



Research and Economic Development

2006/2007



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German Aerospace Center (DLR)

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Preface

Mobility, communication, safety, energy, and climate change – these are the challenges facing our modern-day society. As research center, space agency and the largest project management agency in Germany, the German Aerospace Center (DLR) is working to become the driving force on these issues by applying mental agility, flexibility and top performance. For a century now, scientists have been researching and developing innovative technologies in the area of aeronautics and subsequently space that have done far more than enrich our daily lives. They also enable us to meet the growing competition in Germany, Europe and the world and to take on leading roles in certain segments, thus allowing us to secure Germany's lead position in business and science.

As of March 1, 2007 I have had the opportunity to accompany and influence our activities as Chairman of the Executive Board. Since assuming my post, my experiences have been extremely positive, employee commitment has been impressive and partner relations in the business, science and political arenas provide an excellent foundation for the furtherance of DLR.

A look back at the astonishing and fascinating research results of institutionalized aeronautics and space research over this past century fills us with pride. During an anniversary celebration in February 2007 numerous outstanding achievements were honored in the presence of high-ranking guests from government, science and industry. To successfully apply performance and innovation in areas of development and advanced technology is a tradition DLR was able to continue last year with remarkable stories in four key areas: aeronautics, space, transport and energy. For example, the creation of the Center for Computer Applications in AeroSpace Science and Engineering (C²A²S²E) in Braunschweig laid the foundation for the development of a globally recognized and multi-disciplinary center of expertise for numerical flight simulations. Furthermore, we were able to begin research on the state-of-the-art field of cabin climate control and acoustics by adding a Do 728 as a new test platform. The remarkable research results in aircraft wake vortices have significantly contributed to safety and improved capacity utilization of large commercial airports. Climate and environment are always important issues in these research areas; this is another reason why the "Climate Change Report" by the Intergovernmental Panel on Climate Change (IPCC) relies overwhelmingly on DLR research results when covering the topic of air transport.

Currently, one of the most exciting solar system exploration projects is the Cassini-Huygens mission to Saturn. Every week for over three years the jointly developed US/European spacecraft has been transmitting data of invaluable scientific benefit to Earth. With Mission Astrolab, German ESA-astronaut Thomas Reiter successfully completed 33 European experiments on the International Space Station (ISS) and, if that were not enough, broke all European records by spending a total of 350 days in space. The most recent highlight in earth observation is the successful start of the German radar satellite TerraSAR-X, that scored a record turn-

around for its first data transmissions. This mission is just one more instance of how Germany is leading the field in remote radar exploration. The challenges faced in aeronautics and space research are also reflected in the research undertaken in transport and energy. The diverse utilization potentials of satellite technologies in transport are astonishing. Not only can we now be navigated through traffic on the roads, but we also stand to experience future benefits from this technology as rail and airplane passengers and even as pedestrians. Energy research is also moving forward with significant innovative achievements. Impressive evidence of the advances in the research area of smaller, efficient fuel cells can be seen in the "HyFish" flight prototype. Project HYDROSOL received the internationally acclaimed Descartes prize for its development of a new solar, thermochemical process for the production of hydrogen. The focus on hydrogen generation, independent of already existing carbon-fueled energy carriers, demonstrates the significance of a fuel such as hydrogen and puts it on track as a fuel of the future.

Being a pushing force in science and application means more than doing excellent research. DLR continues to develop its expertise with regard to economic profitability, efficiency, personnel, and quality management. This annual report is therefore divided into two parts. Under the heading "Research Results", part one describes fascinating highlights in scientific developments in aeronautics, space, transport and energy. These topics represent an essential contribution to the future development of Germany as a commercial and scientific location of

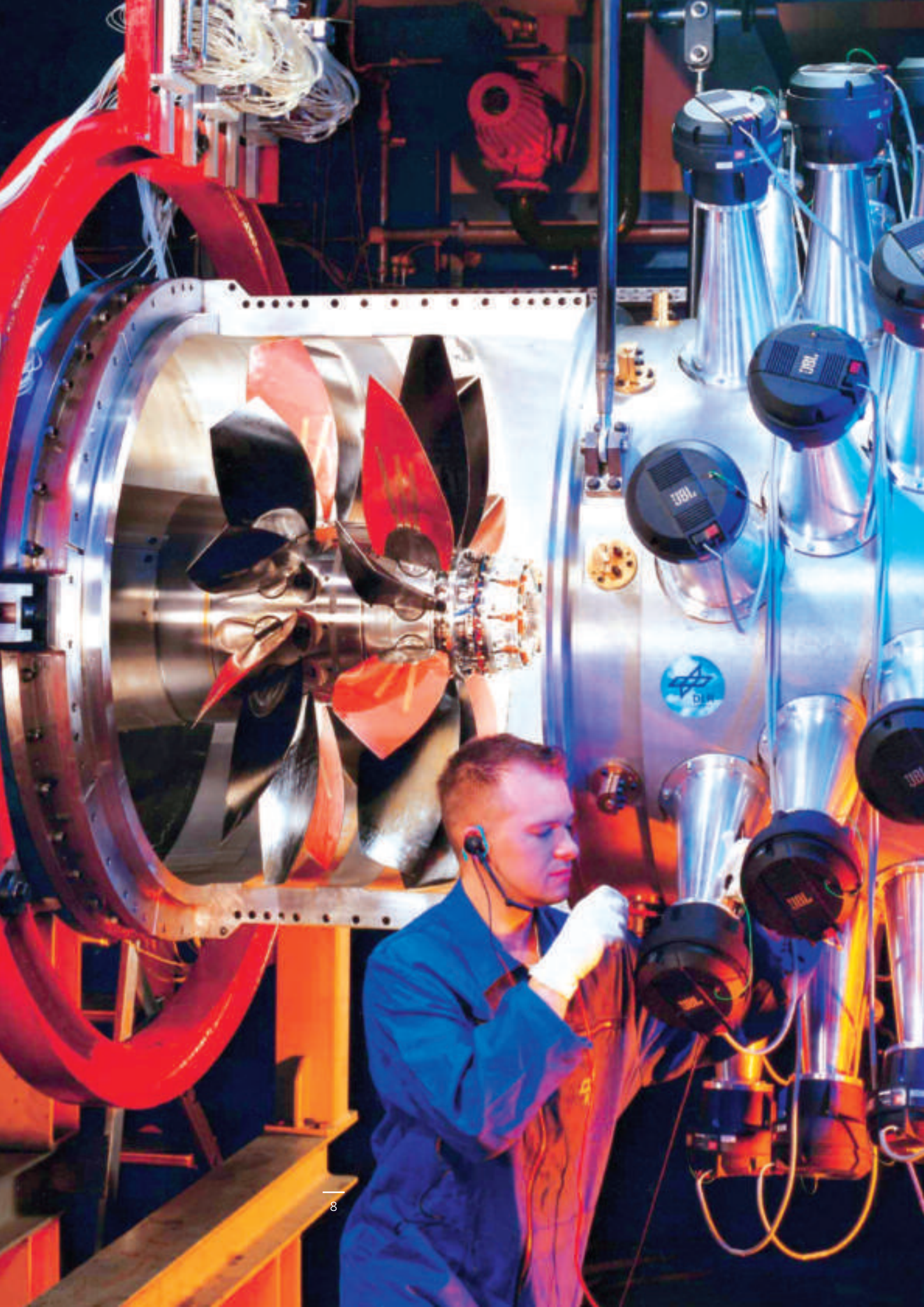
choice. In part two, entitled "Corporate Results", we describe the development DLR as a whole is taking in terms of its identity as a research facility. A well-balanced third party funds business, modern personnel development, quality assurance, and management of an extensive research infrastructure are important goals, equaled only by our determination to establish and expand international cooperation.

DLR actively engages in visionary, cutting-edge research and it will continue to rise to the challenges of society in dynamic and resourceful ways, thanks to the commitment of its nearly 5,300 employees. To cooperate, organize, and think in innovative and integrated ways requires a consuming passion and a curiosity for uncharted territories. I hope that you too have developed a curiosity for last year's exciting events and will allow yourself to become swept away by our exciting research results.

Cologne, December 2007

Prof. Dr. Johann-Dietrich Wörner
Chairman of the Executive Board







RESEARCH RESULTS



Aeronautics

As documented in the medium-term programs of national and European research agendas, the DLR research program continues to concentrate on national and European objectives. DLR successfully participated in the two bids for the national program (LuFo IV and LuFo IV-IP). The results of the first bidding process of the 7th Framework Program for transportation research, including aeronautics of the EU, have not been received at this time. DLR, in collaboration with many partners from industry and science, submitted multiple project proposals.

Within this reporting period, DLR has started 15 new in-house projects in its aerospace program of fixed wing aircraft, helicopters, propulsion technologies, air transport management and environment, covering such diverse topics as a new generation CFK-fuselage, investigations into cabin comfort and noise reduction, numeric simulation for future aircraft design, the configuration of UCAVs (Unmanned Combat Air Vehicles), including aspects relating to the Total Airport Management concept.

In addition, several new experimental platforms were purchased, for example, a cabin-mockup along guidelines of the A380, a new coating system for thermal barrier coatings (MEGA, multi-source, magnetron sputtering systems), as well as the Dornier Do 728 test platform, which DLR will use in its current and future research activities.

These new projects and test facilities support DLR in its endeavor to strengthen the competitiveness of the national and European aeronautical and aviation industry to satisfy political and societal aspirations.

“MEGA-Start” for novel protective coatings

Multi-functional coating system in operation

With the boost of an HGF-investment in the amount of Euro 3.2 million, a new Coating Technology Center was built and started up at the Institute of Materials Research during 2006-2007. At its core is the new MEGA (multi-source magnetron sputtering system) multi-functional coating system.

It will now be possible to produce totally new protective coatings with improved characteristics by depositing of particles in the vapor phase; this process is particularly suited for aero engine applications. The system uniquely combines the advantages of different coating technologies in one system. For the first time around the globe, magnetron sputtering, high frequency sputtering and hollow cathode sputtering are presented as one process.

Using state of the art process monitoring equipment, materials scientists will be able to produce cost-effective protective coatings for high-temperature applications with properties that could not be achieved in the past. The present challenges in the aviation and aerospace industry as well as in transportation and energy research are lower fuel consumption, reduced pollutant emission, and extended component life. Here, new, complex high temperature protective and functional coatings offer excellent opportunities to reach these targets.

Along with the new large-scale MEGA system, two new pilot-scale electron-beam evaporation systems are being operated at the Institute which allow rapid implementation of complex, leading-edge coating systems for applications with turbine components. For the thermal insulation coating of turbine blades, new high-quality coatings for high temperatures were developed in collaboration with engine manufacturers, process equipment manufacturers and coating specialists, research facilities and universities.

The vital benefits of these newly developed coatings will be, for instance:

- complex multi-functional multi-layer-thin films of the highest quality;
- gas-flow sputtering for coating components with complex geometry and high rate;
- high coating quality, reproducibility and process efficiency;
- variable loading: large components (prototypes with industry-related geometry), or multiple small specimens, including mini series;
- innovative micro-structures, new coating properties, variable coating composition, particularly metals, intermetallics, oxides and nitrides; and
- potential areas of coating systems applications: antioxidants, thermal insulation, sensor and catalyst beds, protection against wear and erosion.



Installation of a turbine blade for coating in the new multi-source magnetron sputtering system (MEGA)

Increased passenger comfort

Comfortable temperature and a silent cabin environment (CoSiCab)

Project CoSiCab (Comfortable and Silent Cabin) was mainly used to develop methods and technologies to improve the thermal and acoustic comfort of passengers inside aircraft cabins. In addition, new technologies were examined with respect to integration in aircraft systems. Here, the special focus was on applications for fuel cells.

The tests for thermal and acoustic passenger comfort were mainly conducted in an Airbus A380 cabin-mockup. Furthermore, thermal comfort experiments in a sleeper cabin were investigated. Velocity fields were measured with particle image velocimetry and temperature fields were recorded with temperature sensors and thermo-cameras. By interviewing test subjects, the measured results were compared with the sense of comfort perceived by passengers. Numerical flow simulations were used to compare the statements of test subjects in relation to the perceived comfort, in order to gain

detailed insight and forecast air-conditioning scenarios in sleeper cabins and in the mock-up.

The A380 cabin mock-up was a key factor for attracting third party funding. The CoSiCab experiments showed that the experimental DLR methods can deliver detailed results on air conditioning of an A380 cabin. Consequently, DLR received orders from Airbus. At the same time, it became clear that there was a need for further realistic experiments to be performed in connection with comfort studies. Preparations were made for the Do 728 to be used as a test setup. The inauguration of the Do 728 took place on June 15, 2007.

In the area of experimental processes, both new so-called particle image velocimetry methods (PIV helium soap bubbles) as well as new acoustical sensors (P-U probes) were developed. These processes are used for orders with external funding.

In this sector of numerical flow and acoustic simulation, new processes were established. On one hand, DLR's proprietary THETA flow model was adapted and further developed for numerical simulation of mixed convection flow in cabins. THETA's performance was demonstrated in a project commissioned by Airbus. In the field of acoustic simulation, the PIANO vortex injection process for calculating sound propagation in cabins was introduced.



Aircraft engine of the future

Promising quieter engines with new fan technology concepts.

The Institute of Propulsion Technology is focused on developing new fan technology concepts for aviation gas turbines. One of the most promising designs for a next generation aero-engine (e.g. the engine for the Airbus A320 successor) is a slow-rotating fan, which has a significantly increased induction current ratio. This slow-rotational fan is driven with a reduction gear powered by a high-speed, low-pressure turbine.

The main objective is to reduce noise propagation by approximately 6 dB during take-off, through the following measures:

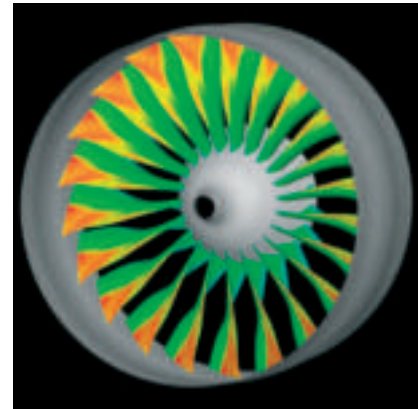
- increasing the bypass ratio to 12, plus a significant increase in the axial flow density in the fan;
- reduction in maximum blade tip speed, in order to prevent "saw tooth noise"; and
- large spacing between the rotor and bypass-stator.

In addition to the improved acoustical characteristics, this increase in flow density permits an increase in the bypass ratio to achieve significantly higher propulsive efficiency.

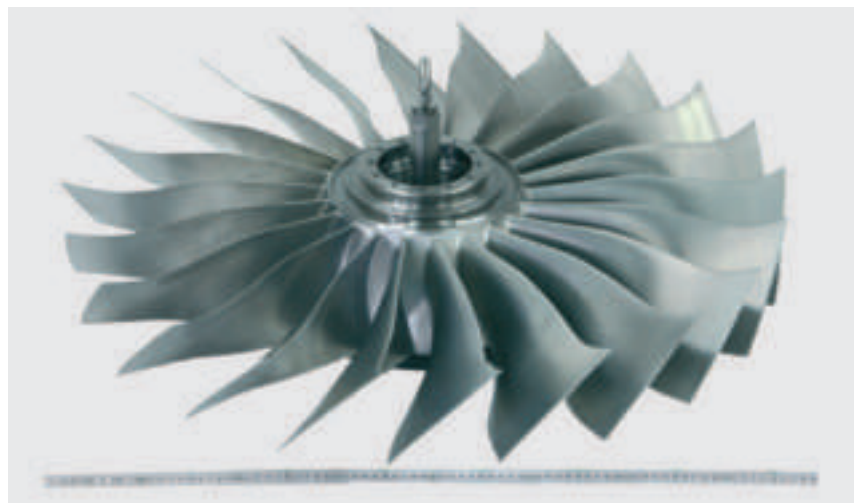
For future long-term research projects and to review the results of the design, the Institute of Propulsion Technology, in collaboration with the Institute of Structures and Design (Department of Mechanical Rotor Design), has developed a generic experimental compressor from

the numerically designed fan stage; this is presently being built. This compressor can also serve as an ideal basis for testing the effectiveness of passive and active noise reduction methods.

The fan rotor was manufactured from a titanium blank, using the "Blisk" design, and is in its final production stage at this time. The picture shows the three-dimensional fan blades with S-shaped leading edges. This milling technology was developed at great expense and can be rapidly implemented into series production (Partners: MTU Munich and CPR Ampfing).



DLR-high bypass fan with calculated Mach number distribution on the blade surface



Fan rotor from titanium in "blisk" design



Assembly of the test section: hub contour in the back cascade (top) and control of the blade tip radius after the rotor has been mounted (bottom)

Increased engine performance with improved environmental compatibility

Single-stage turbine model produces results

The development of modern “next generation” engines has been driven by the desire for substantial improvement while reducing environmental pollution. In collaboration with Rolls-Royce Deutschland (RRD), the aeronautics research program (LuFo) developed, designed and built a single-stage model turbine. This development aims at saving one turbine stage in future engines, in order to reduce manufacturing and maintenance costs and achieve superior performance, particularly in the thrust-to-weight ratio. Based on these measurements, which were conducted with and without forced air to simulate air cooling, the RRD designed a heavy-duty, single-stage model turbine, which was built and finished at DLR and then tested in the wind tunnel for rotating grids in Göttingen. Engineers used measurements from transient pressure sensors to better understand the impact of the radial clearance above the rotor and determine variable flow effects both in the stator as well as in the rotor in terms of chronological and spatial effects. In addition to determining efficiency, depending on the rotor speed and stage pressure ratio, there is also interest in the effect that ejection air has,

for example on rotor disk, or as leakage air from the gap between the stator and the rotor hub. As a result of these measurements, a critical review of the conditions contained in the design tools with respect to the overall result can be made.

Shorter flight times and lower environmental pollution

New innovative air transport systems with IFATS

Innovative Future Air Transport System (IFATS) is a European Commission funded project that pursues the basics of automating air transportation systems to the extent that pilots and air traffic controllers are no longer necessary. The initial idea of the project is purely technical. Key to the complete automatization of the air transport system is the agreement on a non-conflicting four-dimensional flight trajectory between aircraft and ground segments that determines the flight path in the three spatial coordinates and time. Compliance with this process would ensure smooth traffic flow. DLR has developed an appropriate traffic simulation which simulates a busy air traffic day in Frankfurt. The simulation included all aircraft flying in and out of Frankfurt during one day (approx. 1,000), which included both “normal” as well as “irregular” scenarios, e.g. thunderstorms or emergency situations. The Institute of Flight Guidance in Braunschweig conducted air traffic simulations with actual air controllers and so-called “pseudo-pilots” in comparison with fully automated IFATS. According to initial results, IFATS reduced the length of air routes and therefore the flight time as well as environmental pollution. IFATS also improves airport capacity, particularly under poor weather conditions.

Simulation using the WIONA wind tunnel model

Improved knowledge of the structural dynamics of wing/engine interference

Engines with a high bypass ratio can cause major aerodynamic wing/engine interference effects on the wing in the form of aerodynamic instabilities (buffeting) and the resulting dynamic air loads. They also favor the tendency for aeroelastic instability (e.g. wing flutter). The DLR High Performance Flexible Aircraft (HighPerFlex) project, which ran from 2004 - 2006, developed measures to prevent instability by examining the physical process, models and numerical calculation of the engines.

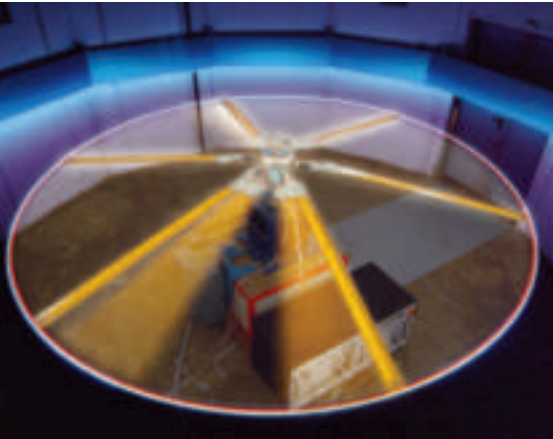
In order to reach these goals, a generic configuration of Wing with Oscillating NAcelle (WIONA) was designed to demonstrate these effects. Using an appropriate model, transient aerodynamic forces and flow parameters were examined in the Transsonic Wind Tunnel Göttingen (TWG) in the presence of induced oscillation and during buffeting in transonic separated flow patterns, and comparative numerical simulation were performed. The work was performed in close cooperation between DLR and ONERA. Based upon the experimental and numerical results, localized flow separation between wings, engine, and pylon and their dependency on geometric details was determined in the wind tunnel



WIONA wind tunnel model in DNW-TWG

as the cause. The numerical CFD TAU elsA codes for solving the mean Reynolds Navier-Stokes (RANS) equations could be validated for transient transonic air flow separation. Furthermore, a simple measure to prevent buffet oscillation could be demonstrated.

The results obtained significantly improved the knowledge of dynamic wing/engine interference and represent a valuable basis for further validation of numerical processes.



Active rotor blade in the spin test stand

Successful spin test for active twist rotor

Individual rotor blade control improved with actuators

The reduction of noise and vibrations is a highly topical objective in helicopter research. In order to achieve this goal, different technologies for realization of individual rotor blade control are being conducted at present. The active twist rotor represents a promising approach. Forces are being introduced via piezoceramic actuators, which are integrated in the rotor blade skin, to permit torsional deformation of the rotor blade. This is an effective method for suppressing aerodynamic effects such as the blade-vortex interaction (BVI), which produce vibration and noise.

An important obstacle for performing wind tunnel experiments with an active twist rotor could now be successfully removed. The highest loads for rotor blades are generated by centrifugal forces. For correct mapping of the aerodynamic effects in wind tunnel experiments, the rotor blade model has to be operated at significantly higher rotational speeds than with an equivalent rotor blade at original

scale. In this instance, the rotor blade test was performed at 1,043 rpm. The forces acting on the blade root exceed 30,000 N. The spin test demonstrated that the active rotor reaches a 3° torsion twist at these high centrifugal forces. This result agrees with the torsion without load measured in the lab test, thereby effectively demonstrating the load capacity of actuators.

In addition to preparing and performing wind tunnel experiments, further studies focus on the transfer of this technology to a rotor at the scale of 1:1. This marks an essential contribution to expanding the possibilities for safe, convenient and eco-friendly application of helicopters.

FHS inaugural flight with active side-stick integration

Flying Helicopter Simulator (FHS) now also with active control

In order to reduce the strain on helicopter pilots during flying maneuvers and to improve the flying characteristics of modern helicopters, innovative control concepts for helicopters are being researched. DLR's focus in this area is on the design certification of so-called active sidesticks. In February 2007, DLR conducted an inaugural flight of the FHS simulator with active sidestick integration. This is a major milestone in the expansion of the scope of applications of the FHS Flying Helicopter Simulator at DLR. The development refers to supplementing the active control by active control functionality. Active sidesticks permit the transfer of additional Haptics information to the pilot. The spectrum of this information covers limiting of structural loads as well as flying range, including tactile information at the time of operation.

The integrated sidestick model is the "Goldstick" manufactured by Stirling Dynamics; this is a simulator stick, which has been subjected to special testing, as proof of compliance with the conditions required in terms of aeronautical engineering certification. The process for integration began in May 2005. The overall costs were split up under third party funding, with one-third being financed by the Federal Ministry for Defense Technology and Procurement (BWB). DLR initiated a large-scale capital investment campaign. The necessary work for integration was performed as a multi-disciplinary project among four departments at the Institute of Flight Systems Engineering. This goal was achieved only through highly coordinated collaboration with the DLR Flight Systems Engineering Division. Any questions relating to optimal integration of the control system into the cockpit were solved by two helicopter test pilots at the location, including any issues relating to the configuration and the operation interface. They also evaluated the new system in the systems simulator and were present during the initial startup and the successful inaugural flight.



