiative to further support European industry in its market-oriented activities. This pilot project will be implemented via Announcements of

Opportunity, to be issued twice per year, seeking proposals to be co-funded by ESA and industry on a fifty-fifty basis. This new initiative within the GSTP follows ESA's commitment to strengthen industrial expertise and European industry's position in today's highly competitive space market.

Technology Flight Opportunities Programme (TFO)

The TFO initiative encourages the in-orbit demonstration of promising technologies. Developed within the TFO, the Combined European Two-Phase Loop Experiment (Com2Plex) was delivered in 2002 and launched aboard the Shuttle on 16 January. After successful flight demonstration, the cooling system will be marketed for commercial and scientific satellites.

The experiment aims at equalising extreme temperatures in a spacecraft. The technology is based on capillary forces, which can be used to sustain liquid flow in porous materials. This novel system therefore avoids the electrical pumps used in conventional liquid cooling loops. Three different loop heat pipes were integrated into one technology experiment, mounted outside of the Spacehab module. Loop heat pipes, developed in the last few years, are key technology elements for deployable radiators, thermal control of laser-based instruments, and heat transfer from remote equipment to radiators.

Strategy and Harmonisation

European Space Technology Requirements Document (Dossier 0)

This document is a key element of the space-technology strategy being developed by ESA, since it collects together in a single document:

- all proposed missions and activity descriptions
- the related top-level technology requirements (user pull)
- the generic technology (technology push).

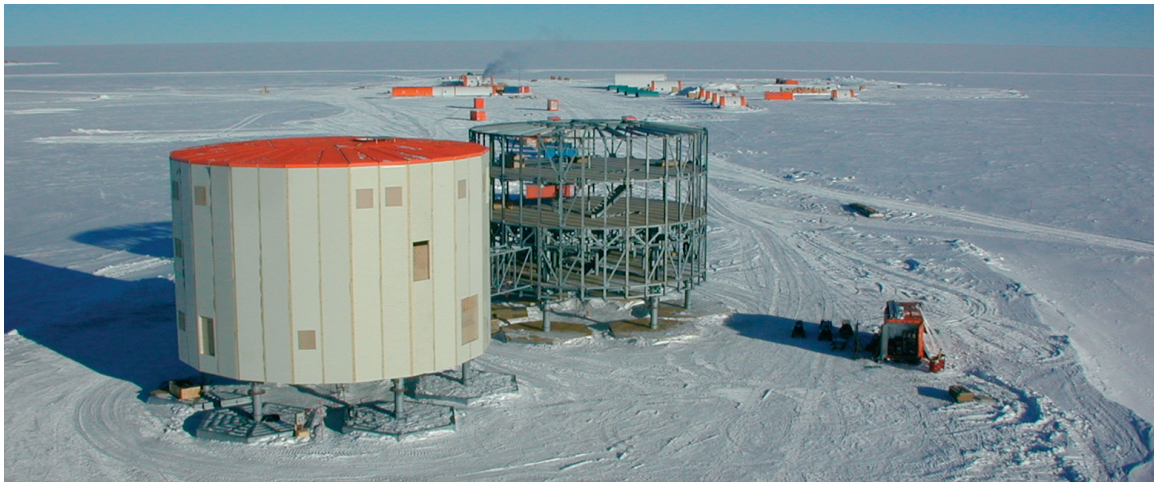
All ESA Directorates, national Delegations, and Industry (mainly through Eurospace) have contributed to Dossier 0, first issued in 1999. Because it provides the space community with a global view of all future technology requirements, it is a fundamental tool for the preparation of all European space-technology R&D plans. The 2002 update was presented to the IPC in March, before being further consolidated and then distributed in July. Future updates are planned on an annual basis.

European Space Technology Harmonisation

This harmonisation effort is centred around a process of dedicated, results-oriented meetings per technology. ESA's central role in this process is to prepare and facilitate - through coordination, documentation, recommendation and synthesis - a fruitful dialogue between the ESA Directorates, the national Delegations, the European Commission and European space industry. After the pilot phase in 2000 and 2001, the process was up and running in 2002, resulting in 14 technology areas beind harmonised by year's end, with better-coordinated R&D plans and well-targeted industrial activities.

The year saw two successful harmonisation cycles dealing with 8 technologies: on-board radio-navigation receivers, thermal and space environment software, aerothermodynamics, batteries, microprocessors and microelectronics, electric motors, chemical propulsion, and ground-system software, documented in comprehensive proceedings.

The harmonisation process allows one to analyse the status and the needs of key space technologies, to share this detailed information, and to define and agree on a concrete European roadmap for these technologies. The roadmaps also provide the necessary elements for building a harmonised European Space Technology Master Plan. In November, the IPC approved the work plan for the first semester of 2003.