Two test pilots and the test flight engineer standing in front of the FHS with the active sidestick

New helicopter concepts – tilt rotor technology

Increased speed and greater distance – a challenge for rotorcraft

The ability to hover is a key advantage helicopters have over fixed wing aircraft. This advantage is associated with a relatively low cruising speed (<300 km/h) and low haulage capacity. Within the scope of two "Specific Targeted Research Projects (STREP)", TILTAERO and ADYN, sponsored by the European Union, new technologies for increased speed and operational range of rotorcraft were explored. A tilt rotor half-hull model was measured with respect to flow interference and noise propagation on two rotor blade sets in the LLF (Large Low-speed Facility) wind tunnel in the Netherlands. High-speed experiments with the blades were conducted at ONERA.

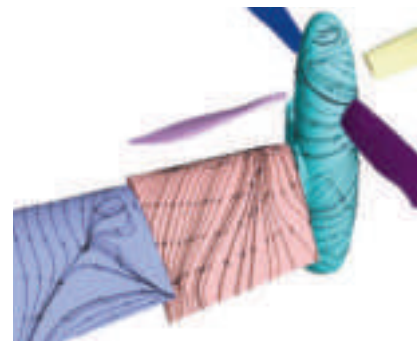
DLR's contribution focused on

- interference calculations (Euler- and Navier-Stokes-methods) between rotor downwash flow, nacelle and airfoils;
- design and testing of reduced-noise tilt rotor blades;
- control and data management of a wind tunnel model; and
- flutter examination on an airfoil/nacelle/rotor configuration in the LLF.

After the above-mentioned projects are completed, the work under the 6th Framework Program will be continued as "Integrated Project (IP)" NICETRIP with a 1:5 complete model.



The TILTAERO half-hull model in the wind tunnel



Flow line curve on the surface of the TILTAERO half-hull model



Aircraft torso in the low-pressure chamber

Ideal Cabin Environment (ICE)

Over 1,200 people participated in long-distance flight passenger comfort studies

The EU Ideal Cabin Environment (ICE) project analyzes comfort on long-distance flights, particularly with respect to cabin pressure and the interaction between pressure and other environmental conditions, both for normal healthy passengers as well as health-impaired passengers.

At the Flight Test Facility (FTF), different levels of pressure in an aircraft cabin were tested. This laboratory at the Fraunhofer Institute for Building Physics (IBP) has a low-pressure chamber, in which a 16 m cabin section of an A310-200 is suspended. The interior almost resembles the original condition. This offers "passengers" a realistic feeling, while the environmental parameters such as air pressure, air- and external cabin wall temperature, relative humidity, noise level, vibration, light, air circulation, etc., can be changed under controlled conditions. One thousand two hundred test subjects participated in these physical, psychological and physiological experiments.

As one of the 5 testing groups, the DLR-scientists found that the expected effect was confirmed, in that the oxygen circulation level in the blood drops under present standard interior cabin pressures. Next, evaluations must be performed to establish whether there is a clear limit for cabin pressure at which the oxygen saturation level is significantly reduced. These findings will then have to be provided to aircraft manufacturers and standards committees.

Completion of the Wirbelschlepp II (wake vortex) project

More than 3% extra capacity gained at large commercial airports

Thanks to completion of the project in early 2007, the bottlenecks created by wake turbulence at large commercial airports can now be eliminated without having to make cuts in safety procedures. To achieve these goals, work began for faster disintegration of the wake vortex, set-up of a wake vortex prediction system for airports, development of equipment for the detection and quantification of wake vortices from the ground and from the cockpit, as well as control mechanisms in the aircraft to avoid potential entry, i.e. flying into a wake vortex.

The following goals were achieved:

- meta stable multi-vortex pairs behind the aircraft trigger faster wake vortex disintegration. Such multi-vortex systems can be generated through differential or oscillated flaps.
- the reaction of the aircraft (especially rolling) during the approach toward wake turbulence can be decreased through automatic feed-forward of the control surfaces on the aircraft.
- with a pulsed LIDAR, the movement and disintegration of wake turbulence can be quantitatively described. The wake vortices of very large (A380) and relatively small aircraft (VFW614, ATTAS) were precisely characterized, both from the ground as well as from on board of the Falcon research aircraft.

- the "WSVBS," which is the DLR-system for wake vortex prediction and observation, was established. It can predict the local weather conditions and the resulting vortex movement and disintegration. It then calculates safety margins around the vortices, monitors the local weather and the wake vortices, with the LIDAR functioning as safety backup in the system resulting in proposed safe time intervals between the aircraft on the glide path to air traffic control. WSVBS proved its functionality during a campaign from December 2006 to February 2007. Its predictions were stable without breakdowns. In 75% of all weather conditions in Frankfurt, it offers methods for increasing capacity, and the predictions were accurate and safe – there were no warning alerts from LIDAR.
- air traffic control requirements for the WSVBS were satisfied. The expected gain in capacity (taking into account all actual traffic situations at the airport) is in excess of 3%.



Noise measurement during low-noise takeoff and landing procedures

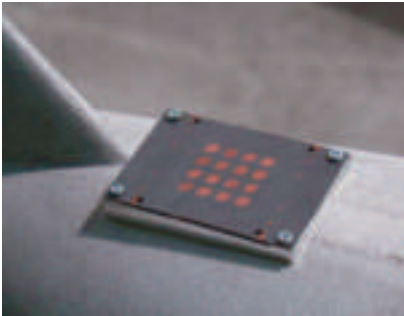
Low-noise approach and take-off procedures

First recorded in-flight medical data from pilots under real-time flying conditions

Because of the additional aircraft- and airport-specific procedures, low-noise approach and takeoff procedures require increased alertness from pilots. Adding any unfavorable associated factors and/or the lack of acceptance by pilots could affect air safety. Comparable approach procedures were previously investigated in an earlier, comprehensive study in collaboration with Deutsche Lufthansa and the Technical University Berlin in their A320 and A330 simulators. During the "Implementation of a measuring campaign for the verification of predicted

noise reduction potential of low-noise takeoff and landing procedures," in-flight medical data for two pilots were collected under actual flying conditions for the first time.

The recorded physiological values (E.C.G. blood pressure, stress hormones) did not show any significant differences between the individual landing procedures. One exception was a noise-reduced landing procedure (SLDLP = optimized Low-Drag-Low-Power with a steep final approach), during which the heart rate, Cortisol concentration, the psychogenic stress and the work load were elevated. Any assertions based on scientific and statistical facts would require further investigation under real conditions.



An antenna array, installed on top of a scaled Fokker 100 model with variable beam for satellite navigation.

IPAS EU project

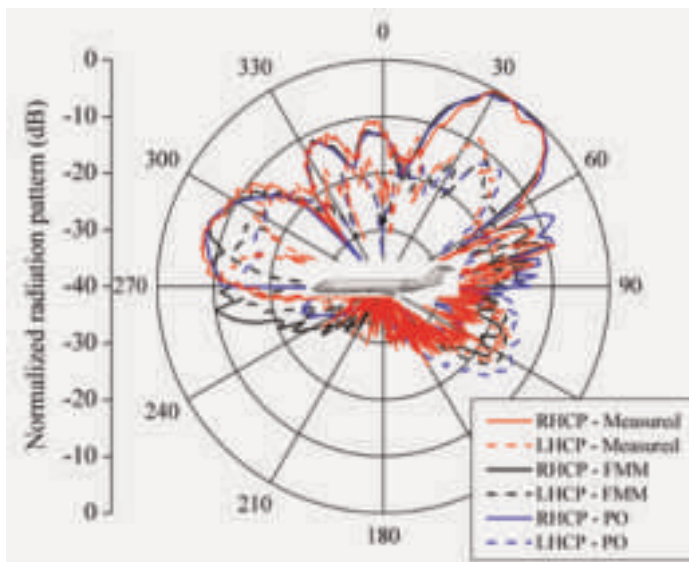
Reducing manufacturing and installation costs through up-front antenna positioning

Antenna properties can change significantly once they are installed on aircraft. The EU project Installed Performance of Antennas on AeroStructures (IPAS) developed processes and computer models for the exact simulation of installed antennas by taking into account the aircraft structure and by validation through measurements on scaled and non-scaled models.

DLR's contribution included studies of the properties of intelligent, adaptive group antennas for satellite-based communication and navigation systems, such as GPS or GNSS (formerly Galileo). These digital control antenna arrays can distinctly suppress intentional and unintentional interference together with appropriate

algorithms through multipath propagation. A scaled navigation antenna with variable beam was simulated on a Fokker 100 model and measured on the DLR antenna measuring system.

The results obtained in the IPAS Project were implemented in the guidelines for optimum positioning and for the interference-proof installation of antennas for the design and certification phase. This allows aircraft manufacturers to place the task of antenna positioning to the beginning of the design and modification process and significantly reduce manufacturing and installation costs. Because of the excellent conformity of simulated and measured data, the Civil Aviation authority in France (DGAC – Direction Générale de l'Aviation Civile) is reviewing whether simulated data can be accepted exclusively for certification in the future.



The results for radiation characteristics obtained with different simulation methods were compared with respective measurements (RHCP – right-circular polarization, LHCP – left-circular polarization, FMM – Fast Multipole Method, PO – physical optics)

Approach management with 4D-CARMA

Up to 30% increased takeoff and landing capacity on runways

The takeoff and landing capacity of a runway system can be increased by up to 30% if the runway system is used as a so-called mixed-mode-operation, i.e. takeoff and landings are handled on the same runway. Initially, this means increased work for air traffic controllers and results in a pattern change in the approach sector, away from distance-based staggering to time-based aircraft management.

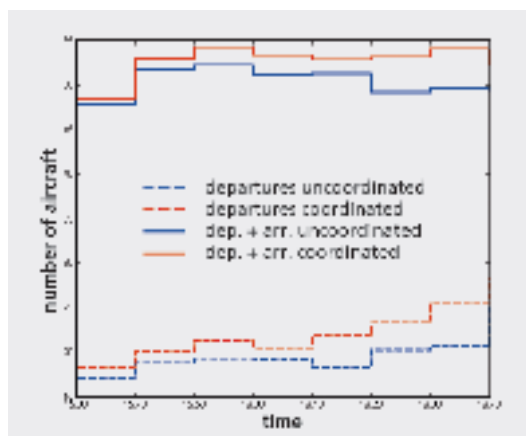
The 4D Cooperative Arrival Manager (4D-CARMA) system developed by the Institute of Flight Guidance supports on-time landings by calculating the exact aircraft trajectories. Together with another coordination module, the Arrival Departure Coordinator (ADCO), which was also developed by the Institute, departure management requirements can be integrated with the arrival management in order to achieve efficient mixed-mode operation. With ADCO, the entire traffic situation can be evaluated by means of a fuzzy control system, to determine appropriate time intervals allocated for takeoffs. The efficiency of a time-based management increases with the accuracy with which the aircraft actually adhere to their scheduled landing times. This can be substantially improved by smooth cooperation between cockpit and air traffic control in the trajectory planning process.

For this purpose, 4D-CARMA is coupled with the on-board flight management system (FMS). 4D-CARMA creates non-conflicting approach trajectories on the ground to generate constraints used by the FMS to calculate high-precision aircraft trajectories, which also take into account the various stipulations of the respective airlines. The aircraft trajectories are communicated to ground control, where they are monitored and modified in case of problems or deviations. If no data link is available, 4D-CARMA generates guidance instructions instead of constraints for approach controllers, so that time-based approach management is possible even in the event of reduced accuracy.

The 4D-CARMA concept was presented to professionals at the ATC Maastricht 2007 exhibition and conference. At the 7th Eurocontrol-FAA ATM Symposium (Barcelona 2007), simulation was used to demonstrate that this coordination methods increases the reliability of planning and increases the capacity of the system for takeoffs and landings on runways (see picture), while at the same time also improving cost-effectiveness by reducing taxi-out delays. 4D-CARMA has created worldwide interest and was also introduced in the United States through the efforts of Lockheed Martin.



4D-CARMA presentation to professionals at ATC Maastricht 2007



Hourly throughput of takeoffs and landings



Space Agency and Space R&D

Germany's national and international space activities are combined under one roof at the German Aerospace Center. While the DLR space institutes are responsible for research activities, the DLR Space Agency is responsible for the implementation of national and international space policy on behalf of the German Federal Government. DLR's in-house research facilities make research contributions in areas of science, technology and operations. The integrated German space program links German partners to programs of the European Space Agency (ESA), EUMETSAT, the National Space Program, DLR's R&D "Space" program and other space activities in science and industry.

Last, but not least, Europe under the German EU presidency has contributed in reaching common space-related cooperation goals and principles in space travel. The European space policy adopted in May 2007 gives details of planned European activities over the coming years and creates an optimal regulatory environment for Europe's peaceful exploitation of space, for the benefit of Europe's citizens.

Europe concentrates its strength on aeronautics

Resolution on the European space policy

Jointly drafted by the European Commission and ESA's Director General, the European Space Policy outlines the strategic guidelines for Europe's future activities in space. The European Space Council in a joint session with the Competitiveness Council of the European Union adopted this on May 22, 2007. This step concentrates Europe's energy in aeronautics and also takes into account security and foreign policy aspects. In order to optimize the available resources, the coordination between the space programs of the EU member states and ESA will be improved, utilizing the synergies between civilian and security related space programs. In its resolution, the European Space Council points to ESA's long-term experience and successful industry policy in the management of space projects. The EU was invited to provide flexible, long-term funding tools for space projects and align its industry policy with the specific demands of the heavily institutionalized space sector. This particularly intends to secure financial funding for the development of "Global Monitoring for Environment and Security" (GMES). In terms of the adopted resolution, the DLR Space Agency intends to play a crucial role in participating in the organization and coordination of European space policy.

ESA Council Meeting in Dresden

Transfer of chairmanship to Sweden

The ESA Council met June 13-14, 2007 in Dresden. In keeping with traditions, the outgoing German Chairman, Prof. Sigmar Wittig, hosted the meeting in his native country Germany.

His two-year term as chairman of the highest decision-making body of ESA ended on June 30, 2007. His successor is Per Tegnér from Sweden, with support from Prof. Johann-Dietrich Wörner of Germany and Dr. Daniel Fürst of Switzerland. The ESA Council recommended that the official term of the chairpersons of the bodies of all ESA Committees as well as of Program Board Directors be extended to three years.

GMES – The Munich Roadmap

The path to the European Earth Observation System

As part of the German EU Council Presidency, the conference for Global Monitoring for Environment and Security (GMES) was held on April 17, 2007 in Munich. Framework was the European initiative under the German EU Council Presidency. The conference “The Way to the European Earth Observation System” was opened by the German Federal Minister of Transport, Wolfgang Tiefensee, together with EU Commission Vice-President, Günter Verheugen, Administrative Secretary of State of the Federal Ministry of Economics and Technology, Walther Otremba, and State Minister, Erwin Huber, of Bavaria. The conference was specifically directed at government departments, chairpersons as well as government agencies and

organizations with responsibilities in environmental and security matters, users and operators of relevant infrastructures, industry (infrastructure, service providers and users) as well as researchers from scientific and business sectors.

The DLR Space Agency in collaboration with the organizing sponsor, the Federal Ministry of Transport, Building and Urban Affairs and the Federal Ministry of Economics and Technology, played a key role in planning the content and presentation and the discussions concerning the conference findings. „The Munich Roadmap – The Way to the European Earth Observation System” was presented of the conclusion of the conference. This document contains the cornerstones for the system architecture, long-term management and funding patterns of GMES. It also sets additional milestones for the implementation of the initiative.

“The Munich Roadmap” is therefore intended to serve as the basis for the future resolutions in Europe. The successor presidencies of Portugal, Slovenia and France, as well as the European Commission, have expressed their support for the “The Munich Roadmap”. With the resolution of the Council of Europe on May 22, 2007 regarding the European space policy, the “Munich Roadmap” has meanwhile also been accepted by the EU Space council.



Prof. Dr. Johann-Dietrich Wörner, Prof. Dr. Sigmar Wittig, Jean-Jacques Dordain, Per Tegnér and Dr. Daniel Fürst at the ESA Council Meeting in Dresden



First image of TerraSAR-X (over Russia)
(© DLR/Astrium)

SANTANA

Entertainment in passenger planes via mobile satellite communication

Smart Antenna Terminal (SANTANA) involves the development of a flat, electronically controllable antenna with computer-supported digital beam-shaping and beam-shifting for broadband and mobile satellite communication at a high data rate in the Ka-band. The functionality of the technology development was successfully demonstrated during field experiments between a research aircraft and a ground station. The SANTANA antenna is particularly well suited for the application of mobile satellite communication. Of particular interest are applications in which mechanically actuated dish antennas are impractical. An "In-flight Entertainment" system, for example, could provide Internet access and email services via an integrated antenna in the fuselage surface.

These flight experiments were successfully completed at the Braunschweig Airport in early 2007. In all tested scenarios, excellent connection quality was produced.

TerraSAR-X in Orbit

First contact only 15 minutes after liftoff

The TerraSAR-X earth observation satellite, a high-resolution radar satellite operating in the X-Band (9.65 GHz), was successfully launched at Baikonur/Kazakhstan on June 15, 2007 at 04:14 MESZ (UTC/GMT + 2 h).

The Russian/Ukrainian Dnepr-1 boost rocket entered its orbit with extremely high precision of just 87 m or a 0.03 seconds deviation. In the meantime, the satellite has reached the required reference orbit. First transmissions could be received at the ESA ground terminal in Malindi, Kenya, a mere 15 minutes after liftoff. All other operational services ran according to plan, so that the commissioning phase which began on June 25, 2007, which will ostensibly continue until the end of 2007. After successful conclusion, the satellite's functional operation will be recorded.

The satellite and the instrument are in nominal operating condition, without any constraints. First images were generated at the German Remote Sensing Data Center (DFD) at the DLR location in Oberpfaffenhofen in record time – just five days after the launch. The excellent image quality shows that both the satellite, as well as the processing-chain on the ground, are functioning as expected. In the meantime, more than 1,600 "Imaging Data Takes" have already been processed successfully. A stress test of the instrument with 320 seconds of "DataTakes" in each orbit over the course of 3 days produced no abnormalities.

TerraSAR-X is a joint Public-Private-Partnership (PPP) mission between DLR and Astrium GmbH. The DLR Space Agency is responsible for carrying out this mission together with a team of four DLR Institutes. This covers the entire range of required technologies from design to mission control all the way to processing and use of the data by science. Astrium GmbH developed, built and launched the satellite. All commercial marketing will be exclusively through Infoterra GmbH (Friedrichshafen), a geographical information service.

GATE in Berchtesgaden

Realistic simulation for navigation systems

GATE (formerly known as the Galileo Test and Development Environment) is intended to cover the needs of research and industry to enable early preliminary development for new products and value-added services for the future European satellite navigation system and far in advance of actual satellite signal availability. Through DLR-Institute for Communication and Navigation participation, GATE will be used to build an "end-to-end" test environment in the Berchtesgaden region, which will use six signal generators to simulate the signals of satellites and beam them into the region. The signal simulation will take scenarios of real navigation systems into account, such as Doppler shift as well as ionospheric effects occurring relative to the observer, bringing simulation in the test area realistically close to the future European satellite navigation system.

SEA GATE in Rostock

Maritime test and development environment for navigation application

The "SEA GATE" project started in October 2006 with the aim to develop a local test environment for maritime navigation application in the research Port of Rostock. Similar to the GATE project for the Berchtesgaden region, signal generators with transmitter masts are to be erected in the port area of Rostock as part of the SEA GATE project. This will provide simulated signals for future satellite navigation systems for a broad region. Based on

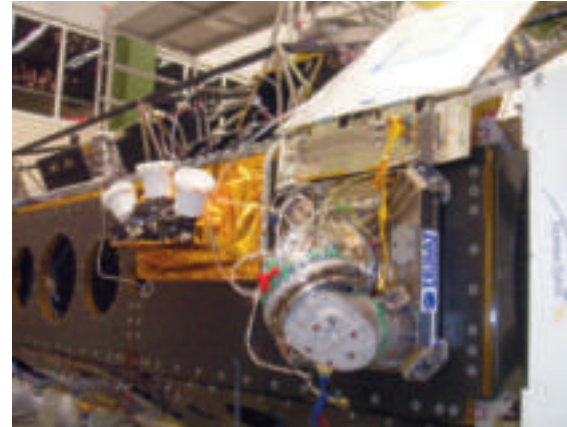
the European satellite system, the availability of these simulated signals will offer manufacturers of navigation applications an advanced opportunity to develop and test new products for this future system.

Optical communication via Laser Terminals

Transmission of more than 200,000 DIN A4 pages with text in one second

Broadband connections between satellites will be needed both for linking the geostationary satellites as well as for the connection to platforms in lower orbits, in order to be able to serve the growing demand for capacities for data transmission in the areas of telecommunication, navigation, earth observation, weather and manned space stations. Therefore DLR ordered the development of two Laser Communication Terminals (LCT) with a data transmission rate of 5.6 Gbit/s which corresponds to the transmission of the content of more than 200,000 DIN A4 pages per second. These LCTs fly as experimental payloads on the German TerraSAR-X radar satellite (see picture), and on the NFIRE test satellite, as part of German-American collaboration. The two LCTs were launched on April 24, 2007 and on June 15, 2007 and were successfully put into operation.

Starting in summer 2007, tests from the satellite to a ground receiving station are to be carried out. Thereafter, the performance capability of the new laser technology is to be demonstrated with ISL-connections between NFIRE and TerraSAR-X.



TerraSAR-X with Laser Communication Terminal (LCT) (© Tesat-Spacecom GmbH & Co. KG)



Signing of the MoU by Prof. Nosenko (left) and Dr. Baumgarten, on March 23, 2007

Jules Verne ready for Kourou

Inaugural flight of the Automated Transfer Vehicle planned for 2008

In mid-July 2007 the "Jules Verne" Automated Transfer Vehicle (ATV) will be on its sea journey to the European Spaceport Kourou in French Guiana. From this location, the inaugural flight of the Automated Transfer Vehicle (ATV) is scheduled for mid-January 2008 with at least four subsequent flights at regular intervals of approx. 15-18 months until 2013.

The ATV will transport supplies to the ISS and represents a major European contribution. The launch will take place from Kourou on an Ariane 5 booster rocket with a re-ignitable upper stage (EPS-V). After separation from the upper stage, the ATV will autonomously perform the required rendezvous and docking maneuvers with the space station while being monitored by the ATV Control Center in Toulouse, France.

SGEO Satellite Program

Geostationary platform for telecommunication applications

During the last few years, a niche market for small, geostationary telecommunication satellites has established itself. These "SGEOs" have a payload mass of approx. 300kg with a payload capacity of typically

3 kW, which amounts to a launch mass of less than 3 tons, meeting the needs of a broad spectrum of private services, e.g. broadband internet and standard TV broadcast services.

For this reason, a new program-line, ARTES-11, was created within ESA; of in addition to the development the geostationary satellite platform, it also contains the in-orbit qualification. The agreement between ESA and OHB as the main contractors for building the satellite platform was signed in March 2007. The start has been earmarked for the beginning of 2011.

In addition to pure telecommunication applications, space agencies, research institutes and industry are already discussing new application opportunities for this geostationary platform, which also include scientific and earth observation assignments. The flexibility of the platform simplifies the introduction of innovative technologies in order to offer innovative solutions for the sophisticated challenges of space research.

eROSITA

Exploration of the dark energy in the universe

The Extended Roentgen Survey with an Imaging Telescope Array (eROSITA), is a new project in "extraterrestics." The primary objective is to explore the so-called dark energy, the dominating and mysterious part of the energy density of the universe and the underlying cause of the constant rapidly increasing expansion of the cosmos. The existence of dark energy has only become known in recent years. Exploring its origin become one of the most exciting research issues in astronomy.

Using eROSITA, approx. 100,000 galaxy clusters are to be identified through their hot gases which emit X-rays. By studying their distribution, the extensive structure of the universe can be derived, which in turn will allow deductions with reference to dark energy.

The development of the instrument is headed by the Max-Planck-Institute for Extraterrestrial Physics (MPE), Garching, and will be made available to the Russia's Roskosmos Space Agency for integration into the Spectrum-X-Gamma satellite. The launch is scheduled for 2011, and the mission is expected to run for at least five years.

The official start of the project was in March 2007, by signing a Memorandum of Understanding (MoU) between DLR and Roskosmos, and the authorization of the grant to MPE.

SOFIA

Infrared telescope for the observation of galaxies and interstellar matter

The Stratospheric Observatory for Infrared Astronomy (SOFIA) developed in cooperation with NASA, has reached an important milestone with its first inaugural flight on April 26, 2007. The centerpiece of the observatory is the German Infrared Telescope with its primary mirror having a diameter of 2.7 meters (almost 9 feet). The telescope was integrated by NASA into a Boeing 747 (jumbo jet). Through the specially designed hydrostatic suspension assembly, the telescope can precisely observe sky objects irrespective of the normal aircraft movements. In order to provide the necessary unobstructed view, a large segment from the fuselage of the former cargo aircraft had to be removed and replaced with stiffening and a sliding door. The aircraft test program is presently running with a closed door in order to prove safe aircraft operation. In the next test phase with an

open door, the entire aircraft/telescope unit will be tested and the transition to the scientific operation will initiated.

The scientific operation of the flying observatory is anticipated to last up to 20 years. The operating altitude of 14,000 meters will permit observation in the infrared spectral range, due to the low water content of the upper stratosphere (similar to space). The observation of galaxies, star formation areas, interstellar matter, planets and comets is considered to be a particularly interesting field of research.



SOFIA aircraft in test flight (© NASA)

Astronauts in balance

German-Canadian cooperation in research of motion coordination

The return of the shuttle mission STS-116 shortly before Christmas 2006 did not only bring back ESA-astronaut Thomas Reiter, after having spent 6-months on the ISS. In terms of German-Canadian cooperation, the STS-116 also made the beginning of the research experiments on motion coordinates, particularly for the process of adapting to weightlessness in space and after return to earth.

Using these results, scientists hope for new ways of evaluating stress at the workplace and the human capacity in general. The topic "motor learning" (kinetic) is currently also a field of high interest in neuroscience research on earth, not least because of an aging population.



ESA Astronaut Thomas Reiter during the Astrolab mission with a 3D Eye Tracking Device for research of the balance system



COLUMBUS Module (© ESA)

COLUMBUS

Material-, bio and life sciences in space

At the Kennedy Space Center (KSC), the launch preparations for the European ISS-Module COLUMBUS have begun. Final functional tests were completed successfully, including system tests of the external payloads. The launch of COLUMBUS with the STS-122 (Atlantis) will occur in early 2008. It is the docking station for the COLUMBUS module. The Node 2 connecting module launched into space in October 2007 and was integrated in November 2007.

The COLUMBUS is a pressurized multi-purpose laboratory for multidisciplinary research in material, bio and life sciences and for technology development. Another objective is industrial/commercial exploitation. The module is the main workstation for the European astronauts and holds the European scientific payloads, i.e., the MicroGravity facilities. On the outside of the pressurized laboratory, external platforms offer opportunities for experiments to be carried out with full exposure to space. With COLUMBUS, Europe gains experience in the uninterrupted long-term use and operation of an orbital infrastructure. The operation is managed by the COLUMBUS Control Center at DLR's German Space Operation Center (GSOC) in Oberpfaffenhofen near Munich. Primary strategic partners in Germany are the following companies and research facilities: Astrium GmbH, Kayser-Threde GmbH, MT-Aerospace, Arianespace, OHB Systemtechnik, Jena Optronik GmbH, and DLR.

Lunar Exploration Orbiter

National Satellite Lunar Mission planned for 2012

The Space Agency of DLR is reviewing the potential for a national satellite mission to the moon, the Lunar Exploration Orbiter (LEO). The launch is scheduled for 2012. Subsequent operation is currently scheduled for a four-year period.

The main focus of the mission is to gain scientific knowledge about the moon. In selecting the scientific payloads of the orbiter, the focus will be to gain knowledge of complementary scientific equipment on other missions in the past or any other international missions which may be in the planning stage. For this reason, the German Space Agency has entrusted the German space industry to conduct an initial four-months project phase, the so-called Phase 0 study.

Phase 0 is intended to define and analyze the mission-specific framework. This, among other things, calls for a mission concept to be developed, estimates of mass, electric power and data rates, as well as determination of costs through all project phases. At the same time, the specific requirements of the individual instruments of a model payload from the mission must be considered.

An important goal of the LEO mission is to map the entire surface of the moon with high spatial resolution and high-quality measuring results. In addition, LEO will continue to secure Germany's place among leading space exploration nations and will demonstrate expertise and technical know-how under the label "Made in Germany".

ROKVISS – support for astronauts

Robots will assist astronauts with routine jobs in space

Robotic Components Verification on ISS (ROKVISS) is a German technology project committed to preparing and testing innovative robotics technologies to assist with inspection and maintenance of spacecraft. Such technologies will support astronauts in performing complicated external repairs and take over routine jobs in space. Satellites equipped with robotic arms, remotely controlled from Earth, will be able to restore any satellites that are spinning out of control and repair them. The objective of ROKVISS is to amass initial knowledge about long-term behavior, applicability and reliability of the robotic components used. Since January 2005, a robotic arm, close to 50 centimeters in size and 7 kilograms in weight has remained on the external skin of Zvezda, the Russian service module of the ISS. The essential part of the robotic arm is a metal pin and two robotic joints of the most advanced lightweight construction in the world, which were developed at the Institute of Robotics and Mechatronics. The robotic flight unit is equipped with an earth observation camera, two video cameras to transmit 3D-images, and an experimental structure with integrated springs. Because of the great success of the mission, it has been extended until spring of 2008.

ROKVISS owes its existence to the joint collaboration between the Russian Aviation and Space Agency, Roskosmos; RKK Energia and Partners, a Russian commercial enterprise; and the German space industry partners (Astrium Space Transportation, Kayser-Threde GmbH, von Hoerner & Sulger). The DLR Space Agency Department of Technology of Space Systems and Robotics are the managing entities of the project.

Astrolab mission with Thomas Reiter

A new chapter in German medical space research

During the first extended presence of a European on the ISS, the German ESA-astronaut Thomas Reiter worked from July to December 2006 not only on maintenance and operational jobs but also conducted an extensive research program. Eight of a total of 30 scientific experiments were led by German research scientists. Five of these, a physics project for plasma crystal research and four in bio-sciences and medicine, utilized space conditions for research issues. While Reiter successfully continued work on existing experimental projects concerning research of the human equilibrium system and measuring space radiation and their effect on chromosomes, the "Immuno" project opened a new chapter in Germany's medical space research. Although it is commonly known among experts that the immune system of astronauts is affected by their long-term presence in space, the exact causes and mechanisms still remain unknown for the most part.

Scientists at the Ludwig-Maximilian University in Munich are currently exploring changes in the immune system of Reiter and other astronauts and cosmonauts by means of extensive biochemical analyses and psychological tests.



ROKVISS in Space (© Roskosmos/NASA)



JUSTIN, agile and sensitive, is the Robo-darling with trade fair attendees

Highlights from the Space R&D program

Supplies for the ISS

ATV engines ready for maiden flight

In early 2008, the Europeans will initiate the transport of supplies to the ISS with the Automated Transfer Vehicle (ATV). DLR facilities in Lampoldshausen were critical to the mission, testing qualifying the ATV second upper stage engine in March 2007. With the second test run, the flight qualification for the Aestus upper stage engine of Ariane 5 for the first ATV mission was completed. This has qualified the first two ATV engines for the maiden flight.

The ATV is an unmanned, autonomous spacecraft which can transport a maximum payload of up to 9.5 tons. This was developed and built on behalf of the European Space Agency (ESA) by the EADS Astrium Space Transportation, a spacecraft-engineering firm. The participation of German companies in the ATV design and production was about 24% and 51% respectively. A total of 30 firms from 10 European countries took part in the production process. Eight firms from Russia and the United States also supply products and components.

With the aid of a two-stage Ariane 5 ES rocket, the ATV will lift-off into orbit from the European Spaceport Kourou in French Guiana. After docking with the ISS, the

ATV will correct the course of the station under its own power and thus compensate for normal losses of altitude due to flow resistance. The ATV will be the first space vehicle of European origin that will automatically dock at an orbital space station.

Robonaut JUSTIN

Spectator magnet at the AUTOMATICA

JUSTIN, the two-arm robotic torso system, developed by the Institute of Robotics and Mechatronics, became a crowd pleaser at the AUTOMATICA International Trade Fair for Automation, Assembly and Robotics in Munich. With its total of 43 torque-controlled joints, new standards for humanoid inspired robotics were established.

The two arms with their four-finger hands as well as the upper body section with neck and head, react acutely to contact with their surroundings, making direct, safe interaction between humans and robots possible.

In particular, the DLR institute in Oberpfaffenhofen strove to demonstrate the two-handed manipulation of objects and promote further robotic developments. These abilities are key to the "Robonaut" application in space, as a production assistant in industry, or also as a "helper" for the bedridden or disabled. This adds to the reasons why JUSTIN can manipulate three balls simultaneously. Using its multi-sensor head, equipped with stereovision cameras, laser scanner and light section projector, the Robonaut can recognize and grasp even transparent glass vessels, open bottles, pour beverages and even lift heavy water containers.

Navigation system for shipping

Increased safety in shipping traffic and docking operations.

Compared to the existing Global Navigation Satellite System (GNSS), the planned European satellite navigation system will bring significantly higher precision for navigation on water, land and in the air. In addition, the system will benefit shipping traffic in the Rostock research port, particularly in the areas of safety and economic profitability. In order to perform an exact situation analysis in the port and its surroundings, DLR conducted an initial series of measurements between January 30 to February 2007, as part of the ALEGRO project, financed by the Mecklenburg-Western Pomerania Ministry of Economics. DLR is assisted by the Hafen-Entwicklungsgesellschaft Rostock (Port Development Co.) and the Institut für Ostseeforschung (Baltic Sea Research Institute).

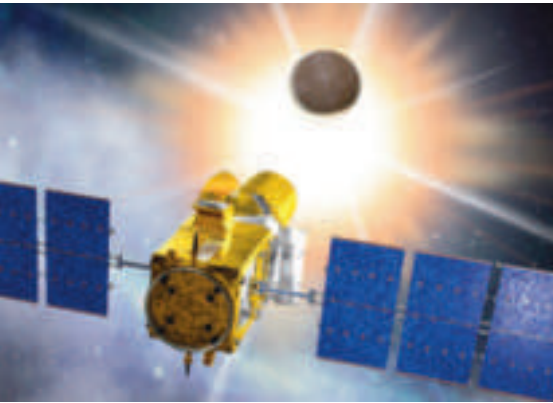
ALEGRO stands for "Development of a local additional maritime system in support of high precision applications and services of the European satellite navigation systems (formerly known as Galileo) at the Rostock research port". The Rostock research port is the product of an initiative by the Land of Mecklenburg-Western Pomerania. The Institute of Communications and Navigation is a partner in the project; its field office in Neustrelitz develops processes and algorithms for reliable precise navigation in critical safety areas. Objectives for the ALEGRO project include the development

and proof of performance of differential processes for the future European satellite navigation system, particularly for use in maritime operations (Safety of Life, Service and High Precision). In order to prevent collisions at sea and to automate the docking operations of ships, there is a need for high accuracy, high dependability and availability of position determination. These parameters are to be determined and controlled by ALEGRO practically without time lag and made available to users for information.

As part of this project, an experimental infrastructure will be developed to include a reference station, a processing center, as well as a mobile user platform. The development of algorithms and processes specifically involves differential processes such as DGPS (differential GPS) and the extraction reliability information from satellite signals. The validation of the new and/or advanced algorithms and processes is part of the experimental operating phase.



Navigation system under test at the port in Rostock



From its earth orbit, COROT searches for planets beyond our solar system

COROT discovers planet

Space telescope in search of planets beyond our solar system

Shortly its launch on December 27, 2006, the COROT satellite discovered its first extrasolar planet, the COROT-Exo-1b. Conducting its mission from an earth orbit, COROT is searching for planets outside of our solar system. The COROT-Exo-1b, is a hot "gas giant," similar to Jupiter. Its orbital period is 1.5 days, with a radius of a roughly 1.5 to 1.8 times of Jupiter. Spectroscopic measurements with terrestrial telescopes were able to determine its mass to 1.3 be up to times that of Jupiter. It orbits a sun-like central star about 1500 light-years from earth. By measuring the total light emitted by a star in the targeted telescopic sight of COROT, the telescope system Berlin Exoplanet Search Telescope (BEST), operated by the Institute for Planet Research in Southern France, contributed to the discovery of COROT-Exo-1b. The same time, any potential interference from neighboring stars could be excluded.

International center of competence for climate observation

Using GRIPS to detect tsunamis, earthquakes and explosions

The Boards of the German Aerospace Center, the German Meteorological Center in Karlsruhe, and the Research Center for Health and Environment announced at the Schneefernerhaus (UFS) Station that their facilities will collaborate as the Virtual Institute for the "Schneefernerhaus Environmental Research Station". In close agreement and with support of the Free State of Bavaria, the station will be systematically developed as a technology center within the globally linked network.

The focus will be on innovative technologies for observation of climate and the atmosphere, satellite validation, high-altitude medicine, and early detection of natural disasters. The UFS station has the status of a global station in the Global Atmosphere Watch Program of the WMO. In addition, it is part of the NDACC program and is linked with the ICSU global data center for remote sensing of the atmosphere (WDC-RSAT), at DLR.

The specialized focus of the Deutsches Fernerkundungsdatenzentrum (DFD) [German Center for Remote Data Sensing] is on monitoring the upper mesosphere (approx. 80-90km altitude) using the GRIPS 3 infrared spectrometer on the ground. One objective of the measurements is the early recognition of climatic signals such as for checking the Kyoto Protocol effectiveness. But the examination of scientifically-based questions, such as the analysis of small-scale flow systems for the improvement of climatic models, e.g. to understand the interaction between the sun and the earth, is also a part of these studies. This work is primarily performed in collaboration with the Institute for Physics at the Augsburg University and the World Meteorological Organization (WMO). Moreover, GRIPS 3 is the global standard of the newly established Network for the Detection of Mesopause Change (NDMC) in which 52 institutions from 21 countries participate. The DFD will manage the coordination of the new NDMC network. In collaboration with the Kayser-Threde GmbH Company, GRIPS 3 is also to be developed as an industrial system for the detection of tsunamis, earthquakes and explosions, using infrasound analysis. The DFD moreover coordinates the development of a national contact center for satellite validation in the UFS. Together with medical professionals from the Ludwig-Maximilians University in Munich, it will coordinate the development of a satellite-based system to study health hazards for illnesses of the respiratory system in relation to climatic change.

The DFD will also manage the creation of a European Association of observatories for climatic and atmospheric monitoring within the research program of the EU, in collaboration with partners from the UFS.

AeroSande – an impressive process for foundries

Award by the State of Bavaria for joint continued development of AeroSande products

The Institute for Materials Physics in space has developed and patented a new product named "AeroSande", which is a combination of aerogels and classic foundry sands. In collaboration with Metallguss Herpers GmbH Aachen, the new core molding material is used for aluminum castings. The castings have an impressive high quality, encouraging further development of AeroSande products to the point where they can be marketed. On March 14, 2007, Metallguss Herpers GmbH in collaboration with DLR, was awarded the State of Bavaria Prize.

Expectations are high for the new product. Casting geometries with filigree structures and undercuts, which could previously not be obtained with sand casting, can now be produced with high quality, since cores can be removed easily.

Through successful collaboration between industry and research, the AeroSande products are now ready market.



Presenting the "Bavarian State Prize for special design and achievement in industry 2007" to Metallguss Herpers GmbH in collaboration with DLR. From left: Prof. Ratke (DLR), State Secretary for Economic Affairs Hans Spitzner and Dipl.-Ing. Nolte (Metallguss Herpers). (© Metallguss Herpers)



Transport

DLR's transport business area continued its positive development through 2006–2007. This was confirmed by the successful completion of research studies, new research cooperation with science, business and government agencies as well as third party funding projects attracting public attention and leaving a public impact. Appointments to prestigious national and international bodies and committees also reflect the high degree of recognition of DLR's transport research. A proof of the growing importance of DLR's transport research at the European level can be found in its prominent role in European Conference of Transportation Research Institutes (ECTRI). In addition to its broad involvement in working groups, DLR has taken on the position of General Secretary of this group of leading European transport research facilities since the spring of 2007.

The decision by the Executive Board to expand DLR's commitment in the coming years to the field of transport is evidenced by the growing demand from society and industry and strongly reinforces DLR's competitive position. In this context, the program structure of the business area was modified on the basis of a dialogue with all participating institutes, resulting in an even closer alignment to customer requirements and applications.

At the same time, a more forceful and consistent debate with regard to prime research themes, complex systems and innovative concepts, as proposed in the interim evaluation, has been moved to center stage. As a significant consequence, the transport program is now focused on the three research topics, "Terrestrial Vehicles," "Traffic Management" and "Transport System". Based on its own transport expertise, and taking advantage of the transport-related know-how from the fields aeronautics, space and energy, the DLR area transport provides its own input toward analyzing the many diverse transport-related questions. This symbiosis of disciplines, which is unique in Germany, ensures research results through the benefit of innovative high technology solutions.

SuperLightCar

Weight reduction by more than 50% through use of magnesium

Within the scope of the EU SuperLightCar project, different concepts regarding the field of lightweight vehicles have been developed. This involves a complete vehicle floor assembly group in Multi-Material-Design (MMD). Subsequent validation and optimization was performed with in-house calculations and simulations under different load conditions. Tests showed that a Multi-Material-Design using magnesium, aluminum and thermoplastic organic sheeting met all relevant stress tests. This includes frontal, lateral, pole and rear crashes as well as static load conditions. When compared with conventional structures, this concept produced a weight advantage of 44%. A concept involving a suspension strut mount in magnesium has been under development since early 2007. One

concept has been able to achieve a weight reduction of 56% by means of integrated functions and material substitution. The design of the “suspension strut mount in magnesium” involves detailed integration of the associated aluminum casting (chassis leg area) into the proposed “front end” demonstrator.

Rail vehicle localization system

“DemoOrt” improves cost efficiency and line capacity in rail transport

Currently the position of trains in rail transport is supervised by localization systems which are installed fixedly at the tracks. DLR is currently working in a joint project called “DemoOrt” together with the Technical University of Braunschweig, the University of Karlsruhe as well as Bombardier Transportation, which is funded by the Federal Ministry of Economics and Technology. DemoOrt demonstrates a localization system, which will be integrated in the rail vehicles. Such a localization principle improves cost efficiency through higher line capacity, optimized energy consumption and a reduction in maintenance.

In order to ensure a high safety level DemoOrt is operating with two different independently working localization components. A satellite receiver determines the absolute position at the beginning with GPS, and in the future with the European GNSS (formerly Galileo). In addition, an eddy current sensor generates a magnetic field, which reacts to metallic structures. This for example allows rail switch recognition. With the aid of a previously captured signature of all switches in a line, the current position of a train can thus be determined. Furthermore, the data obtained will be compared with a digital route map. Finally, the determined position must be precise that even in case



Rail switch recognition for localization using an eddy current sensor under a train

of several parallel tracks of a line a track-selective position can still be identified.

Field tests will be performed with the developed localization platform until the end of 2008. For this purpose, the DemoOrt platform will be installed into two respective rail vehicles, one in the vicinity of Karlsruhe and the other at the High Tatras in Slovakia, where they will operate for a period of 12 months as part of regular railway operations. The logged test data will be analyzed by an accompanying detailed evaluation in Braunschweig.

Modelica

Over 1,000 users in Europe and Japan

Modelica is a software language developed under substantial collaboration. Its focus is on multi-disciplinary system modeling, as required for computer-aided concepts of entire vehicles. Beside the language development, DLR played a leading role in initiating the concept and development of the Modelica standard library. The commercial PowerTrain Modelica pro-

gram has been successfully marketed since 2004; further commercial programs are currently under development. In the meantime, Modelica has experienced broad acceptance not only within DLR but also on a national and international scale with already more than 1,000 users in Europe and Japan. Dassault Systems, next to SAP, the biggest software company in Europe and global market leader for CAD as well as Product Lifecycle Management, announced in June 2006 that it would use Modelica as a central modeling component in the new CATIA Systems product line. Over 80,000 users worldwide employ this software, the entire aircraft and most of the vehicle manufacturing industry along with their suppliers. Dassault Systems decision presents an important success for the Modelica software, which was developed with financial resources from the transport program and opens the door for substantial new market shares. Moreover, this will allow the enlargement of Modelica’s technological lead as its integration into CATIA and PLM databases will enable the direct first-time use of product databases and CAD data in system simulations. Dassault Systems aims to push Modelica technology into becoming the leading global open standard for system modeling and simulation.



Study of novel driver assistance systems in the DLR Dynamic Driving Simulator and the DLR ViewCar

Driver assistance

New software makes the road safer for drivers

In order to assist drivers, behavior studies are simulated as well as carried out in real traffic situations. The goal is to generate models that can describe and predict driver stress, driver error and driver behavior. This is followed by the development, application and evaluation of targeted assistance functions. The research also looks of how drivers perform with automated systems in order to avoid any potential negative impacts.

With respect to driver modeling, a stress model was developed for the objective estimation of driver stress with regard to their surroundings (e.g. type of road), actual driving maneuvers (e.g. passing) and nearby traffic conditions (e.g. traffic density). It was also demonstrated that the understanding of gaze recognition could be used as a factor for determining intended driving maneuvers. A project sponsored by the Federal Highway Research Institute (BASt) and the federal state of Lower Saxony analyzed roughly 4,500 accidents to determine the cause of human error. A particular emphasis of the study were accidents involving older drivers. The goal was to highlight on one hand characteristic age-related accident situations, and on the other hand typical errors committed on the road by that age group.

In order to evaluate the effectiveness of driver assistance systems and develop models for their impact, basic functions for longitudinal and lateral assistance were set up in the DLR dynamic driving

simulator and as a warning system in the DLR ViewCar. Four studies, also sponsored by the federal state of Lower Saxony, showed that in order to achieve wide acceptance of assistance systems, function and design (e.g. to inform, warn and intervene) to the complexity of the situation and the associated action required by the driver is important.

Use of alternative energy in cars

Converting of waste energy into electrical energy holds great promise

Approximately two thirds of the energy used in road vehicles are emitted into the environment as waste heat. The energy efficiency of road vehicles can be significantly increased by converting previously unused energy flows into useful energy. Within the scope of the DLR project "Vehicle Energy Systems," appropriate technologies are examined and further developed. Within the framework of conceptual studies, thermoelectric energy conversion of waste heat into electrical energy was identified as showing great promise. Inherent technical hurdles remain in thermoelectric materials, the installation of the thermoelectric generator in the exhaust system, as well as the integration into the electrical systems of the vehicle. Another challenge is the integration into a vehicle system with a highly dynamic load profile.

By the time of the inception of the studies a long-term and comprehensive cooperation could be established with a prominent industry partner (OEM). Based upon conceptual work and calculation programs for the design of thermoelectric generators, a system-specific solution for the exhaust system was conceived. The first functional model was already able to achieve an electrical output of about 100 watt, near-

ring the total specified output capacity of the thermoelectric module. These results point to a CO₂ reduction potential of approximately 5 g CO₂/km for a medium class vehicle with an additional multifold increase potential after foreseeable progress in the materials technology.

Energy Consumption and Emissions in the Transport Sector

Stagnant energy consumption despite increased traffic volumes

On behalf of the Deutsches Verkehrsforum, DLR worked out a study entitled "Energy Consumption and Emissions in the Transport Sector". The Institute for Energy and Environmental Research (ifeu, Heidelberg) was a substantial partner and contributor of the emission data and its interpretation. The study revealed significant facts with respect to the general development in transport. Basis for the study was a pragmatic but differentiated analysis of passenger and freight transport for the period of 1991 to 2004. It was demonstrated for example, that despite an increase in traffic volumes, there was stagnation in energy consumption with constant CO₂ emissions as well as a drastic reduction in HC, CO and SO₂ emissions. A substantially lower reduction was particularly found for nitrogen oxides, dust and soot particles due to the effects of freight transport.