The Institut Paul Emile Victor (IPEV) is building a new research centre at the Franco-Italian Antarctic base, 'Concordia'. Although Concordia will not be involved in space activities, it will rely on space technology from ESA's MELISSA project to meet its critical water-recyling needs

European Space Technology Master Plan (ESTMP)

In response to the request by the Council at Ministerial Level in Edinburgh in November 2001, the Executive prepared the first Issue of the ESTMP, which forms part of the overall European Space Technology Strategy process, together with Dossier 0 and the harmonisation activities. The ESTMP addresses the high-level description of the technology authorities and programmes of ESA, its Member States, and the European Union, and reflects on, shares and analyses the respective technology plans.

The HEART (Harmonised European Agencies Research & Technology) of the ESTMP is the database, containing more than 1300 technology activities currently being conducted in Europe by the ESTMP contributors. It allows the identification of technology gaps and unwanted overlaps, the prioritisation of technology activities for subsequent harmonisation cycles, and the identification of the Dossier 0 requirements satisfied by each activity.

The ESTMP was presented to the IPC in November and to the Council on 12 December. Based upon the IPC's recommendations and the positive reaction from Council, it will be regularly updated and extensively exploited, in particular to support the harmonisation process.

Concerted Programmes: the Solar Sail

A Letter of Agreement between ESA and DLR covering the modalities of the joint execution of this project in equal partnership was signed in May. The industrial proposal for the solar-sail in-orbit deployment demonstration (400 m^2 sail) was received from Kayser-Threde in mid-2002 and evaluated. The development contract is planned to start in 2003, once sufficient confidence in the proposed design has been established.

Cooperation between ESA and the European Commission on Technology

The Technology Working Group of the ESA/EC Joint Task Force focused its efforts in 2002 on its key recommendations: to have the EC participate fully in the ESTMP and in the prioritisation process, and to have ESA take a larger role in the 6th Framework Programme through upstream consultation in the work programme's preparation and in its implementation. The conclusions of the fruitful exchanges reflect a strong potential for synergy between the activities of the two organisations in space-related technology.

Whilst ESA was preparing the first edition of the ESTMP, to which the EC contributed, the Commission was finalising the work packages for the 6th Framework Programme, where a high degree of complementarity/non-duplication is achieved with ESA and national R&D activities.

The Technology Transfer Programme (TTP)

The ESA TTP is aimed at stimulating space to non-space technology transfers and the creation of spin-offs. Ground-breaking European space technologies are becoming increasingly more available for development and licensing to the non-space industry through the technology-transfer process. In the thirteen years of its existence, the TTP has, through its network of brokers, effected more than 150 transfers, including 22 in 2002, leading to a cumulative turnover of about 300 million Euro, for both donors and receivers, at the end of 2002 and an annual income equivalent to more than 1000

jobs. Since the TTP was started in 1990, more than 25 new companies/start-ups/spin-offs have been created, with the revenues generated exceeding the related TTP expenses by a factor of 15 to 20.

Highlights

The European Space Incubator (ESI) is a facility/service that will give small companies the means and opportunity to develop technologies and products based on space-developed expertise in a secure environment and with limited risk. The ESI is part of a larger network of 25 incubators in 14 countries, known as 'ESINET'. It was officially inaugurated in Brussels on 17 July in the presence of EC Commissioner for Research Philippe Busquin. Activities to promote the ESI are intended to attract some 50–80 entrepreneurs annually to seek hosting, with the Incubator supporting 6–10 pre-start-ups per year. ESI fund-raising activities to secure a minimum of 25 MEuro to be used as seed capital and the first round of start-ups both made progress.

The highly successful work of the Harsh Environment Initiative (HEI) was also continued in 2002, attracting a further investment of 5 MEuro.

A spin-off company focusing on the promotion of technologies developed within the MELISSA (Micro-Ecological Life Support Alternative) project addressing life support for long-term space missions, is close to creation. This project has spawned a variety of technologies with considerable potential in the environmental field (waste water, biotechnology, etc.).

The TTP has established several technology-transfer programmes at national level in cooperation with the authorities in Belgium, Canada, Norway, Italy, Austria, Holland, Finland, Ireland, etc. It has also established a partnership with the EC's Network Innovation Relay Centre to boost trans-national technology transfer.

The year also saw the publication by ESA of a number of flyers and brochures, each relating to the successful transfer of space technologies in a particular domain. In an effort to promote space-developed technologies in new ways, a number of competitions were organised: The Influence of Space on Design, Space2Tex, and the Clarke-Bradbury Science Fiction Essay.

A series of workshops were also held on a variety of topics, including tunnelling, mining, offshore engineering, the Arctic environment, textile, and the automotive industry.

In October, ESA was present for the first time at the Mondial de l'Automobile in Paris. The stand, featuring the record-breaking solar car 'Nuna', was visited by no less than four Ministers, who were impressed by the car and its race-winning technologies emanating from space developments.