Anticipated trends predict moderate gains in volumes of terrestrial traffic and a significant growth in aviation. Expectations concerning motorized individual transport predict continued absorption of the largest transport percentage. The growth rate in freight transport will significantly

outweigh passenger transport, pointing to a distinct shift of freight to rail and water transport provided massive government intervention takes place. All in all it is assumed that increasing emissions could be countered by corporate innovations which will open significant technological potentials. These will however be reflected in partially higher procurement and operating costs. The research study was introduced in March 2007 to an broad audience.

Low Cost Monitor

Consideration of "Low Cost Carriers" indispensable for forecast of air transport development

In recent years, so-called Low Cost Carriers have taken hold in the German aviation market. They create demand with favorable price structures thereby gaining market share from established carriers. As a consequence they cause an increase in air traffic volume. Since Low Cost Carriers within the entire German air transport market are experiencing massive significance and are exhibiting a number of distinct characteristics, DLR monitors and analyzes this specific market segment in great detail. The current findings are published in the Low Cost Monitor in cooperation with the Arbeitsgemeinschaft Deutscher Verkehrsflughäfen (ADV). The market dynamics become apparent in the rapid growth of routes being flown.

This is reflected by the fact that in 2006 Low Cost Carriers provided service on 426 routes up from 128 routes in 2003. With 18.6 million passengers in the first 6 months of 2006, the share of low cost passengers of the total passenger volume at German commercial airports serving international routes represented roughly 25%. Focusing on just the German domestic market for the same time period, the Low Cost Carriers already held a share in excess of 40% of the total passenger volume.

However, DLR analyses are not confined to routes and passenger volume statistics. In addition to the number of Low Cost Carriers on the German market, their internal competition and their preferred airports, other primary research parameters of importance include price structures and their trends. This still rather young but certainly dynamic Low Cost Carrier phenomenon requires comprehensive understanding, which is absolutely essential for predicting developments in air transport and for structural analyses in the aviation sector.

Energy

Energy conversion and energy utilization play a key role in all technical systems. This particularly applies to the DLR subjects in which efficient handling of energy is an important aspect. Energy optimization is vital to power stations, aircraft and vehicles. Efficient power supply in space during space travel and the optimized energy conversion in engines is also very important. The business segment Energy focuses its primary activities on stationary applications for the supply of power and heat at a relevant scale for the energy economy. Thus, Energy research lends itself to the extensive use of multiple synergies with the other DLR business segments.

The development of stationary gas and steam turbines takes up a central position at DLR. With emphasis in the areas of compressor, combustion chamber and turbine, and its system competence, DLR contributes to generating power at highest efficiency, irrespective of the fuels to be used in the future. Fuel cell systems will be well established in energy supply. A particular promise holds the coupling gas turbines with high temperature fuel cells for operation in a hybrid power station. A 10% efficiency increase in the power generation is expected compared to running the components separately. Methods for concentrating solar technology offer the option to provide cost-effective power generated in an environmentally compatible manner and down

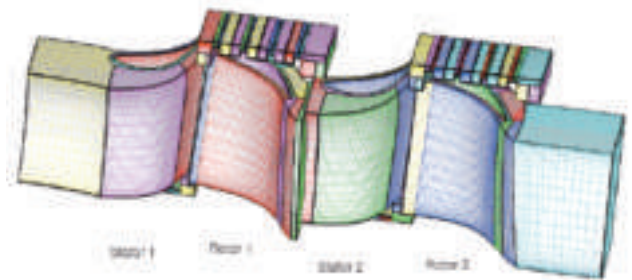
the line may even make hydrogen available. The multidisciplinary systems analyses serve to advise policy makers and support the programmatic orientation of energy research at DLR and the Helmholtz Association.

High-efficiency steam turbines

Using TRACE to track instationary phenomena in steam turbines

A research project for the study of instationary phenomena in high and medium pressure steam turbines started in collaboration with Siemens Power Generation, using the DLR TRACE simulation code. The anticipated new findings for the design of modern steam turbines are expected to increase the efficiency of the entire power station. Within the 3-year investigation period the configurations provided by Siemens (two stages each from the high and medium pressure steam turbine) will initially be examined in their original configuration and later in a shorter axial design.

Evaluation of simulation results achieved so far showed excellent conformity with the specifications of the extensively developed design method by Siemens Power Generation, so that based upon these instationary data records of the original configuration, they could be compared



Grid for both first stages of the high pressure steam turbine with four cavities

with those of the shorter axial design. This comparison clearly shows that by reducing the axial distance in the center of the machine, the entropy development at the discharge area of the first upper cavity increases and drops at the discharge of the second lower cavity. Using the results of the instationary CFD simulation, designers are now in a position to examine the production and development of losses in greater detail and provide counteractive measures by changing the geometry.

Mobile power supply

A step towards marketability for a portable fuel cell system

Portable fuel cells at DLR have managed to take a leap toward marketing readiness. To date, cable-free applications for indoor and outdoor use relied on battery capacity and the time needed for charging. For the compact fuel cell unit created by means of DLR research and DMT GmbH development, demolishes these limitations. By using a hydrogen fuel cell it is now possible to provide permanent electrical energy in the area of portable equipment. One main focus in this new development was a substantially simplified hardware concept and maximized compact system architecture. This could be achieved by the collaboration of DLR, using its long-term experience in the area of low-power fuel cells, and DMT GmbH, using its many years of experience in the area of prototyping. The functional Tricon Design AG housing has a 12V power outlet for many varying application uses. The compact air-cooled system (400x180x400 mm) with minimal auxiliary power has an integrated quick-connect hydrogen cartridge with snap closing and offers a nominal power of 300 watt with a weight of approximately 12 kg, including a storage tank.

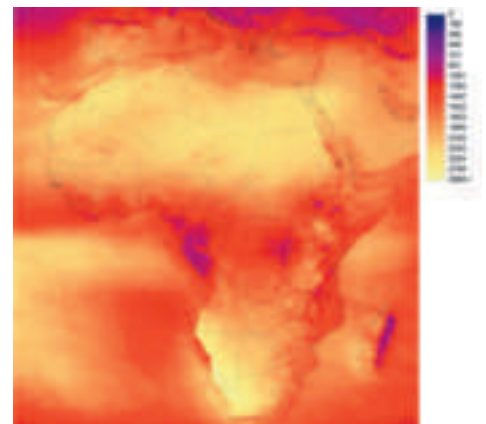
SOLEMI

Information about radiation for solar power stations from satellite data

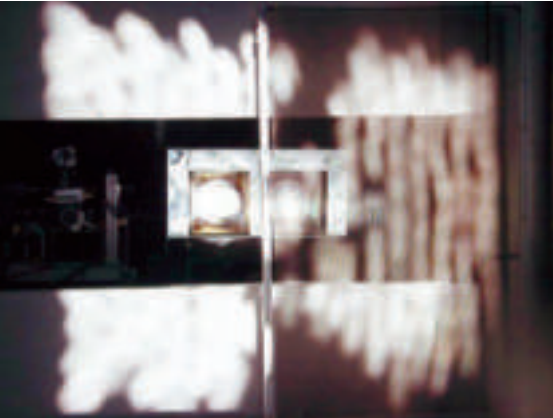
The available solar resources are a decisive factor in determining the economy of solar power station projects and represent an essential information for project planning. Good data to date have been scarce. In this context, DLR developed the SOLEMI (Solar Energy Mining) project so that this information can be made available through remote sensing data from satellites. In a multi-program cooperation (between Energy and Space, three DLR institutes) data collected over a period of up to 15 years from geostationary Meteosat satellites were integrated into the Data Information Management System (DIMS) of the Deutsche Fernerkundungsdatenzentrum [German Center for Remote Data Exploration]. Using these raw data, extended time series of direct solar radiation can be calculated for Europe, Africa and large parts of Asia. Several partners from industry have already used this service provided by DLR for their locations in Spain and on the Arabian Peninsula.



Compact Hydrogen fuel cell system Power Pack



Example of the total annual direct solar insolation (2004)



HYDROSOL reactor pilot plant operation in the solar furnace in Cologne

HYDROSOL is awarded the Descartes Prize

European Commission science award for groundbreaking hydrogen project

As part of the HYDROSOL project, DLR scientists for the first time were successful in splitting water thermally into hydrogen and oxygen by means of solar energy, and hence without carbon dioxide emission. For this groundbreaking work, the team was awarded the prestigious Descartes Prize for research by the European Commission in Brussels on March 7, 2007. The Descartes Prize is already the third and to date the most renowned award for the HYDROSOL project, following the Technical Achievement Award 2006 by the International Partnership for the Hydrogen Economy IPHE and the Global Eco-TeCh Award at the EXPO 2005 in Japan.

In a solar furnace of DLR in Cologne-Porz (a pilot plant, using concentrated solar light for research activities), water was split into hydrogen and oxygen in a closed thermochemical cycle using solar energy. Other than with direct thermal water splitting, which only occurs at several thousand degrees centigrade, this novel process uses a combination of different

chemical reactions, which proceed at temperatures below 1400° C and are therefore controllable in terms of available technical materials.

During these reactions, all chemicals used, except for the water and/or the hydrogen and oxygen gas produced, can be recycled for repeated processing. Results from the HYDROSOL research project could provide the basis for a future sustainable hydrogen industry. It seems feasible to generate hydrogen on a large scale as an energy source in the future without carbon dioxide emissions which are harmful to the climate. For this purpose, the follow-up project HYDROSOL 2, a joint partner effort is continued with the public entity Spanish National Research Center for Energy, CIEMAT. Project management is undertaken by the CERTH/CPERI Research Center in Thessaloniki, Greece. The goal of HYDROSOL 2 is to build a pilot plant of roughly 20 times the size of the existing DLR solar furnace. With an output of twice 100 kWth, test-runs for the pilot plant will be conducted at the Plataforma Solar de Almería.

Micro gas turbine

New laboratory for gas turbine combustion systems

Operation of the new micro gas turbine laboratory began at the Stuttgart site in 2006. The installed Turbec T100 micro gas turbine will be used for the advancement of gas turbine combustion systems. Research will focus on minimization of contaminants as well as analyzing the reliability of technical combustion systems. Further research emphasis will be on fuel flexibility with regard to liquid fuels, as

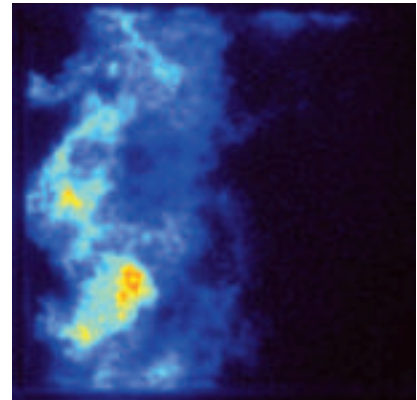
for example kerosene, and gaseous fuels, e.g. natural gas or synthetic gas from coal, biomass or technical processes. The experimental data collected under real technical conditions are used to generate validation data for the numeric simulation. The micro gas turbine is also a central pilot plant for research and implementation of a hybrid power station comprising a high-temperature fuel cell and a gas turbine.

The detailed instrumentation of the micro gas turbine was completed on schedule by mid-2007, and the infrastructure of the micro gas turbine laboratory was expanded. This amongst other things included acquisition of measurement data, the process control system for monitoring the micro gas turbine, the synthetic gas supply and the installation and startup of the gas analysis. Initial project work and measurements on the micro gas turbine experimental platform has started successfully. The next step will be the commissioning of the optical combustion chamber in early 2008 to enable the examination of combustion processes using laser-based measuring methods.

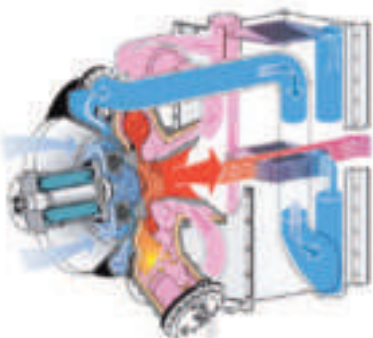
Fuel-flexible gas turbines

Reliable and clean combustion with different fuels

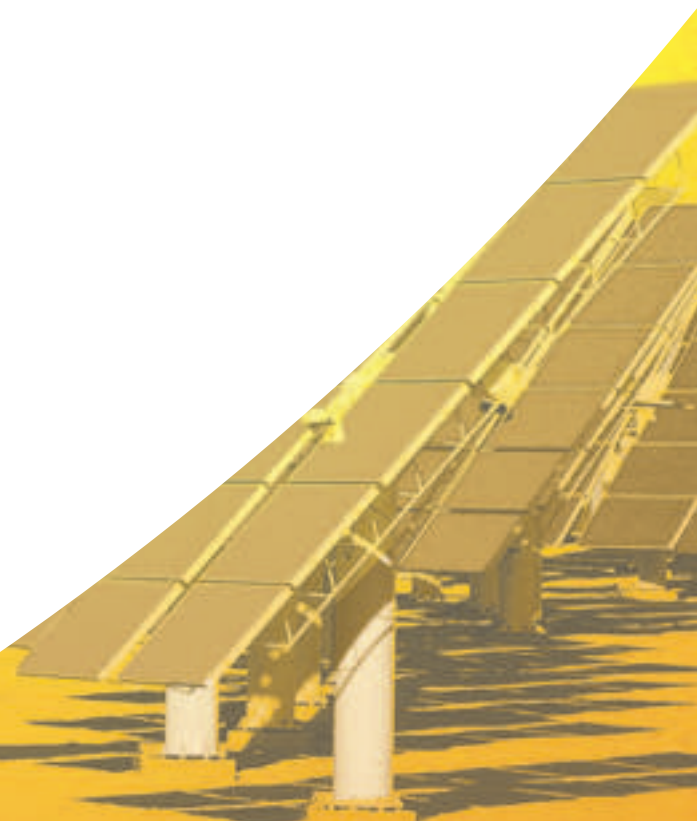
Reliability, flexible use of different fuels and low pollutant emissions are the main requirements for future gas turbine combustion chambers. The effects of change in fuel composition with regard to stability and pollutant emission in modern gas turbine combustors were closely examined for the first time under real conditions at DLR in collaboration with partners from industry. A visually accessible high-pressure test rig enabled scientists to use modern optical and laser measuring methods. These experiments were a central contribution for the development of a new generation of fuel-flexible gas turbines.



OH-radicals distribution in a turbulent flame



Cross-sectional view of the micro gas turbine



Project Management Agencies

Aeronautics Research and Technology

Upswing in aeronautics research

Aeronautics research project management (PT-LF) assists the Federal Ministry of Economics and Technology (BMW i) in implementing the aeronautics research program ("LuFo") of the Federal Government and the Federal States Bavaria, Hamburg, Brandenburg and Rhineland-Pfalz, which supplement the Federal program with their own promotional programs or projects.

The Federal Government has intensified its engagement for civil aviation research as part of the "High-Tech-Strategy Germany" resolution which was adopted in 2006 and will provide significantly increased budgetary resources for the 2007 to 2012 period. In this context, in addition to looking after the roughly 200 current promotional projects of PT-LF during the reporting period, priority was given to the preparation and start of the first LuFo IV program phase for the 2007 to 2010 period, for which funds of Euro 160 million were allocated. Appropriation notices for all 139 selected promotional projects were completed by the end of 2006, so that the projects could be started at the beginning of 2007. Because of additional budgetary funds in the amount of Euro 40 million for 2007/2008 at the beginning of 2007, another program package under the topic of "Transdisciplinary Hull" was issued for RFPs and set into motion with 16 further projects.

A second LuFo IV project phase with approximately Euro 250 million and a timeframe until 2012 is in the planning stages to be prepared by PT-LF during the remaining year. In order to handle the now more than 500 projects within the scope of the aeronautics research program, the current project management

agreement with BMW i, which is effective until 2010, must then be amended/expanded accordingly.

In addition, PT-LF will undertake multiple special projects for BMW i as follows: PT-LF will support and assist BMW i in a consulting capacity for the EU aeronautics research program, by preparing and participating in EU committee meetings and panels as well as preparing and distributing information. Furthermore, PT-LF on behalf of BMW i will act as the "Information and Consulting Agency for aeronautics research of the EU," and is accredited by the EU Commission as the "National Contact Center (NKS) for Aeronautics" and in this capacity acts as consultant to parties making applications in the aeronautics field.

In terms of the 6th Framework Program 2002-2006, the German participation in RFPs for Aeronautics could be increased to more than 23% of the grants, and in the last RFP even to more than 27%. Based upon the updated Strategic Research Agenda 2 (SRA 2) of ACARE (Advisory Council for Aeronautics Research in Europe), the work program for the first RFP for Aeronautics within the 7th Research Framework Program of the EU was compiled with the support of PT-LF.

The EU project ERA-Net "AirTN-Air Transport Net" with 26 partners from 17 countries in Europe was launched successfully with PT-LF as coordinator. The entry of additional partners is being prepared and the request by the EU Commission to assist in Advisory Council for Aeronautics Research in Europe (ACARE) has been arranged.

PT-LF will also coordinate all subsequent activities in the future. PT-LF has been appointed the speaker for the BMW i in the Executive Committee of the oldest research network of the leading European aeronautics nations, Group of Aeronautic Research Europe (GARTEUR), and is a member of the Council. The chairmanship of Germany for 2008 and 2009 as part of the rotation cycle requires

the establishment and management of a GARTEUR Secretariat by PT-LF and all management tasks connected therewith.

The Federal States of Brandenburg and Hamburg have particularly intensified their engagement and funding for new projects in the regional Aeronautics research activities to be supported by PT-LF. This will increase the number of the projects of the Federal States to more than 60.

During the reporting period, the fact that only 15 persons were available for compiling and working with the projects presented a particular challenge, notwithstanding the fact that subsidies increased by 50% and the number of projects almost doubled. In spite of the additional growth in subsidies and an anticipated number of more than 600 projects by the Federal Government and the Federal States to be processed, the size of the project team will be restricted to 20 persons maximum, due to cost reasons.

As project manager of the BMWi, and as project manager for aeronautics research, PT-LF has assumed a central role as service provider and source of knowledge in aeronautics research at the EU, national and regional level, and is therefore in a position to provide effective support to BMWi in its endeavor for coordinated and efficient advance of aeronautics research in Germany and prevent duplication. This special role is absolutely unique when compared with similar institutions of the European partner states.

DLR Project Management Agency

The Project Management Agency in DLR (PT-DLR) will provide organizational scientific and related administrative management tasks within the framework of the respective promotional programs on behalf of the Federal Ministry of Education and Research (BMBF), the Federal Ministry of Economics and

Allocation of budget funds	in 1,000 Euro 2005	2006
Information technology	178,864	187,391
Health research/Human genome research	166,423	176,433
Environmental research and technology	59,899	74,668
New media in the economy	35,324	36,904
New media in education and technical information*	29,838	30,312
Work structuring and services	25,770	26,400
Education research**	33,417	26,112
International office	12,134	14,354
Equal opportunity/Gender research***	6,241	5,886
Helmholtz Association Strategy Fund	4,828	4,285
Büro Einsteinjahr 2005 (Einstein Year Office 2005)	3,137	5,815
Humanities	2,743	3,596
Competence agencies****	–	360
European programs	58	–
Total:	558,676	592,516

Co-financing by the European Social Fund (ESF) in the amount of:

* Euro 12.6 million ** Euro 3.9 million *** Euro 1.6 million **** Euro 0.4 million

Technology (BMW), the Federal Ministry of Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) and the Federal Ministry of Health (BMG). To this, smaller projects by the Länder Ministries and private clients will be added.

At the end of 2006, PT-DLR had a total of 542 employees. The total sum of the funds for research promotion supervised by it, increased by 6.1%, compared to the preceding year, and reached a total of roughly Euro 590 million (see Table 1). In 2006, a total of 4,164 projects were supervised.

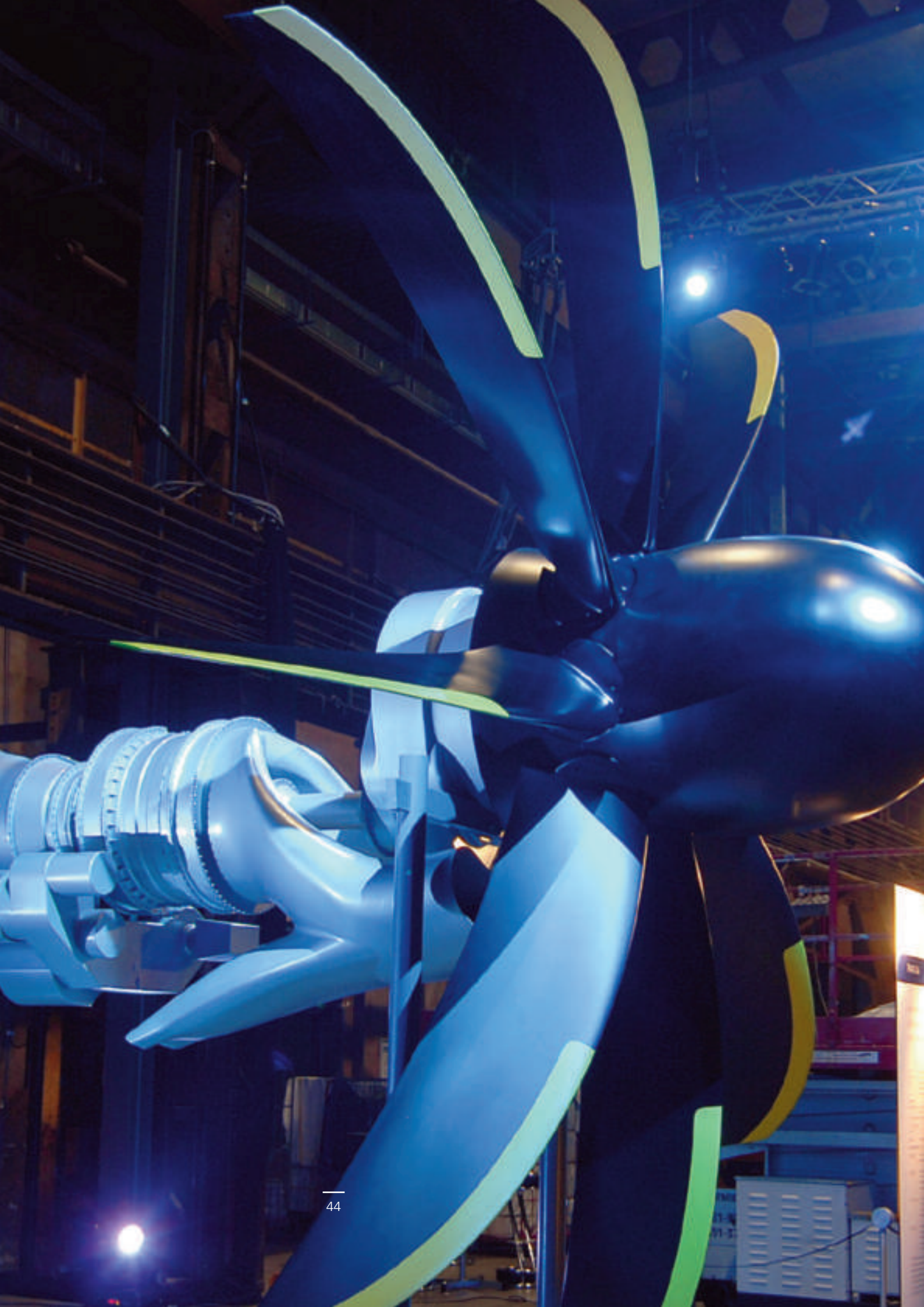
The content of the spectrum represented by PT-DLR is exceptionally broad and comprises most of the relevant fields in science and technology today. The spectrum covers research and health, environment and sustainability, information technology, new media in business and education as well as research issues related to the work environment and service industries, educational research as well as the area of human disciplines and social science and equal opportunity/gender research. The project management extends to activities on both national as

well as international levels, with long-term experience in the areas of promoting research and education; it maintains good contacts with research management and facilities, expert committees and proven experts in the national and international world of research.

The PT-DLR demonstrates its flexibility in taking on and meeting the ever-changing requirements by clients. During 2006, PT-DLR among other things accepted the promotion in the area of "Social Ecology Research" of BMBF and was retained by the Federal Ministry of Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) to provide support for the "Agencies for professional and social integration of disadvantaged youth." It also provided support for the BMBF during the first half of 2007 in its activities connected with the presidency of the EU Council.

Detailed descriptions of all activities and programs can be found in the PT-DLR business for 2006

(www.pt-dlr.de/pt/service/publikationen).





ECONOMIC DEVELOPMENT

Strategy

The research enterprise

DLR's strategy is updated in three-year intervals. The strategy DLR-Research Enterprise – Goals and Strategies 2006–2009 was adopted in the spring of 2006.

The basic system is comprised of five elements:

- Overall Concept: Vision, Mission, Approach;
- Technical Goals of the Business Segments;
- Overall Corporate Core Goals;
- Supporting Goals;
- Strategic Controlling: Performance Measurement System, Strategic Measurements, Target Agreements.

DLR's long-term vision is to be the leading and trend-setting research facility in Europe

in its business segments, aeronautics, space, transport and energy, and to be the formative agency for European space travel through its function as a space agency as well as umbrella organization for the most effective and efficient project management agencies. The main features of the strategy have already been highlighted in the Research and Corporate Results 2006/2007.

The main goals of the corporate strategy are shown in the illustration.

For the achievement of the core goals of the corporate strategy, 14 supporting goals were additionally formulated with regard to the economic situation, development and expansion of relationships, HR development and administration, processes/organization of the research facility as well as the infrastructure and information technology.

Exact details with regard to all goals are set forth in the document "DLR-Research Enterprise – Goals and Strategies 2006–2009" which can be downloaded from the website www.dlr.de/en by visiting Management & Admin., Corporate Development and External Relations.

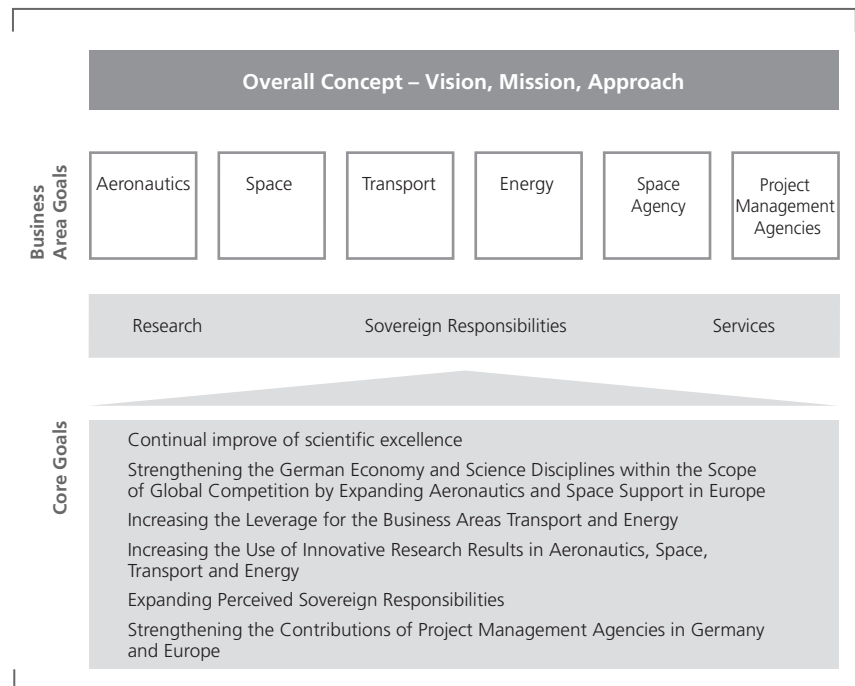
Implementation

Immediately following the official passage of the corporate strategy, a road show was conducted within the DLR centers. Presentations were held at all DLR locations to familiarize employees with the new orientation, to answer questions and to initiate a constructive dialogue. Several opportunities for critical exchanges regarding DLR's new orientation were offered in the context of the regular meetings by the Executive Board and the heads of the institutes, e.g. at the quarterly meetings or the annual exchange between the heads of the institutes and next-generation researchers with the Executive Board. To continue this dialogue, the DLR-internal education program is explained in a course where employees can familiarize themselves with the methodology for the development of the corporate strategy and its direct, concrete implementation.

DLR's corporate strategy is also reflected in the organization's internal science competitions titled "DLR Center of Excellence" and "Competition of Visions". Via the criteria that are set for the selection of the winners, we are able to define a new focus that is in line with DLR's alignment of goals.

In addition, the corporate strategy is further supported by a strategic controlling action. Inside an internal DLR Management Information System (MIS), selected code numbers are continually updated. This measure is how DLR's development in various areas can be monitored and, if necessary, steered. Furthermore, an MIS that is always up to date helps with the harmonization of figures relative to internal and external DLR reporting.

Core Goals of the Strategy



Presentation of results

This second part of DLR's annual report – on corporate results – will outline any progress that has been made with regard to the continued implementation of DLR's strategy. This section of the report describes important activities relative to the economic situation, technology marketing, national and international relations, structure, process and organizational improvements as well as with infrastructure and information technology.



Results

Third-party funds

Compared to the previous year, third party funding declined slightly for the reporting year 2006, ending with Euro 255 million; however, third party funding could nevertheless be maintained at a high level. This type of funding contributes 48% of DLR's overall revenue. The changes were mostly due to developments in the large project segment. The drop in third party funding is correspondingly reflected, in particular, in the area of public projects funded by the federal and regional state governments (subsidies as well as orders) and supranational organizations (ESA). The reason for this

development lies in the progress and/or conclusion of long-term projects that had a crucial impact on the growth of third party funding activities during the previous year.

In contrast, proceeds from projects within the domestic economy could be increased by 41% to Euro 56 million (excluding patent and royalty incomes), which is significant. The reason lies essentially in the fact that in the business sector Space, a project is assigned directly by industry. In addition, other large projects could be brought to their successful completion.

The revenue share of foreign principals could be held at approximately the same level as during the previous year. Third party funding income by foreign governments was almost constant, ESA earnings dropped by half, but a considerable increase in earnings was recorded from foreign businesses. The reason for this situation is to be found once again in activities involving large projects, specifically at the Lampoldshausen location.

In the area of EU projects, viewing the past three years with 297 EU projects ordered, it was possible to increase the number of sponsorships once again during the reporting year, despite the expiration of the 6th Research Framework Program. Primarily the success rate of 54% is remarkable in this context, because the number of submitted project applications for the same period dropped. The quantity of EU projects in the framework of which DLR exercises its consortia-coordinating function has declined minimally. In addition to the ending of some corresponding projects, this development is certainly also attributable to the start-up of the 7th Research Framework Program.

Third party funds	2004	2005	2006
Revenue from third party funding totaling	Euro 242 m	Euro 275 m	Euro 255 m
revenue growth, R&D revenues from domestic business activities	+18%	+1%	+41%
Third party share as part of the revenue total	49%	52%	48%
Share of revenues from foreign clients (revenue volume)	35%	31%	29%
Success rate of EU proposals in the last three years (accepted/submitted)	42%	40%	54%
Revenues from EU promotions	Euro 12.5 m	Euro 15.6 m	Euro 17.3 m
Coordinator/total ratio (EU projects)	18%	21%	16%

Research-related results

DLR places a high standard on the scientific quality of its research. Consequently, in addition to procuring third party funding which is important to ensure that research activities are aligned with the demands of industry, the quality of the scientific results is just as crucial. Publications, presentations and teaching assignments are identifiers for measuring scientific quality and productivity, and they are continually recorded. Any variations are mainly due to project work, personnel-related fluctuations or application activity.

With 495 articles, the number of publications in reference periodicals (561 for the previous year) decreased slightly. If reference publications in proceedings, books etc. are added to this figure, the number of publications submitted in any form for expert review prior to publication amounts to 1,031 (comparison figure for 2005: 1,127).

With regard to presentations, on the other hand, DLR's untenured scientists were more active during the reporting period than during 2005. The increase in the number of completed diploma papers that was seen over the past few years has remained unabated. The number of accepted teaching jobs at the university level stabilized at last year's volume.

Technology marketing

Technology changes markets; markets in turn influence technologies and products. DLR Technology Marketing views its role in this field of exchange as that of a mediator between innovative technologies and a partner to industry in search of technological solutions to problems. Technology Marketing at DLR designs the

Product-related results	2004	2005	2006
Publications in peer-reviewed journals	450	561	495
Peer-reviewed publications in proceedings, books, etc.	500	566	536
Presentations at scientific conferences, workshops, readings	0.88	0.81	0.85
Calls to universities	12	9	8
Masters Degree	235	264	318
Dissertations (internally)	86	71	78
Post-doctorate	5	5	4

process – ranging from the demand situation in the marketplace in all sectors, via the development of ideas and their implementation in the context of transfer projects, all the way to integrating DLR know-how into contexts of economic utilization. The envisioned main objectives are, in response to the demand, preparation of DLR technologies in order to implement products together with partners from the industrial sector, as well as the acquisition of new customers, the securing of business areas by way of proprietary rights and support for the creation of new companies.

Examples of successful technology marketing

Subsequent to the completed transfer project "Tempering and Processing of Compound Fiber Components with Microwaves", Bolle & Cords introduced a resin heating system in the marketplace. Scholz made a large autoclave available to the Institute of Composite Structures and Adaptive Systems, free of charge. At the current time the autoclave is being converted, in cooperation with Fricke & Mallah, for microwave curing. After refitting is complete, Scholz will launch this type of autoclave in the market. The aeronautics industry has shown major interest.

The HDTV scanner was developed in collaboration with Kinoton. The scanner allows for quick and high-resolution scanning of analog film material and transfers the information to a format that corresponds to HDTV. The 0-series model was presented at tradeshows in 2006; the Kinoton company will introduce it in the marketplace in 2007.

In the context of the transfer project "Scientific Software Portal" the virtual laboratory was improved as a cell-based portal and equipped with the capability of providing scientific software, plus it was made available for implementation. Within the framework of a pilot application, DLR implemented the portal internally and/or connected program packages in order to make it available to other users. The project was completed with an operational portal, including the corresponding documentation.

Created as part of the transfer project "Modular Air-cooled Low-Temperature Fuel Cell System" a driverless transport system and, in cooperation with the company CARDEC, an airfield vehicle was built. Both systems are based upon a fuel cell drive system. At the 2007 tradeshow in Hanover and the 2006 Air Traffic Congress, this vehicle aroused great interest in industry circles. CARDEC has good order volume; DLR already delivered five fuel cell systems to CARDEC.

An installation for solar wastewater treatment of household and industrial wastewater is currently in development as part of the transfer project "SOWARLA (Solar Waste Water Treatment)" in collaboration with the companies KACO GmbH and Hirschmann GmbH. Licensing and marketing agreements were signed with HIRSCHMANN and KACO Gerätetechnik, the partners of this cooperative effort.

In the context of the transfer project "Slungload", a system for the safe transport of outboard helicopter loads was developed and brought to maturity for market launch in collaboration with the company iMAR GmbH. A licensing agreement was signed. The transfer project "Cargo Handling" is conducted based on said agreement; in particular, the project's added objective envisions the development of point-specific precision during the setting-down operation of outboard helicopter loads. The German Federal Armed Forces and iMAR GmbH have shown great interest in the technology; a licensing agreement was signed with iMAR.

The companies Hydro Aluminium GmbH and Metallguss Herpers GmbH are co-operation partners in the transfer project "Aerogelbinder". The project's goal is the development of cast cores made of aerossands for aluminum precision-casting applications. The automobile industry exhibited great interest in the technology at the GIFA 2007. The technology received the "Award for Innovation of the City of Aachen" and the "Bavarian State Award for Special Design and Performance in Craftsmanship 2007".

The transfer project "Product Development of a Potential and Seebeck Micro Thermal Probe for Semiconductor Characterization", in a collaborative effort with the company PANCO, resulted in the conversion of a lab procedure to a measuring device. Three beta testers already declared their willingness to buy these instruments after the conclusion of the beta testing phase. The company LOT ORIEL was contracted as distribution partner.

Following the transfer project "Four Finger Hand", Schunk signed a marketing agreement with DLR. DLR has already delivered five hands, which were sold by Schunk; more orders are expected. The robotic hand won the "EURON Technology Transfer Award 2007" as well as the "iF Product Design Award 2007".

The company S.E.A. GmbH could be committed for the marketing of the display system that had been created in the context of the transfer project "iObjects." The brand name is "2Indicate".

Intellectual property rights

In 2006, the number of applications for inventions climbed to 232. This translates to an increase of approximately 8% relative to the previous year (216). German intellectual property rights owned by DLR

increased in 2006 in comparison to the previous year by about 13%; at the end of 2006 DLR owned 1,203 national rights of protection.

Applications for proprietary rights abroad are necessary primarily for the industrial partners. DLR applies for foreign intellectual property rights at its own expense only if this is essential in order to secure core work areas, thereby ensuring that DLR will have free maneuverability in the long run. Due to this restrictive patent application policy, the number of intellectual property rights acquired abroad dropped between 1998 and 2003 by about one third. Even though the inventory of intellectual property rights abroad has remained approximately constant in terms of nominal figures since 2004, when compared with the national inventory of protective rights, however, it has continued to shrink. The reason is to be found mainly in cost control efforts.

Licenses

DLR's royalty income increased in contrast to the previous year from about Euro 2.7 million to about Euro 4.15 million, thereby returning to the levels of 2003 and 2004. The reason for the strong decrease in 2005 had been a major drop in sales of two important licensed DLR products. It was subsequently possible to compensate for this drop with good sales figures for other licensed products in 2006 as well as with a lucrative one-time payment by one licensee. Thus, in comparison to the average of the years 1996 to 2000, DLR's annual royalty income has approximately doubled. The reasons for this development are the successful technology transfer projects started by DLR Technology Marketing between 1998 and 2002 and that now generate the increased royalty revenue.

With regard to external costs for patent applications, general cost increases – in particular, the expenditures for external patent attorneys – have resulted in slight expenditure increases. DLR spends about

0.5% of its budget for the application, maintenance and defense of its inventions.

Spin-off companies

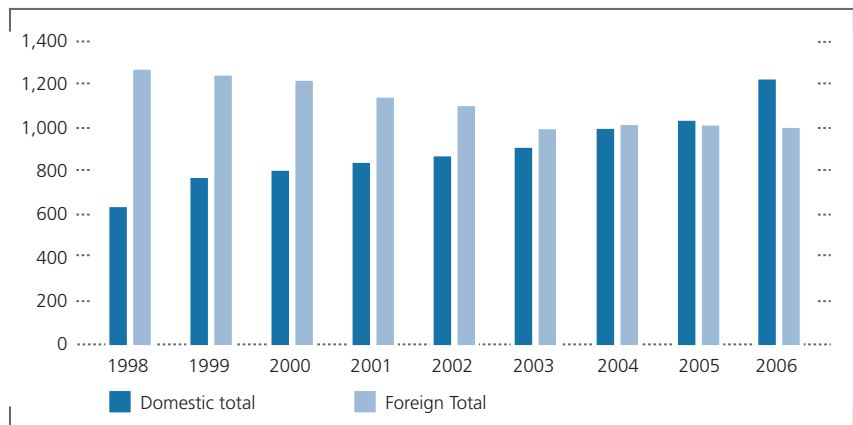
The purview “Company launches” supports spin-offs from DLR institutes and facilities. Corresponding employee initiatives leading to such spin-offs can be supported with funding from the Helmholtz Society’s Impetus and Networking Fund. Since the inception of the EEFII fund last year at HGF, four DLR facilities have received subsidies of up to Euro 100,000 each to help with the preparations for setting up a company. Four additional previously organized companies were introduced and have already received in part positive evaluations.

With the new technology companies that were spin-offs from the DLR organization, DLR secures further access to the market. The companies are given licenses for the utilization of DLR technology, which they incorporate in value-adding applications leading to further third party funding income for the institutes. Aside from the purely economic consequences for DLR’s business activities, this support measure constitutes an attractive outlook for employees leaving the organization and seeking a professional alignment for their future. Both, the entrepreneurial activities as well as the collaboration within a young, DLR-technology-based company are a foundation for a professional future.

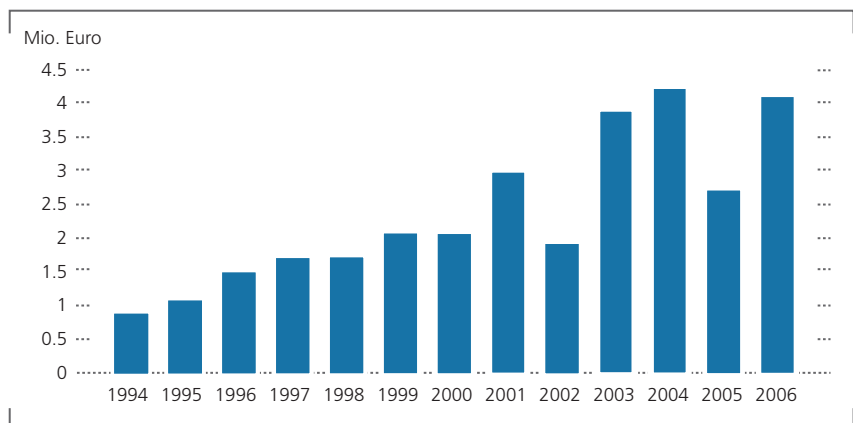
Different kinds of funding are available for company financing at the Kreditanstalt für Wiederaufbau (KfW). The high-tech entrepreneurial start-up funds were set up specifically for financing companies that are organized as spin-offs from research facilities. Technology Marketing supports the DLR facilities in their application processes and – in conjunction with the Department for General Legal Affairs – in the drafting of cooperation and licensing contracts with these companies.

Technology marketing	2004	2005	2006
Revenue from licenses	Euro 4.2 m	Euro 2.7 m	Euro 4.1 m
Company hive-offs	1	1	2
New in-house technology transfer projects	12	15	13
Investments in technology transfer projects	Euro 2.4 m	Euro 3.5 m	Euro 2.8 m

DLR patents in Germany



Received royalties





Structure

Corporate development

ATI - DLR's Administrative and Technical Infrastructure in transformation

The project "Effectively/Efficiently Optimizing Processes (PEO)" was completed on schedule at the end of 2006 as part of the multi-year change process "Changing ATI". The goals that were set for process organization, acceleration, structure adjustments and a cost-control measure, cutting cost by 10%, were achieved. In addition to the previously ISO-certified support processes "Managing Orders" and "Purchasing", the processes "Managing Personnel" and "Planning and Steering" were certified as part of the matrix certification in November 2006. An EFQM assessment by way of a parallel measure resulted in an excellent evaluation.

The sustainability of the changes initiated by the PEO project is supported by a code number system that was introduced in 2006 for the support processes of the Administrative Infrastructure.

Aside from the code numbers for directing the processes, the year 2006 also saw a benchmarking of the process "Managing Personnel" with the GKSS HR Administration. The result led to cooperation in concretely identified subject fields, such as the web-based applicant management tool, travel expense accounting and personnel liaison model.

Thirty supervisory personnel feedbacks were conducted with over 300 employees as part of the administration's culture development project in the course of the second half of 2006. The results break

down the information regarding satisfaction in the workplace, process organization and leadership as well as cooperation within the organizational units. A second interview round is slated for 2008 in order to assess the progress made following the initiated improvement actions.

In 2003, the project "Fit for Future" was started within the framework of "Changing ATI"; this project targets stronger customer and market focus in the context of the purview Technical Infrastructure. The evaluation was focused on "Facility Management", "System House Technology", "Construction Management" and "Building Management".

To isolate the best option from among the possible alternatives, the DLR Executive Board decided at the end of 2005 to pursue the model of a Public Private Partnership (PPP) as a pilot project for Facility Management (FM) at the site in Cologne. This approach envisions finding a private third-party that delivers, by way of a life-cycle management, all construction and FM services at the location Cologne and retains the employees tasked today with FM-related responsibilities. The process method in the context of the project is aligned with the PPP guidelines issued by the regional state the federal state North-Rhine-Westphalia, as well as the guideline "Profitability Studies in PPP Projects" published by the federal work group of the same name.

The suitability test recommended by the federal and state PPP work groups was implemented and produced positive results; the inventory of services, building and technical installations at the site Cologne is available. They are the basis for the output specifications of all services that will be the starting point for any Service Level Agreements (SLA) to be negotiated in the future.

The present results with regard to the projects "Systemhaus Technik" (SHT), "Construction Management" and "Building Management" were evaluated

over a time period of almost two years.

Experts assessed the results as positive and support further planned actions with regard to the individual projects. A summary of the results for the individual projects that have been achieved to date follows.

The following targets were reached and implemented with regard to the project "Systemhaus Technik" (SHT):

- Effective and efficient collaboration across different site locations as part of the overall concept "Systemhaus Technik" were effected on the basis of uniformly and consistently introduced processes as well as harmonized documentation throughout all technical operations.
- Implementation of a regional, step-by-step organization and a process organization, starting in 2007, that is based on described roles and functions.
- Implementation of an ongoing enhancement process that is linked to a continual process review regarding issues related to effectiveness.
- Successful transfer of the "Systemhaus Technik" (SHT) to a demand-oriented result unit starting January 1, 2007.

In 2006, the processes for providing and maintaining technical infrastructure systems were modeled under the umbrella of the "Construction Management" project; in this context interfaces and responsibilities were clearly defined, such as the responsibilities of principal and contractor. Moreover, one of the objectives consisted in harmonization with users for the purpose of improving transparency in the preparatory and realization phases of construction projects as well as the improvement of secure application of DLR's corporate strategy across locations.

The building management project saw the compilation of a product and service catalogue for all services that are provided in the context of building management.

To this end, all of the respective services were analyzed and harmonized with established standard structures in Facility Management. Based on this modeling of processes, and while involving the customer, a service management model with a central service desk was set up and tested.

In addition, preparatory work for the implementation of the key process in terms of space management "area management", including the selection of a suitable area management tool, was conducted in order to create an adjustment lever for the institutes and facilities for the purpose of directing their use of space and, consequently, the impact and responsibility relative to cost.

Defense technology and security research

Research in the area of military defense technology is an integral component of DLR's program policy. In the interest of mutual research and the technology transfer between civil and military applications, technological military defense themes are integrated as part of DLR's civil research activities. The goal consists of utilizing as much as possible, and with the close collaboration by the relevant government departments and their dependent official authorities, the results from civil sector research and to supplement specific military aspects with research and development projects.

The goals of military research at DLR are as follows:

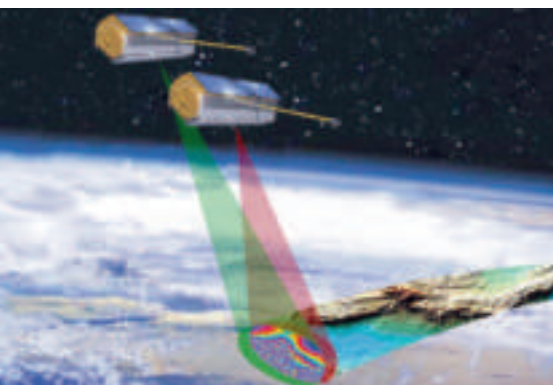
- Providing contributions to meet demand and to close the capacity gap at the German Federal Armed Forces based on research that is both focused and in response to phenomena and application requirements.
- Providing methods, installations and the implementation of demonstrations for testing and evaluating new technologies.



Presentation of certificate in April 2007. From left to right: K. Hamacher, Vice-Chairman of the DLR Executive Board, M. Senden, Division Head of Finance and Corporate Controlling, W. Kuhnert, Department Head of HR and Legal, Prof. J.-D. Wörner, Chairman of the DLR Executive Board and J. Stoll, Head of the Team of Junior Associate Officers at the German Society for the Certification of Management Systems (DQS)

- Maintaining and expanding the assessment and consulting responsibilities on behalf of BMVg and BWB as well as their dependent official authorities and on behalf of the science sector. In addition, there is always an ongoing related search for new and improved technologies.

At the 415th meeting of the DLR Executive Board on June 11, 2007, it was decided that DLR would join the newly founded German European Security Association e.V. (GESA) at the end of 2006. GESA seeks to help bring together the interests of the German research community and of parties seeking such research in the areas of security and the security market in order to promote the creation of the best possible framework conditions for innovation in this area.



The new DLR Centers of Excellence house the development for cutting edge technologies in the subject areas of high- temperature coatings (top) and 3D-SAR (bottom: TanDEM-X in formation flight for cross-country models)

DLR's own science contests

DLR's science contests are very much underway. In an effort to create an incentive for further improving scientific excellence, for increasing expansion of expert leadership positions, or for indulging in the pursuit of new, visionary ideas, DLR conducts two complementary in-house contests in regular intervals: "DLR Center of Excellence" and "Competition of Visions". Winners of the annual "DLR Center of Excellence" competition receive recognition of their stellar performance, both by being awarded the same-name title and by receiving additional funding. In the fall of 2006, we honored two topics in this manner. Surfaces and surface coatings for high-temperature applications took center-stage at the "DLR Center of Excellence SURFACE". Structural materials became functional materials; in fact, mere materials were morphed into "intelligent" materials. The resulting coating center was erected with the assistance of HGF's large investment funds and officially opened in the spring of 2007.

The "DLR Center of Excellence Advanced High-Resolution & 3D-SAR Technologies and Applications", also held in the fall of 2006, develops high-end technologies for Earth observation applications. Relying on the experiences of three DLR institutes when it comes to Synthetic Aperture Radar (SAR) technology, ranging from sensors developed for specific missions to highly precise processing of data and the generation of user-specific data products, this DLR Center of Excellence competition meets the extreme requirements in connection with a detailed exploration of our Earth and its climate. Winners are each awarded the sum of 500,000 Euro for the years 2007-2009. The Board of Experts, along with the program directors, coordinates and comes to agreement on concrete goals. Another invitation for submissions is underway. With the event "Competition of Visions", DLR promotes innovative

ideas for the technologies of the future. The funding goes to smaller employee groups who submitted subject proposals that capture topics of special scientific, technological and social relevance. Funding of 100,000 Euros per year over two years is to be used for the initial feasibility studies. The work from the last contest, which DLR initiated in 2005, is still active through the end of 2007. A new call for submissions is anticipated for 2008.

German personnel at ESA

Since 2003, DLR has been increasingly active in the area of personnel recruitment for the European Space Agency (ESA) in order to promote Germany's strategic position via growth of the share of German nationals who are employed by that organization. The target marker is an increase of the number of employees to a level that would correspond to the German percentage share relative to ESA funding, which is 23.6%. With a share of 27.8% of newly hired personnel in 2006, which translates to 25 new employees, Germany is in a fairly good starting position. Utilizing existing instruments, i.e. the DLR work group for ESA recruitment, the delegation program, and promotional events and participation at company job fairs, DLR was able to stabilize and in fact slightly increase the German personnel share – despite HR losses due to retirement and low new applicant figures. As of the target date of June 30, 2007, ESA has a total of 1,925 employees. Of those 375 are from Germany, corresponding to a rate of 19.5%. However, this positive development should not detract from the fact that, in view of Germany being one of the seven major funding contributors, we are still considerably underrepresented.

The activities mentioned above have been the foundation for DLR's success. Two partial aspects shall be emphasized below. With currently 12 young graduate trainees, Germany supplies the largest contingent in this area by far. This creates a good springboard for young people

intending to make the switch to a future with ESA. Thanks to newly hired personnel, Germany, next to France, has also become the leader over the past few months in the area of the so-called A6-positions, which is comparable to the position of a division head. The positive developments of the HR results at ESA for 2006 and the first six months of 2007 is an excellent start as DLR continues in its pursuit to achieve an even more enhanced development of the ESA personnel strategy. In addition, the continued search for qualified candidates to fill strategically important A5 positions has remained a crucial focus for the DLR work group during the second half of 2007.

Quality management and environmental protection

The quality of DLR's research results, products and services is the foundation for its organizational ability to perform and to compete. DLR strives to satisfy the highest demands placed upon its research, management and infrastructure. This is reflected in the slogan that DLR published on its internet website www.dlr.de – "DLR – Our Research Secures the Future". With regard to the development of the DLR management system and any of its further pursuits in connection with the idea of excellence, DLR's new integrated quality policy posits the integration of quality, security, environmental protection and sustainability. This policy was drafted in cooperation with Corporate Strategy, the Liaison for Environmental Issues and the Work Group of the Liaison for Quality then passed by the Quality Board in 2006. At the same time, the DLR management system was incorporated as an integral part of "Goals and Strategies 2006-2009".

Quality management

Excellent research results as well as high-quality scientific and technical services and products are the foundation for DLR's successful customer relations. To maintain and expand these relationships, DLR operates a management system that satisfies the characteristics of a public research company in the areas of aeronautics, energy and transport as well as the tasks of the national space agency and the functions of the project management agencies. A total of 15 institutes, facilities and organizational units relative to quality management (QM) systems were introduced and certified by mid-2007. They are currently undergoing an expansion in 12 additional institutes and facilities. With the achievement of a fulfillment level of 53% (introduced systems and systems in development), a growth of 7% was realized in comparison to the previous year. The uniform quality management (QM) system for the overall DLR organization is one of DLR's special features that make it stand out from among the large research facilities. In the summer of 2007, the Bureau Veritas Certification once again completed a successful audit pursuant to DIN EN ISO 9001 of the direction process applied to DLR's quality management (QM) as well as of the facilities for quality and product assurance. The Space Operation facility successfully integrated the work protection management system this year, in accordance with OHSAS 18001 as part of its management system according to ISO

9001. The Institute of Transportation Systems achieved the demanding certificate pursuant to Standard VDA6.2 of the automotive industry. Technical Services with Systemhaus Technik West earned a certificate pursuant to ISO 9001 and ISO 14001 (environment). The Institute of Aerodynamics and Flow Technology received accreditation by an inspection authority for natural smoke and heat venting equipment (NRWG) pursuant to the construction products law. The Institute of Aerospace Medicine continues to be a holder of the certificate pursuant to the Medical Devices Law ISO 13485. Both Development and Flight Operations were able to maintain their LBA accreditation in force. The materials testing facility for fire behavior in Trauen was integrated in the development operations and is therefore also recognized by LBA. LBA-recognition is unavoidably crucial for the operation of the DLR research fleet as well as for the corresponding experiments and scientific studies.



Quality management	2004	2005	2006
Certifications and accreditations	13	15	15

The Administrative Infrastructure (AI) placed all support processes under a joint certificate pursuant to ISO 9001 and submitted its total organization simultaneously to an IBEC assessment. All four processes are certified in accordance with ISO 9001. At the beginning of the year, DLR became a member of the European Foundation for Quality Management (EFQM) and now faces, in addition to the quantitative growth of its management system, the challenge of increasing the qualitative requirements placed upon the performance of its partial systems. Self-evaluations as well as external assessments support this development. Training measures for EFQM assessors are planned. The DLR QM repeatedly participated in the Ludwig-Erhard Award 2006 with a junior executive and it participated with another junior executive in the European Excellence Award (EEA). The DLR Quality Prize Award took place for the fourth time on the occasion of DLR's annual general meeting. With an increasing number of customer and partner certifications surrounding DLR, there is a growing demand that DLR as an overall organization and/or its individual institutes and facilities require audit evaluation or the need for a certificate in their role as suppliers. In some instances the requirements are already exceeding the standards as set forth under ISO 9001, e.g. AIRBUS and Rolls-Royce with their demand for EN 9100, EADS with the demand for ISO 14001. In individual cases it was possible to explicitly develop additional acquisition potential that would otherwise, without a QM system of the facility, not have been possible.

The analysis of DLR customers for the years 2001-2006 showed a complex customer structure with approximately 500 customers in the area of third party funding annually. Approximately 5% of the third party donors give 80% of third party funding. A decentralized uniform procedure across all of DLR for determining customer satisfaction was introduced and is increasingly being utilized by the facilities. DLR also introduced a uniform supplier evaluation instrument. Starting in September 2004, employees with sufficient technical knowledge and expertise concerning standard DLR procedures have been appointed DLR auditors. During the reporting period, these auditors handled 24% (new calculation in contrast to the previous year) of the planned DLR system audits. DLR hosted the second mutual exchange for auditors in November 2006 with a large number of auditors in attendance.

In the future, all DLR institutes and facilities will be audited systematically. This includes creating inventories and monitoring product-relevant measuring and testing materials that DLR uses, plus anchoring the scientific quality assurance as part of the management system, incorporating the guideline for investment protection with regard to software developments, harmonizing DLR's process landscape, and incorporating the guidelines for safety in the workplace as part of the integrated system.

Environmental protection and safety

For years, DLR has had a firm commitment to protect the environment and to ensure safety. Aside from a multitude of research activities in the areas of climate protection, conservation of resources and reduction of emissions, company-based environmental protection in accordance

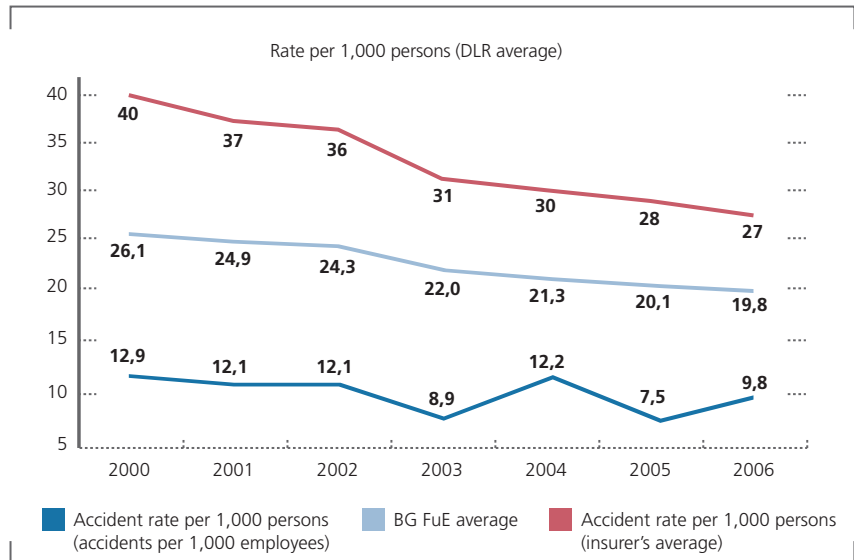
with international standards is also an important aspect. Eight years ago DLR laid the groundwork for ongoing improvements in accordance with the environmental management standard ISO 14001 as an integral part of the technical infrastructure at the location Cologne. Since that time, this path has been followed without deviation, with the integration of improved safety and quality systems. Technical Services were certified in March of 2007 in accordance with the ISO standards that are relevant for quality, environment and safety. In connection with the above, the corporate policy was revised as well. These integrated systems define goals and regulate the recording, documentation as well as the publication of all relevant activities. In particular, they contain the self-defined commitment on the part of the DLR to continually strive for the further enhancement of the measures used to handle products and installations, to minimize effects impacting the environment and to optimize safety devices for the protection of personnel, environment and facilities. Independent experts confirmed this commitment.

Communications transfer, both internal as well as external, including risk communication, continues to be at the center of the ongoing improvement process. In part, these efforts include the continual expansion as well as updates to the internet and intranet platform www.umwelt.dlr.de in order to communicate with the different target groups. Any interested person will find information ranging from an alert plan, to ergonomics, manuals, quality assurance, radiation protection and issues relating to environmental protection. The section that addresses the management of hazardous materials is currently undergoing a comprehensive revision. In 2006, much of the content of the "environment servers" in inter-operational work groups was linked and supplemented in more detail with the work and environmental protection portal of the Helmholtz Association at www.argushelmholtz.de. This included an expansion of the legal databases and comprehensive supplementation of training and practice modules.

Last year, the liaisons undertook the further development of their own films and animations for training purposes and also for external companies; this material is intended to enhance sensitivity training. In addition, informational events for employees as well as special training for supervisory personnel are offered and conducted. With regard to fire protection and building preservation, older buildings in particular were audited, and catalogues with steps to improve fire protection were created. In addition, sewer systems were upgraded and above and underground structures were cleared of pre-existing harmful substances and waste.

Unfortunately, accidents can not be completely avoided, despite comprehensive efforts at prevention. Fifty-two accidents occurred in 2006 that required reporting; half of those did not occur in the workplace but in public traffic and involved motor vehicles and bicycles. With an accident rate of less than 10 accidents per 1,000 persons, DLR is at a low accident level for 2006. In our 13th year of public record keeping since 1993, we achieved the third-best rating. The declining rate is once again far below the average value of about 27 for the Federal Republic of Germany, and also below the figure listed by the servicing social insurance for occupational accidents, which is at almost 20. The diagram, top right, depicts this positive trend. Thanks to the low accident rates, DLR is assessed only the lowest-level premium rates by the insurance company. The evaluation of the safety and environmental protection system has led to improvements in the area of safety management, organizational structure, and human resources specific to full-time employees in the course of the past two years. In this context, the areas of protection in the workplace, environmental protection, fire and operational protection were combined and centralized in the liaison system. Over the past year, DLR conducted comprehensive internal continuing education measures for its

Accidents at DLR



employees utilizing the services of specialized educational institutions. Everybody is thus able to support supervisory personnel and employees alike in all safety-related issues with competence and interdisciplinary expertise. It is in this internal group, "Work Group Integral Safety," that the combined related forces are bundled in one central place. This includes the definition of focus areas of responsibility. For many partial safety-related areas, there is (are) only one or several special expert(s) available who lead the work on these issues. One team currently develops improvements on risk defense plans as well as plans on how to avert a pandemic. Another aspect of safety management involves the clear and transparent implementation of safety and environmental duties along the entire line of the management channels of responsibility. This year, obligatory safety and environmental standards will

be generated and passed for DLR in the format of company-internal standards, guidelines and recommendations that will be linked to existing manuals.

Cultivating the next generation of human resources is also an important issue for the areas of environmental protection and safety. In this context graduate theses and independent written work assignments are handed out and supervised dealing with relevant subject matters, such as protection against explosion and legal updates. The results then become part of the liaison's work.

Relations

Helmholtz Association of National Research Centers

Program performance

As in years prior, DLR achieved the goals set by the Program-Oriented Sponsorship plan ("PoF"). The activities initiated in Bremen with the new Institute of Aerospace Systems must be taken into account in the context of the pending program application for the second evaluation round for Program-Oriented Sponsorship. In this manner, DLR supplements its portfolio and comes closer to its goal of creating an overall system of competence for space programs.

Impulse and networking fund

Efforts to secure financing for a new group of next-generation scientists from the Impulse and Networking Fund were successful. The influence of aircraft emissions on the chemistry of the tropopause region will, in cooperation with the University of Mainz, be the subject matter of a six-year funding program. In addition, the funding for three other next-generation groups was extended successfully. Two applications for new funding were submitted to the Helmholtz Association business office. Funds from the Impulse and Networking Fund were effectively used for spin-offs: Whipox Development and Marketing Company, in the area of materials research; Thelsys, specializing in a holistic approach to air transport sys-

tems; and Dualis, an expert in robotics. The rehiring of two scientists was also achieved via this route. Design of Safety Critical Systems (DESCAS), another DLR proposal for a Virtual Institute, won the upper hand in the Helmholtz-wide competition. DLR submitted four further applications for the pending evaluation round.

National and European Networking

Cooperation with universities

Cooperation with universities is a strategic goal defined in DLR's overall corporate policy. Joint projects in almost all business areas secure the best possible use of available resources in program-based research. Similarly, joint personnel collaborations boost the training of highly qualified next-generation experts for industry and science. DLR and the universities profit equally from the cooperation. With respect to the universities, the scientific and technical infrastructure that DLR has in place is in many instances a prerequisite for many research projects. DLR in turn secures access to next-generation scientists and new research topics. The DLR institutes work with over 500 doctoral dissertation candidates in support of their thesis work annually; approximately 300 students complete their graduate Master's of Science in DLR facilities. The number of DLR scientists securing teaching jobs has grown considerably in the last few years. Correspondingly, 200 scientists were hired last year for presentations, academic in-class exercise courses, seminars etc. at universities and poly-technical universities.

Joint appointments are a central aspect of the personnel-related crossover between research and higher education. As a matter of principle, all DLR institute heads are appointed jointly with a university; i.e. the DLR institute head assumes the job of a university professor with all of its rights and obligations at a given

university in addition to directing the institute. Joint appointments according to qualification criteria by both partners ensure that the best possible personnel is found for the job, with the scientist realizing better research and teaching opportunities.

Participation in German Research Foundation (DFG) programs

The so-called "Coordinated Programs" by the German Research Foundation (DFG) support extensive networks of researchers who dedicate their efforts, on an interdisciplinary basis, to a more comprehensive subject area of interest. In specialized focus research, the main aspect lies on first-rate research; focus programs help develop expert capacities and graduate student education opportunities for training outstanding new young scientists. During the reporting period, DLR institutes participated in nine special focus research areas, 15 concentrated programs and three graduate student programs.

Sponsorships

Securing a pool of highly qualified young talent for research and development work is an essential concern for both science as well as industry. Sponsorships are a vehicle where the promotion of new talent goes hand in hand with the objective of quick technology transfer through people. In these programs companies bear half of the cost of training next-generation scientists who are employed by DLR for a period of three to four years and who work in subject-areas that are of equal interest to DLR and the companies alike. As part of this program, young candidates spend some of their time on site at the company. In 2006, we administered 53 sponsorships, thereby approximately maintaining the high level of the previous year.

National and European networks	2004	2005	2006
DFG participants	36	30	27
Sponsorship contracts	43	54	53

Cooperation with NLR

The cooperation between DLR and its Dutch partner organization "National Aerospace Laboratory of the Netherlands" (NLR) received a strong boost in the area of air traffic management thanks to the founding of the joint company "AT-One EEIG, European Economic Interest Grouping". The AT-One cooperation is based on their excellent expertise when it comes to available simulation and operations tools and experimental installations in the area of air traffic management. Coupled with the planned implementation of the SES ATM Research Program (SESAR), DLR and NLR will take important steps toward realizing a single unified European air space – the "Single European Sky" (SES). The stated goal of the "Single European Sky" is the search for ways to accommodate the increased traffic volume expected in the year 2020, via an efficient, uniform European air space. This is particularly important in light of the fact that the number of flights is expected to double as early as in the next decade. With such a rapid increase in the amount of traffic, we need new innovative concepts, solutions and procedures for efficient air traffic management that are designed with safety and environmental concerns in mind. Under the umbrella of



F. Abbink (front left) and Prof. Szodrich (front right) sign the AT-One EEIG founding agreement in the presence of the two AT-One directors J. Hoeksha and K. Klein

the DLR and NLR cooperation, AT-One comprises two of the largest research organizations in the European air traffic management sector. With its large spectrum of scientists and engineers, the group represents the benefits of independent scientific research, new technologies, concept and system validation and more.

Cooperation with EREA

During this year's Le Bourget air show, DLR was represented as part of the EREA booth and its organized events. The special responsibilities of European research facilities in the aviation sector were presented as part of a lecture series before a special focus audience. Addressed were research topics in the areas of helicopters, materials, turbulent wake and noise as well as large testing installations. The bi- and trilateral cooperation between EREA, such as the "Aero Testing Alliance" (ATA); cooperation between the DLR, NLR and ONERA wind channels; and bilateral ONERA/DLR cooperation in the area of helicopter research were highlighted.

Cooperation with EU and ONERA

On December 22, 2006 the Commission published the first request for bids in the context of the 7th Framework Program for Research and Technical Development (FP7). With a total of 157 project applications, DLR once again played a prominent role, coordinating 23 of the project applications. Of interest are not only the subject-specific program parts, such as transport (including aviation), energy and space travel but also overarching subject areas, such as research infrastructures and personnel exchange programs (partnerships between industry and academics). The evaluation results of the project applications have not been concluded and are expected in the fall of 2007.

In mid-June 2007, the EU Commission submitted its official proposal for a European technology initiative with the stated goal of environmentally friendly air transport, the Joint Technology Initiative (JTI) "Clean Sky", for consideration in the further EU decision-making process. The objective of this large-scale Europe-based program is a bundling of resources from industry and the EU in the framework of a "Public Private Partnership" in order to implement ACARE's strategic environmental goals in the area of aeronautics. The JTI "Clean Sky" initiative is expected to steer the development away from classic project funding, which has been handled on a case by case basis, for dedicated strategic large-scale JTI projects in exchange for achieving a critical mass in favor of the implementation and demonstration of environmentally friendly aeronautics research and technology in Europe.

This goal is to be reached with the assistance of six so-called Integrated Technology Demonstrators (ITD). DLR will participate in conjunction with its partner organization Office National de la Recherche Aérospatiale (ONERA) in the segments fixed-wing airplanes and helicopter ITD. DLR will moreover participate in the flight system ITD. The final decision regarding the implementation of the JTI "Clean Sky" initiative is expected for the end of 2007 under the auspices of the Portuguese EU Presidency.

In a parallel measure, DLR, along with its partners, has also preparations underway for participating in the JTI segment hydrogen and fuel cells; the corresponding submission for this project is also expected to occur during the Portuguese presidency. In the area of space flight, the Space Council's forth conference was prepared with great intensity and finalized during the reporting period. To guide these efforts, talks were held on all levels between the DLR, the German federal government (EU presidency), the Commission and the ESA presidency (Netherlands)

in efforts by the parties to arrive at a successful passage of the resolution for a European space program that is carried by all member states.

Cooperation with CNES

Between April 2-5, 2007 DLR and CNES organized jointly the Seventh International Symposium for Launcher Technologies in Barcelona which addressed the topic of "Opening New Ways to Space Prospective – Advanced Concepts Technologies Missions". Spanish partner organizations, especially GTD, were actively involved in setting up the conference. Two hundred participants from Europe, but also from the United States, China and Brazil, debated proven and visionary launcher concepts alike. The symposium was the second event that was designed as a DLR/CNES partnership. This partnership has led to an exchange of information and cooperative projects on scientific and technical levels and will be continued in the framework of the coming launcher technology conferences as well as being expanded to other subject areas.

In the summer of 2007, a DLR/CNES workshop was organized at the highest level with the stated goal of identifying concepts and topics as well as advancing a close cooperation between the organizations. The formation of joint teams and work groups, the exchange of information and research results in efforts of avoiding duplication, joint programs and projects as well as personnel exchanges were topics that took center-stage. Detailed working group were established to address subject areas of joint interest for the partners (extra-terrestrial life, health science, transport, climate and global change/EO, formation flying and exploration technology). The President of CNES was an invited guest at senate meetings in an effort to acquire a better understanding of the direction of DLR. In addition, one scientist of CNES Toulouse is currently employed on a one-year contract at the aeronautics operation in Oberpfaffenhofen.

International cooperation

United States

The US initiative on space exploration was the reason for two visits by NASA administrator Mike Griffin to Germany. Accompanied by a delegation of experts, he visited the institute in Oberpfaffenhofen in July of 2006. In January of 2007, he traveled to Berlin to participate in policy talks on space travel. Both visits focused on gaining first-hand knowledge of the potential possibilities of the German space program with regard to space exploration; plus, efforts were made to increase German participation in the US space exploration initiative. Shortly after taking office, Prof. Wörner was able to continue this intensive dialogue with NASA. With the ongoing budget negotiations in the US Congress regarding NASA's funding as a backdrop, the main topics at the conference table were the implementation of the two German-US projects SOFIA and DAWN as well as the continued expansion of the ISS and its application for scientific uses. Under the leadership of Deputy NASA Administrator Shana Dale, NASA representatives came for another visit in May of 2007 to discuss topics involving exploration and space sciences. With an established interest in the German lunar mission, an agreement was reached to continue further talks at the expert level.

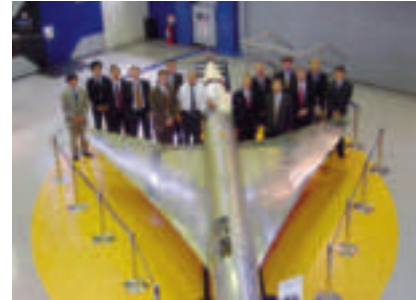
Prof. Wörner traveled to Washington upon the invitation by the German Minister of Foreign Affairs Dr. Steinmeier in order to attend a Transatlantic Energy Technology Forum in the context of the German EU Council Presidency. The conference, with participation of high-ranking representatives from the industrial sector, offered an opportunity to strengthen the relationship with the US Research Center for Renewable Energies (NREL); talks are currently continued at the expert level with the German Federal Foreign Office.

After initial contacts at the ICAS conference in Hamburg in September of 2006, the first meeting with the NASA administrator for Aeronautics Research, Dr. Porter, was held in June of 2007. At the Le Bourget air show, Dr. Porter, along with Prof. Wörner and Prof. Szodruich discussed various topics in transatlantic aeronautics research.

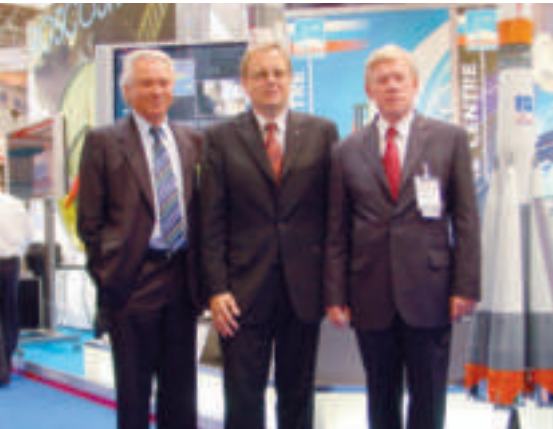
Japan

Le Bourget was also the setting for the first personal conversation between Prof. Wörner and K. Tachikawa, President of the Japanese Aeronautics Agency. Possible areas of cooperation were discussed as well as the respective outlook of both agencies as partners ISS and international development of launcher technology. During a dialogue on strategy, it was agreed to involve representatives from the industrial sectors in both countries for further talks. In the context of aeronautics research, the trilateral dialogue between JAXA, DLR and the French organization ONERA was followed up with a workshop in Tokyo.

Accordingly, new project plans for cooperation in the areas of aerodynamics, structure, flight systems and carrier drive systems are in the initial stages.



Trilateral workshop on aeronautics research with participants from DLR, JAXA, ONERA in September of 2006



Left to right: Dr. Baumgarten and Prof. Wörner with Prof. Perminov, the head of the Russian Federal Space Agency Roskosmos

Russia

Russia proved once more its importance as a German partner in the utilization of the ISS. For example, the German robotics experiment ROKVISS has been housed on board of the Russian ISS module since the end of 2004. The experiment has been extremely successful; as early as 2005, it was decided to extend the one-year mission by a second year. The reliability of the utilized technology and the high relevance of the gathered data during operation of the robotics system, offered all the necessary prerequisites in 2006 to extend the mission once more, until the end of February of 2008. A second DLR experiment on board of the ISS also relies on the partnership with Russia. The MATROSHKA experiment, conducted by the Institute for Aerospace Medicine in its capacity as a main ESA contractor, was brought back into the Space Station during a spacewalk in August of 2005 and equipped with new detectors. This successful experiment for analyzing radiation exposure in space is also being continued. Further topics of cooperation with Russia included space research and carrier services for Earth observation.

In March of 2007, Prof. Nosenko, deputy head of the Russian Federal Space Agency Roskosmos, and Dr. Baumgarten, DLR Executive Board member, signed a Memorandum of Understanding regarding German participation in the Russian X-ray Gamma-Satellite Mission Spektr RG. This project makes it possible to build the x-ray

telescope eROSITA (extended X-Ray Survey with an Imaging Telescope Array) that is under development – with DLR co-financing – by the Max-Planck Institute for Extraterrestrial Physics in Garching.

Moreover, on June 15, 2007, the German radar satellite TerraSAR-X was successfully launched with a Russian-Ukrainian Dnepr rocket. A previously failure had initially caused delays. DLR experts involved in the subsequent investigation of the false start, were to reassured and confident in the reliability of the booster rocket before the TerraSAR launch.

This wide spectrum of a successful bilateral collaboration was the underpinning for a first personal conversation between the new Chairman at DLR and Prof. Perminov, the head of the Russian Space Agency, at the Le Bourget air show. The exchange focused on the above referenced missions as well as other scientific missions still in the planning stages.

In the area of aerospace research, DLR participated in late March of 2007 in the EU Russia Workshop on Aerospace Research that was conducted in Moscow in response to an initiative by the European Commission. This workshop is the continuation of a dialogue between facilities and companies in the aerospace industry with the goal of a more effective Russian involvement in European aerospace research, specifically as part of the 7th Framework Program for Research and Technical Development.

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China

Research cooperation with China was discussed during the 23rd Joint Committee Meeting (JCM) between DLR and the Chinese Aerospace Establishment (CAE) on September 25, 2006 in Beijing. A meeting under the direction of Prof. Szodruch addressed current issues of bilateral cooperation but focused primarily on the development of the Chinese ARJ 21 or its successor versions.

Following the Joint Committee Meeting, talks were held with representatives of Aviation Industry Corporation II (AVIC II) in Beijing and Jingdezhen. The talks focused on the final preparation of the trilateral "Framework Agreement for Cooperation on Rotorcraft Research" between the Chinese Helicopter Research and Development Institute (CHRI), the French ONERA and DLR.

Australia

Another bilateral project was added to the long-standing cooperation of DLR Aerospace Research with the Australian Cooperative Research Centre for Advanced Composite Structures (CRCACS) in June of 2007. During a visit by Prof. Murray Scott, Chief Executive Officer at CRC-ACS, the Australian partners and the Institute of Structures and Design as well as the Institute of Composite Structures and Adaptive Systems signed a technical annex on "Crashworthy Design".

Korea

DLR Aerospace Chair Prof. Szodruch also visited Korea in April of 2007. The discussions focused on the possibilities of expanding bilateral aerospace research with different Korean research facilities and universities. The "Korean Helicopter Program", which selected Eurocopter as its international development partner during an international call for bids, was the point of departure for the talks. On issues of space flight, DLR supports the involvement by German industry with regard to the development of a high-resolution optical Earth observation satellite and the delivery of individual components.

Canada

As a follow-up by the ESA Council on June 13 and 14, 2007 in Dresden, talks were held with L.J. Boisvert, the new President of the Canadian Space Agency (CSA). Subjects were the Canadian involvement in NASA's as well as ESA's exploration program and bilateral topics. In October 2006, an Implementation Arrangement was signed between CSA and DLR at the IAC that addressed the issue of applied Earth observation. The project envisions an exchange of remote exploration data from the two satellites TerraSAR-X and RADARSAT-2 with the objective of the further development of software tools in the area of moving object identification (GMTI).



Joint Committee Meeting of DLR-CAE in Beijing. In front next to Prof. Szodruch is Prof. Zhang Xinguo, President of CAE and Senior Vice President of AVIC I. In the background from right to left: Dr. Eitelberg, Prof. Zhang Juen and Prof. Zhou Jun



Mexico

After several months of development work, operations were started up at DLR's mobile ground receiver station in Chetumal. The setup of the ground station by the German Space Program was implemented in cooperation with the Mexican partner facilities Consejo Nacional de Ciencia y Tecnología (CONACyT) and Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO). The station has two purposes: for receiving satellite-supported Earth observation data from different satellites, including the German TerraSAR satellite; and research-related cooperation on application issues with regard to the Earth's observation, such as e.g. vegetation mapping, biodiversity protection and fire monitoring, together with the Mexican partners and comparable facilities in the Central American region.

Brazil

The very successful cooperation with Brazil in the area of rocket engines (including the delivery of Brazilian engines for the SHEFEX-1 and TEXUS campaigns) continued during the past year. The DLR module that was started in the summer of 2007 contributed to the Brazilian Micro-g mission CUMA II. In the context of the L-Band Sarsatellite project MAPSAR by the Brazilian research facility "Instituto Nacional de Pesquisas Espaciais (INPE)", the phase-A study with DLR was brought to a successful conclusion in the summer of 2007. The project was presented to DLR and the German space industry at a final workshop. Next it will be presented to Brazilian decision-makers.

Chile

The development of an expanded Earth observation program in Chile was reason for a delegation trip to Chile, joined by representatives of the German space industry, in November of 2006. The basis for this collaboration is the cooperation between the Chilean INACH and DLR regarding use and operation of DLR's receiver station at O'Higgins/Antarctica. The objective of the trip was to identify areas of possible cooperation in applied Earth observation with universities and the aerospace industry.

Ecuador

In July of 2006, Dr. Baumgarten attended the Fifth UN-Space Conference of the Americas in Quito, Ecuador. The conference was an opportunity for bilateral talks, including conversations with the agency directors of Brazil and Chile and also with representatives from other research facilities in Latin America.

UN

Using the advisory meeting of the 49th COPUOS meeting in June of 2006 as a starting point, on December 14, 2006, the General Assembly of the United Nations passed the resolution that provides for setting up the UN program Space Based Information for Disaster Management and Emergency Response (SPIDER) under the supervisory authority of the UN Office for Outer Space. Essential DLR-support helped bring one of the two SPIDER offices to the UN Campus in Bonn. In a parallel step, a second office will be set up to operate from Beijing.

At its 50th conference held in June of 2007, COPUOS debated the current situation involving threats to current or future space missions due to space debris and various guidelines for the reduction of space debris were passed. All member states are now asked to ensure that the guidelines are implemented in the context of their national space activities. DLR implements these guidelines in connection with the steps it takes regarding quality assurance and product safety.

On June 7, 2007, UN Deputy Secretary-General Akasaka, Germany's UN Ambassador Mr. Matussek and DLR Executive Board member Dr. Baumgarten opened the exhibition "A New Perspective on Mars" at the main headquarters of the United Nations in New York. Because of the great interest by the public, the exhibition will travel to different locations within the United States over the course of nearly one year. Parallel to the New York exhibit, DLR contribution to the exhibit at the Vienna location entitled "50 Years of Peaceful Use of Outer Space." DLR's main focus in this context was the issue of space-supported disaster management.

Corporate communication

Increased multimedia and online communication

During the reporting period, Corporate Communications intensified its strategic approach of branding various instruments with Multimedia/online communications being a special focus. Simultaneously, the following highlights can be reported:

- DLR held its annual general meeting in Stuttgart.
- Astrolab mission/ Thomas Reiter. In this instance, DLR was able to make a clear national mark on an ESA mission. DLR supported the communications aspect of the final phase of the mission, both in Germany as well as in the United States. This helped inform the public in a transparent and comprehensive way.
- New Year's receptions in Berlin, Washington and Brussels: With all due ceremony Prof. Wittig retired with honors from his official post at the national and international New Year's festivities, and Prof. Wörner was introduced as the new DLR Chairman. The New Year's reception in Berlin has become an established institution in the German capital, so much so that over time the attendance by high-ranking politicians has become commonplace.
- 100 years of institutionalized aerospace research in Germany: Among other personalities, the Federal Minister Glos made an appearance at the event, which was also organized in honor of the centennial of DLR and its predecessor organizations, thereby also reinforcing for employees the corporate culture of the organization and helping to enhance DLR's public image. The next generation of scientists was reached with outstanding effectiveness. Excerpts of the event were broadcast by the TV station "ntv." In connection with the media-based cooperation between DLR and Lufthansa magazine, LH-magazine presented a 15-page spread with DLR at its focus, including a title page highlighting DLR research.
- At a parliamentary soirée held on February 27, 2007, DLR presented plans for a potential unmanned lunar mission. This issue was communicated publicly. DLR Corporate Communications had suggested the topic and a matching slogan: "Germany on its way to the moon." Media and public alike reacted strongly to this announcement.
- Farewell to Prof. Wittig and introduction of Prof. Wörner. On March 21, 2007, at a festive reception attended by Federal Minister Glos, State Secretary Wuermeling and the coordinator of the BRG for Aeronautics Hintze, the new DLR Chairman Prof. Dr. Johann-Dietrich Wörner was inaugurated to his new office. At the same time, his predecessor Prof. Dr. Sigmar Wittig bid his farewell. High-ranking representatives from the science and business communities as well as industry representatives attended the event. DLR Corporate Communication also presented the first part of the corporate film: "100 Years of Flight" in a premier event showing.
- With the start of the TerraSAR mission, the first German space project developed as a Private-Public-Partnership (PPP) left the starting gate. Communication was excellent; DLR was able to generate and communicate the first images from the satellite with unexpected speed thereby surprising the science community.



Federal Minister for Economics and Technology Michael Glos and the former DLR Chairman Prof. Wittig enter their names in the Golden Book of the City of Goettingen

People

Equal opportunities; work-life balance

DLR acknowledges the importance of family and strives to provide equal opportunity for all. Only two years after being awarded the 2005 "Job and Family Audit" certificate ("Audit Beruf und Familie®"), in 2007 DLR received once more the "Total EQuality" rating for its considerable increase of women in leadership positions over the past ten years and the significant increase of the female share among new scientific talent, climbing from 11% to 27% during that time.

A spectrum of family-oriented measures assists in optimizing the balance between job and family, e.g. flex-time and work hour models, teleworking options through telecommunications/ telephonic/wireless channels etc., sabbaticals,

part-time work for certain phases during the life of a family, family services, rehiring assurances as well as company and company-sponsored child care. Targeted HR development programs to improve the share of female employees and to sensitize management with regard to these issues round out our HR policy approach. Because these measures are part of the "Job and Family Audit" ("Audit Beruf und Familie"), they are continually reviewed and improved.

Personnel development at DLR

Personnel development at DLR is part of the support process relative to "Personnel Management". The goal of personnel development consists in providing help to institutes and facilities in reaching their targets by continually improving the performance capacity of employees, teams and organizational units, while simultaneously promoting incentives and satisfaction in the workplace.

With regard to employees, it is crucial to harmonize, on an individual level, qualifications, responsibilities, development requirements and performance potentials with the demands of the job. Management deals primarily with issues of organizational development. Strategic and structural change processes are correspondingly supported by moderated team workshops.

Tools and services in personnel development

Services and personnel development depend on demand. Basically, demand is defined by strategic talks at the management level, structured employee conversations, individual requests regarding

internal continuing education and harmonization with corporate goals. Qualified HR developers create customized personnel and organizational development concepts for customers with these concerns in mind.

They consult on issues, the implementation of varied personnel development measures and evaluate their efficiency. Personnel development also comprises, issues involving continuing education, employee guidance and talent promotion, as well as the following services:

- Education programs, both local and across sites, focusing on language and electronic data processing training, development of social competence, management responsibilities and the promotion of better health.
- Differentiated development for management personnel and next-generation leadership talent.
- Team workshops with regard to the organizational development (e.g. change management, strategy development, leadership and collaboration, especially tailored training seminars for teams).
- Support with the recruitment, selection and familiarization of new employees.
- Coaching of management personnel and employees as well as of small groups.
- Mentoring, in particular to promote efforts for cultivating the next generation of scientists.
- Management feedback on ways to improve leadership and collaboration.
- Project management on issues such as equality of opportunity and creating a balance between job and family.
- Central coordination of training programs.

In 2006, 44% of the employees participated at least once during the year in an educational program or offerings for management or team workshops under the personnel development efforts. Each employee spent an average of 1.7 days per year with personnel development measures (continuing education events or team workshops); for all employees this added up to 9,294 days in 2006. Overall, and comparing to the figures of the previous year, the number of continuing education events that were held as well as the number of days spent on continuing education per employee increased slightly. Particularly the team workshops registered a clear increase from 26 in 2005 to 38 in 2006. This emphasizes the stronger interactive engagement between personnel development and organizational development. The rate of cancelled seminars due to lack of participants decreased from 31% to 24%, emphasizing the increase in demand.

In 2006, personnel development supported a total of eight mentoring pairs. DLR directs also a mentoring project within the Helmholtz Association that extends across individual centers.

Personnel development defines the promotion of the next generation of scientists as its primary goal. A moderated dialogue has become established since 2005 between new leadership personnel and the DLR Executive Board. This exchange makes potential decision-makers part of important strategic developments and conveys an authentic representation of the work on the Executive Board. Hierarchical boundaries are thus transcended and the corporate identity experiences a boost.

DLR's strategic goals are strongly focused on international integration and the corresponding projects in support of this alignment. A special focus in 2006 was the development of intercultural competence by employees. Activities in the area of e-learning underwent intense promotion across the entire DLR organization. Especially blended learning concepts (the

Personnel development and mobility	2004	2005	2006
Continuing education days per employee	1.7	1.5	1.7
Mentoring teams	11	9	8
Postings abroad (months)	274	485	564

combination of in-class time coupled with phases of self-learning) are being expanded on an ongoing basis. In the area of language and electronic processing training, this approach is already well defined.

New developments and projects

DLR's personnel development participates in the Helmholtz Academy program for leadership personnel; the organization focuses its efforts, in conjunction with the Management Center St. Gallen, specifically on conveying excellent management skills to persons with high leadership potential.

The first doctoral symposium, which created positive feedback from the approximately 70 participants from almost all locations, was held in January of 2007 at DLR. The goal consisted of integrating all DLR doctoral candidates into a network in order to facilitate subject matter and personal exchanges. The resulting action plan includes the creation of an information platform, the generation of a support guideline, information exchange on further career opportunities and the intense utilization of what personnel development has to offer from within DLR. A concept on talent management will be developed for the vice-chairman; the concept is to be initially implemented as a pilot project under the vice-chairman's purview. The entire process "Personnel Management" qualified for DIN EN ISO 9001 certification at the end of 2006. A grievance management system was introduced especially for the area of personnel development; this will further help optimize services.

The DLR-specific draft of the collective bargaining agreement on compensation is currently being negotiated between the total works council and the employer. Personnel development will ensure that, following the signing of an agreement, management and employees will be educated on and familiarized with the system in a short amount of time. Another agreed objective envisions establishing management feedback events as an integrative part of the personnel development of DLR leadership personnel. Self-assessment by management personnel is systematically compared with outside evaluations by subordinated employees and the respective next-level supervisor. This will help to improve the direction as well as the cooperation within the organizational units and helps create a more objective assessment of respective management styles.

One important project involves providing support by the entire administration in the implementation of a process organization and the associated leadership and work culture that is necessary to achieve this goal. Guidelines for management and employees were defined in 2006 on the basis of the concept "Process Management";

Personnel	2004	2005	2006
Employees	5,055	5,125	5,344
Scientific Employees	2,336	2,603	2,749
Standing orders/fixed-term contracts	2,913 / 2,142	3,064 / 2,061	3,043 / 2,301
Proportion of women			
- overall	28%	28%	29%
- in leading positions	12%	12%	12%
- scientific assistants	13%	12%	13%
Young scientists	128	113	110
Doctoral candidates (internal/external)	453	519	538
Trainees	251	256	243

these guidelines were discussed in the context of workshops, and action steps for their implementation were devised. The latter half of the year saw employee interviews with management feedback in order to gather data on the development of the corporate culture for all organizational units. Based on these results, concrete action plans were derived setting clear responsibilities for management and employees. These interviews will be repeated in mid-2008, and the development since will be analyzed.

Human resources Administration

The most important issue in HR Administration is the implementation of the new collective bargaining agreement on compensation for public service jobs (performance-based contract). This is the first time in DLR history that part of the salary of all employees will depend on a specific performance evaluation. The volume of this compensation will amount initially to 1% of the annual salary and will increase in the course of the coming years to 8%. This means ultimately the

goal is a performance incentive that, with a sufficiently differentiated performance evaluation, can amount to as much as two monthly salaries.

The evaluation is done on the basis of whether agreed goals were met and by way of systematic performance evaluations. A graduated model will be used in this context that may envision up to five levels. The collective bargaining contract based on performance only defines the overall framework; said framework will fleshed out with a union contract. No final decision has been reached at this point as to whether a single general union contract may be used that will apply across the entire DLR organization or as to whether an undetermined number of local union contracts with different content will have to be drafted. As long as there is no mutually agreed union contract (there is no instance that qualifies to "force" an agreement; this is not permissible under collective bargaining rules), one half of the premium amount will be paid as a lump sum to each employee, and the second half of the premium will be withheld thereby increasing the compensation volume of the following year accordingly.

Special significance is attached to the issue of training management personnel in appropriately and purposefully evaluating the performance of employees.

Awards and prizes

Internal awards 2006

DLR Science Prize

- Dr. rer. nat. Erich Schülein, Institute of Aerodynamics and Flow Technology
- Dr. rer. nat. Olga Shishkina and Prof. Dr.-Ing. Claus Wagner, Institute of Aerodynamics and Flow Technology
- Dr. techn. Ivan C'osovic' and Dr.-Ing. Michael Schnell, Institute of Communication and Navigation, Prof. Dr. techn. Andreas Springer, University of Linz, Austria

- Dott. Simone D'Amico and Dr. rer. nat. Oliver Montenbruck, Space Operation and Astronaut Training

- Dr.-Ing. Roger Schäfer, Institute of Aeroelasticity and Dr.-Ing. Andreas Mack ESA-ESTEC, Noordwijk, The Netherlands

DLR Senior scientist

- Dr. rer. nat. Eberhard Gill, Space Operation and Astronaut Training
- Dr. rer. nat. habil. Martin Rein, Institute of Aerodynamics and Flow Technology
- Dr. rer. nat. habil. Martin Schmücker, Institute of Materials Research

DLR research semester

- Dr. rer. nat. Thomas Gerz, Institute of Atmospheric Physics
- Dipl.-Ing. Luise Kärger, Institute of Composite Structure and Adaptive Systems
- Dipl.-Phys. Holger Mai, Institute of Aeroelasticity
- Claudia Nobis M.A., Institute of Transport Research
- Dr. rer. nat. Michael Ponater, Institut of Atmospheric Physics
- Dr. rer. nat. Jens Schmidt, Institute of Structures and Designs
- Prof. Dr.-Ing. Claus Wagner, Institute of Aerodynamics and Flow Technology

Prizes awarded by the Society of DLR Friends

Hugo Denkmeier Prize

- Dr.-Ing. Michael Dumbser, University of Stuttgart, as the youngest doctorate candidate at DLR.

Fritz Rudolf Prize

- Dr. Olivia Drescher-Schwenzfeier, DLR Space Agency, for outstanding achievements during the preparations of the ESA-Council Conference at the ministerial level in December 2005 in Berlin.

Innovation Prize

- Dr. rer. nat. Andreas Fix, Dipl.-Ing. Christian Lemmerz, Dr. rer. nat. Hans H. Klingenberg and Dipl.-Phys. Peter Mahnke, Institute of Technical Physics for work on laser systems for natural gas detection on board helicopters

Otto Lilienthal research semester

- Dr.-Ing. Jan Teßmer, Institute of Composite Structures and Adaptive Systems with the Chairman prize of the society for the "Virtual testing of composite structures in aircraft construction"
- Dr.-Ing. Daniela Voss, formerly Institute of Materials Physics in Space, as youngest patent applicant of her age group

Individual Awards

- Bernhard Fuhrmann, Director of Business Communication, for the innovative design and layout of the business and media communication, as part of the successful implementation in the overall strategy of all DLR entities.

DLR/ONERA Team Award

- Bernd Gmelin, formerly Program Director of Aeronautics Braunschweig and Jean-Jacques Philippe, formerly ONERA France, for the initiation, establishment and successful implementation of the science/technology DLR/ONERA collaboration in the helicopter sector.

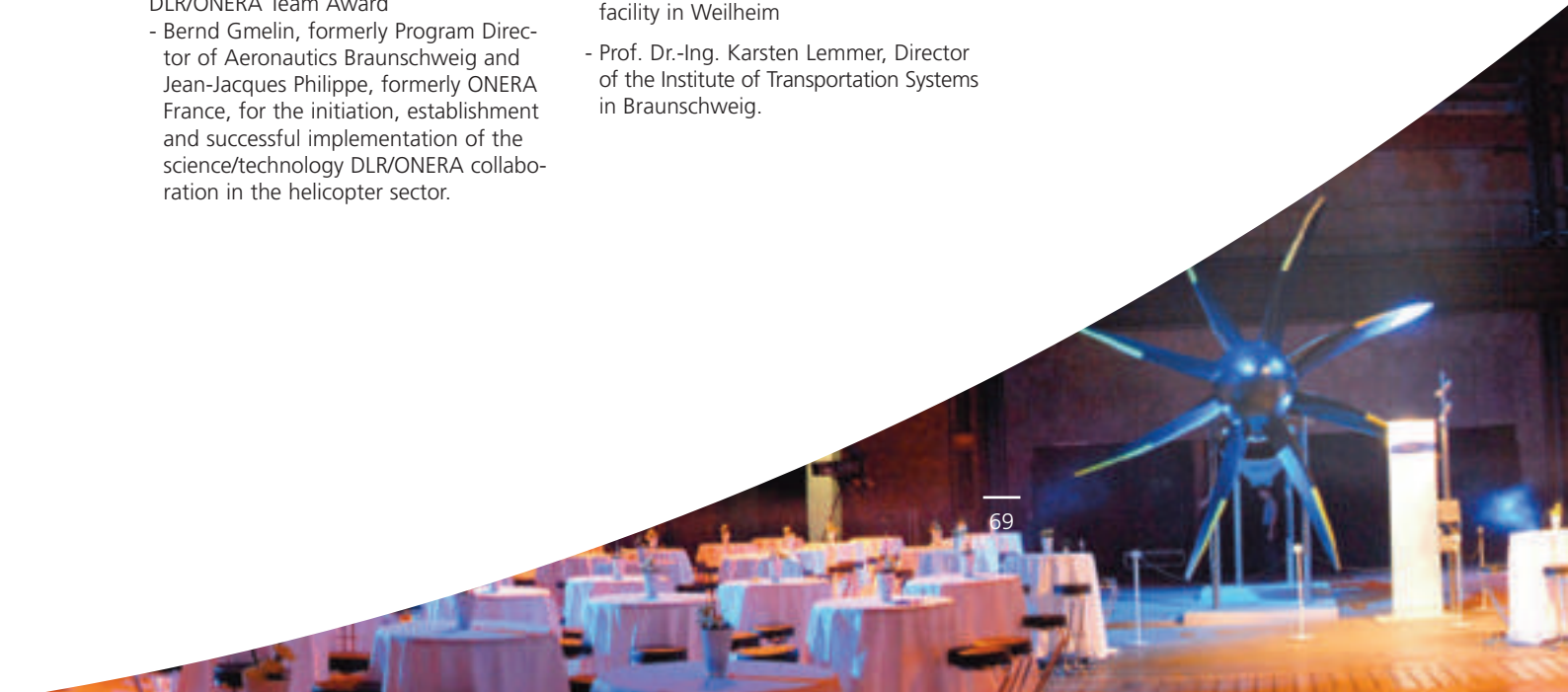
External Awards 2006

Award	Winner
AVT Panel Excellence Award	Prof. Dr. Ing. Horst Körner
Best Paper Award, International Workshop on Satellite and Space Communication	Dipl.-Ing. Laura Rosati Prof. Gianluca Reali
Best Paper Award 2005, Automatic Control Technology, German magazine Regelungstechnik	Dr. Ing. Christian Ott Dr. Ing. Alin Albu-Schäffer
Best Student Paper Award, Digital Avionics Conference	Dr. Ing. Ivan Cosovic
Research Sponsorship Award, University of Mainz	Dr. rer. nat. Patrick Wette
Third Industry Prize 2006 during the award ceremony of the Innovation Prize, Federation of German Composite Industry (AVK)	Institut für Faserverbundleichtbau und Adaptronik
First Winner on the state-level in the 2006 Practical Achievement Competition of Young Journeymen/-women	Dennis Klein
RUAG Aerospace Germany Individual Prize	Dr. rer. nat. Andreas Petzold
Visualization Challenge 2006, NSF National Science Foundation USA and the "Science" Journal	GeoVIS-Team DFD
Zonta International Amelia Earhart Award	Dipl.-Biol. Michaela Herr
Institute of Composite Structures and Adaptive Systems	GeoVIS-Team DFD

DLR Quality Prize

- Dr. Cornelia Schlesier, staff member within the Technology Marketing facility in Berlin-Adlershof, as well as quality representative of Technology Marketing
- Hartmut Keller, staff member within the Space Operation and Astronaut Training facility in Weilheim
- Prof. Dr.-Ing. Karsten Lemmer, Director of the Institute of Transportation Systems in Braunschweig.

In addition the DLR_School_Lab awarded a prize to the student team of the Haimberg Gymnasium-Göttingen for their successful project "Optimization of boat hulls and thermal propulsion of a motorboat". Award-winning team members included Leonie Henschel, Julius Siebner and Lukas Vellmer".



Compilation of Performance Indicators

Third-party funds	2004	2005	2006
Total third-party funding	Euro 242 m	Euro 275 m	Euro 255 m
revenue growth, R&D revenues from domestic business activities	+18%	+1%	+41%
Third-party share as part of the revenue total	49%	52%	48%
Share of revenues from foreign clients (revenue volume)	35%	31%	29%
Success rate of EU proposals in the last three years (accepted/submitted)	42%	40%	54%
Revenues from EU promotions	Euro 12.5 m	Euro 15.6 m	Euro 17.3 m
Coordinator/total ratio (EU projects)	18%	21%	16%

Product-related results	2004	2005	2006
Publications in peer-reviewed journals	450	561	495
Peer-reviewed publications in proceedings, books, etc.	500	566	536
Presentations at scientific conferences, workshops, readings	0.88	0.81	0.85
Calls to universities	12	9	8
Masters Degree	235	264	318
Dissertations (internally)	86	71	78
Post-doctorate	5	5	4

Technology marketing	2004	2005	2006
Revenue from licenses	Euro 4.2 m	Euro 2.7 m	Euro 4.1 m
Company spin-offs	1	1	2
New in-house technology transfer projects	12	15	13
Investments in technology transfer projects	Euro 2.4 m	Euro 3.5 m	Euro 2.8 m
Management tools	2004	2005	2006
Overall project work	65%	63%	66%
Quality management	2004	2005	2006
Certifications and accreditations	13	15	15
National and European networks	2004	2005	2006
DFG participants	36	30	27
Sponsorship contracts	43	54	53
International cooperation	2004	2005	2006
International visiting scientists (stay > 1 month) versus scientific positions at institutes	6.1%	7.9%	6.6%
Personnel	2004	2005	2006
Employees	5,055	5,125	5,344
Scientific Employees	2,336	2,603	2,749
Standing orders/fixed-term contracts	2,913 / 2,142	3,064 / 2,061	3,043 / 2,301
Proportion of women			
- overall	28%	28%	29%
- in leading positions	12%	12%	12%
- scientific assistants	13%	12%	13%
Youth promotion	2004	2005	2006
Young scientists	128	113	110
Doctoral candidates (internal/external)	453	519	538
Trainees	251	256	243
Personnel development and mobility	2004	2005	2006
Continuing education days per employee	1.7	1.5	1.7
Mentoring teams	11	9	8
Postings abroad (months)	274	485	564



FACTS & FIGURES

Experiment



Im Oktober 1997 startete MIRKA an Bord einer russischen Sojus-Rakete ins Weltall. MIRKA war die erste erfolgreiche westeuropäische Windenerkennungsmission, bei der wertvolle Flug-Messdaten zur Bewertung von theoretischen Modellen des Windenergiepotenzials gewonnen werden konnten.

Die MIRKA Mission wurde von deutschen Forschern in enger Zusammenarbeit zwischen Industrie und Hochschule durchgeführt. MIRKA hatte zahlreiche Aufgaben. Dazu zählte auch die Erprobung eines neuen ablativen Wärmeschutzkonzepts. Weitere Experimente dienten unter anderem der Überprüfung der Verfahrensmethoden für die Flugbahn und die mechanischen und thermischen Lasten sowie der Flugprüfung von Sensoren für Beschleunigung, Druck- und Temperaturmessung. Zahlreiche der mit der MIRKA Kapital gewonnenen Erkenntnisse fanden Eingang in die Vorbereitung des NASA Experimental-Raumfluges X-38 sowie des Flugprogramms EXIST der Europäischen Raumfahrtagentur ESA.

Institutes and facilities

- Aerodynamics and Flow Technology
- Aeroelasticity
- Aerospace Medicine
- Aerospace Systems
- Air Transport and Airport Research
- Applied Remote Sensing
- Atmospheric Physics
- Combustion Technology
- Communication and Navigation
- Composite Structures and Adaptive Systems
- Flight Guidance
- Flight Operations
- Flight Systems
- German Remote Sensing Data Center
- Materials Research
- Microwaves and Radar
- Planetary Research
- Propulsion Technology
- Robotics and Mechatronics
- Space Operations and Astronaut Training
- Space Propulsion
- Space Simulation
- Structures and Design
- Technical Physics
- Technical Thermodynamics
- Transport Research
- Transport Systems
- Vehicle Concepts

Members and executive bodies

As of June 30, 2007, DLR had 47 sponsoring members in addition to honorary members, scientific members and ex officio members.

Honorary members

- The Honorable Daniel Saul Goldin, Washington
- Prof. Dr. rer. nat. Walter Kröll, Marburg
- Prof. Dr. rer. nat. Reimar Lüst, Hamburg
- Jean Sollier, Rueil-Malmaison, France
- Prof. Dr.-Ing. Gerhard Zeidler, Stuttgart

Sponsoring members

Public entities that regularly give at least Euro 50,000 annually:

- Federal Republic of Germany, represented by the Federal Minister of Economics and Technology, Berlin
- The German state of Baden-Wuerttemberg, represented by the Baden-Wuerttemberg Minister of Economics, Stuttgart
- State of Bavaria, represented by the Bavarian State Minister of Economics, Transport, and Technology, Munich
- The German state of Berlin, represented by the State Secretary of Science, Research and Culture, Berlin
- The German state of Lower Saxony, represented by the Lower Saxony Minister of Science and Culture, Hannover
- The German state of North Rhine-Westphalia, represented by the Minister of Innovation, Science, Research and Technology of North Rhine-Westphalia, Duesseldorf

Individuals, legal entities, and associations and societies without legal capacity:

- Aerodata AG, Braunschweig
- AIR LIQUIDE Deutschland GmbH, Duesseldorf
- ALSTOM Power Generation AG, Mannheim
- AOPA-Germany, Verband der Allgemeinen Luftfahrt e. V., Egelsbach
- Arbeitsgemeinschaft Deutscher Verkehrsflughäfen e. V., Berlin
- AUDI AG, Ingolstadt
- Robert Bosch GmbH, Berlin
- Bundesverband der Deutschen Luft und Raumfahrtindustrie e. V., Berlin
- CAE Elektronik GmbH, Stolberg
- CAM Computer Anwendung für Management GmbH, Unterfoehring
- Carl-Cranz-Gesellschaft e. V., Weßling/Obb.
- Commerzbank AG, Großkundencenter West, Duesseldorf
- DaimlerChrysler AG, Stuttgart
- Deutsche BP Holding AG, Hamburg
- Deutsche Gesellschaft für Luft- und Raumfahrt – Lilienthal Oberth e. V. (DGLR), Bonn
- Deutsche Gesellschaft für Ortung und Navigation e. V., Bonn
- DFS Deutsche Flugsicherung GmbH, Langen
- Diehl VA Systeme Stiftung & Co. KG, Ueberlingen
- Dornier GmbH, Friedrichshafen
- Dresdner Bank AG, Cologne
- EADS Deutschland GmbH, Munich
- ESG Elektroniksystem- und Logistik-Gesellschaft mbH, Munich
- Fraport AG, Frankfurt/Main
- GAF AG, Munich
- Municipality of Weßling, Weßling/Obb.
- Gerling Vertrieb Firmen und Privat AG/Gerling Vertrieb Industrie AG, Cologne

- Industrieanlagen-Betriebsgesellschaft mbH (IABG), Ottobrunn
- Kayser-Threde GmbH, Munich
- KUKA Roboter GmbH, Augsburg
- LIEBHERR-AEROSPACE LINDENBERG GmbH, Lindenberg/Allgäu
- Lufthansa Technik AG, Hamburg
- MST Aerospace GmbH, Cologne
- MT Aerospace AG, Augsburg
- MTU Aero Engines GmbH, Munich
- Nord-Micro Elektronik AG & Co. OHG, Frankfurt/Main
- OHB-System AG, Raumfahrt- und Umwelt-Technik, Bremen
- RheinEnergie AG, Cologne
- Rheinmetall Defence Electronics GmbH, Bremen
- Röder Präzision GmbH, Egelsbach
- Rohde & Schwarz GmbH + Co. KG, Cologne
- Rolls-Royce, Deutschland Ltd & Co. KG, Dahlewitz
- RUAG Aerospace Deutschland GmbH, Weßling
- Siemens AG, Munich
- Snecma Moteurs, Vernon
- Stadt Braunschweig, Braunschweig
- Tesat-Spacecom GmbH & Co. KG, Backnang
- ZF Luftfahrttechnik GmbH, Calden

Scientific members

- Prof. Dr.-Ing. Maria Esslinger, Braunschweig
- Prof. Dr.-Ing. Philipp Hartl, Munich
- Prof. Dr. Hans Hornung, Pasadena, California/USA
- Prof. Dr.-Ing. Dr.-Ing. E. h. Erich Truckenbrodt, Gruenwald
- Prof. Dr. rer. nat. Joachim E. Trümper, Garching

Ex officio members

- Prof. Dr.-Ing. Manfred Aigner, Stuttgart
- Dr. rer. pol. Ludwig Baumgarten, Bonn
- Jürgen Breilkopf, Munich
- Prof. Dr.-Ing. Dr. h. c. mult. Bullinger, Munich
- Marco R. Fuchs, Bremen
- Prof. Dr. rer. nat. Ursula Gather, Dortmund
- Dipl.-Ing. Rainer Götting, Heidelberg
- Prof. Dr. Reinhard Genzel, Garching
- Prof. Dr. Michael Grewing, France
- Prof. Dr. rer. nat. Peter Gruss, Munich
- Dipl.-Kfm. Klaus Hamacher, Cologne-Porz
- Dipl.-Ing. August Wilhelm Henningsen, Hamburg
- Prof. Dr.-Ing. Peter Horst, Braunschweig
- Andreas Kleffel, Duesseldorf
- Prof. Dr.-Ing. Matthias Kleiner, Bonn
- Prof. Dr.-Ing. Wolfgang Kubbat, Darmstadt
- Dr.-Ing. Reinhold Lutz, Munich
- Dr.-Ing. Norbert Rüdiger Ninz, Ueberlingen
- Dr.-Ing. Manfred Peters, Cologne-Porz
- Dipl.-Kfm. Gerhard Puttfarcken, Hamburg
- Dr. rer. pol. Rainer Schwarz, Berlin
- Dr.-Ing. Klaus Steffens, Munich
- Prof. Dr.-Ing. Joachim Szodruich, Cologne-Porz
- Uwe Teegen, Braunschweig
- Prof. Dr.-Ing. Johann-Dietrich Wörner, Cologne-Porz
- Prof. Dr. rer. nat. Gunter Zimmermeyer, Berlin

DLR Senate

As of June 30, 2007, the Senate has the following members:

From the science sector:

- Prof. Dr.-Ing. Manfred Aigner
- Prof. Dr.-Ing. Dr. h. c. mult. Hans-Jörg Bullinger, ex officio
- Prof. Dr. rer. nat. Ursula Gather
- Prof. Dr. rer. nat. Reinhard Genzel
- Prof. Dr. Michael Grewing
- Prof. Dr. rer. nat. Peter Gruss, ex officio
- Prof. Dr.-Ing. Peter Horst
- Prof. Dr.-Ing. Matthias Kleiner, ex officio
- Prof. Dr.-Ing. Wolfgang Kubbat (Vice-Chairman)
- Dr.-Ing. Manfred Peters
- Uwe Teegen

From the economics and industry sectors:

- Jürgen Breitkopf
- Marco R. Fuchs
- Dipl.-Ing. Rainer Goetting
- Dipl.-Ing. August Wilhelm Henningsen
- Andreas Kleffel
- Dr.-Ing. Reinhold Lutz
- Dr.-Ing. Norbert Rüdiger Ninz (Vice-Chairman)
- Dipl.-Kfm. Gerhard Puttfarcken
- Dr. rer. pol. Rainer Schwarz
- Dr.-Ing. Klaus Steffens
- Prof. Dr. rer. nat. Gunter Zimmermeyer

From government sector:

- Leitender Ministerialrat Dr. rer. pol. Gerd Gruppe
- Staatssekretär Dr. Hans-Gerhard Husung
- Staatssekretär Dr. phil. Josef Lange
- Ministerialdirigent Günther Leßnerkraus
- Ministerialdirigent Thilo Schmidt
- Ministerialdirigent Andreas Schneider
- Staatssekretär Dr. jur. Michael Stückradt
- Ministerialdirektor Dr. Christian D. Uhlhorn
- Staatssekretär Dr. jur. Joachim Wuermeling (Chairman)
- Ministerialrat Hendrik Zillinger

DLR Senate Committee

As of June 30, 2007, the Senate Committee includes six members from the science sector, six members from the sectors of economy and industry, and five members from government:

From the science sector:

- Prof. Dr.-Ing. Manfred Aigner
- Dr.-Ing. Martin Bruse
- Prof. Dr.-Ing. Klaus Drechsler
- Prof. Dr. rer. pol. Martin Grötschel
- Prof. Dr.-Ing. Reinhard Niehuis
- Prof. Dr. rer. nat. Sami K. Solanki (Vice-Chairman)

From the sectors of economy and industry sector:

- Prof. Dr.-Ing. Klaus Broichhausen
- Christa Fuchs
- Dipl.-Ing. Rainer Götting (Vorsitzender)
- Josef Kind
- Dipl.-Ing. Georg Rayczyk
- Dr.-Ing. Peter Tropschuh

Voting members from the government sector:

- Ministerialdirigent Helge Engelhard
- Senatsrat Bernd Lietzau
- Dr. Reinhardt Michael
- Regierungsdirektor Dr.-Ing. Ulrich Stöcker
- Ministerialrat Hendrik Zillinger

Non-voting members from the government sector:

- Leitender Ministerialrat Dr. jur. Reinhard Altenmüller
- Ministerialrat Dr. jur. Axel Kollatschny
- Ministerialrat Karl Schumacher
- Ministerialdirektor Dr. Christian D. Uhlhorn

Members of the Executive Board Scientific Technical Council

(Status: June 30, 2007)

- Prof. Dr.-Ing. Johann-Dietrich Wörner (Chairman)
- Dipl.-Kfm. Klaus Hamacher (Vice-Chairman)
- Dr. rer. pol. Ludwig Baumgarten
- Prof. Dr.-Ing. Joachim Szodruch

WTR members

(Status: June 30, 2007)

- Prof. Dr. rer. nat. Stefan Dech (Vice-Chairman)
- Prof. Dr.-Ing. Alberto Moreira
- Prof. Dr.-Ing. Cord-Christian Rossow
- Dr.-Ing. Georg Eitelberg
- Prof. Dr.-Ing. Karsten Lemmer
- Prof. Dr.-Ing. Horst Friedrich
- Dr. Marina Braun-Unkhoff
- Dipl.-Ing. Michael Bauschat
- Dr. phil. nat. Reinhold Busen (Chairman)
- Dr. rer. nat. Thomas Holzer-Popp
- Dipl.-Phys. Peter-Michael Nast
- Dr. Stephan Ulamec

Space Committee

(Status: June 30, 2007)

- Ministerialdirigent Detlef Dauke, Federal Ministry of Economics and Technology
- Ministerialdirektor Dr. Christian Uhlhorn, Federal Ministry of Research and Education
- Vortragender Legationsrat 1. Klasse Dr. rer. nat. Karl-Ulrich Müller, Ministry of Foreign Affairs
- Wolfgang Reimer, Federal Ministry for Consumer Protection, Food and Agriculture
- Ministerialdirigent Thilo Schmidt, Federal Ministry of Transport, Building and Urban Development
- Director at the Federal Agency for Defense Technology and Procurement Dipl.-Ing. Erwin Bernhard, Federal Ministry of Defense
- Ministerialdirigent Dr. Rainer Sontowski, Federal Ministry of Environment, Nature Conservation and Reactor Safety
- Ministerialdirigent Dr. Gabriel Kühne, Federal Ministry of Finance
- Ministerialrat Dr. Winfried Horstmann Federal Chancellery



Affiliates and joint ventures

DLR Joint Ventures Limited Liability Company, Bonn **100.00%**

The focus of the founded-company, in 2003, is to offer investment opportunities to European economic stakeholders within the framework of the tasks set forth in the DLR bylaws. The company has interest holdings in the European project management agency EDCTP-EEIG and in AT-One EWIV, which was founded in 2007 in order to promote and organize cooperation between DLR and NLR in the field of air traffic management.

German-Dutch Wind Tunnel Foundation (DNW), Noordoostpolder/The Netherlands **50.00%**

The foundation was established as a non-profit with equal shares held by its Dutch partner organization NLR (www.nlr.nl). Its purpose is the operation, maintenance and further development of the foundation's own low speed wind tunnel in Noordoostpolder as well as other DLR and NLR wind tunnels.
(www.dnw.aero)

European Transonic wind tunnel GmbH (ETW), Cologne **31.00%**

The European Transonic Wind Tunnel, ETW, developed and supported by the Germany, France, Great Britain, and the Netherlands is the most modern wind tunnel in the world. New aircraft designs are tested and optimized as scaled down models in the ETW under simulated actual flight conditions. The newly obtained findings are vital to the success of the aircraft project.
(www.etw.de)

T-Systems Solutions for Research GmbH, Wessling **25.10%**

T-Systems Solutions for Research – a joint venture between DLR and T-Systems Enterprise Services GmbH – offers customers in the fields of science and research a long-term IT-partnership. DLR has spun off its centralized data processing to the joint venture.
(www.t-systems-sfr.com)

TeleOp GmbH (company with limited liability), Wessling **25.00%**

The company was founded in 2005 in cooperation with T-Systems, EADS and LfA Förderbank Bayern. Its purpose is the implementation of all necessary negotiations within the framework of the GNSS development (Global Navigation Satellite System), with the underlying target of participating in the development and operation of a European satellite navigation program.
(www.teleop.de)

Anwendungszentrum GmbH Oberpfaffenhofen, Wessling **25.00%**

This application center was established in 2005 as a Public-Private Partnership (PPP), and will continue to receive start-up capital until the end of 2009 through funds from the "High-Tech Offensive Bavaria" re-investment program. Since the early beginnings of the initially solely financed and established incubator by DLR, more than 31 start-up companies in the field of satellite navigation have made use of its facility or have settled in Oberpfaffenhofen.
(www.anwendungszentrum.de)

Europäische Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen Bad Neuenahr-Ahrweiler GmbH, Bad Neuenahr-Ahrweiler **25.00%**

The European Academy is dedicated to studying and evaluating the consequences of scientific and technical developments on the individual and social life

of man and man's natural environment. The main focus is on examining processes that are influenced by natural and engineering sciences and the medical disciplines. An independent scientific institution, the Europäische Akademie pursues a dialogue with industry, culture, politics and society. The other shareholder is the Land of Rhineland-Pfalz. (www.europaeische-akademie-aw.de)

**ZFB Zentrum für Flugsimulation
Berlin GmbH, Berlin
16.67%**

The company provides flight simulators for applied research in flight guidance and flight procedures, system simulation and manipulation and related technologies for training aerospace engineers and aircraft crews. (www.zfb-berlin.de)

**Innovationszentrum für Mobilität
und gesellschaftlichen Wandel
(InnoZ) GmbH, Berlin
9.80%**

InnoZ studies the complex interaction where mobile and changing societies interface and develops innovative solutions for newly created demands to stakeholders in transport and the infrastructure sector. InnoZ maintains an interdisciplinary spectrum of competences: expertise in sociology, geography, economy, and economic transport perspectives. (www.innoz.de)

**ZTG Zentrum für Telematik im
Gesundheitswesen GmbH, Krefeld
6.00%**

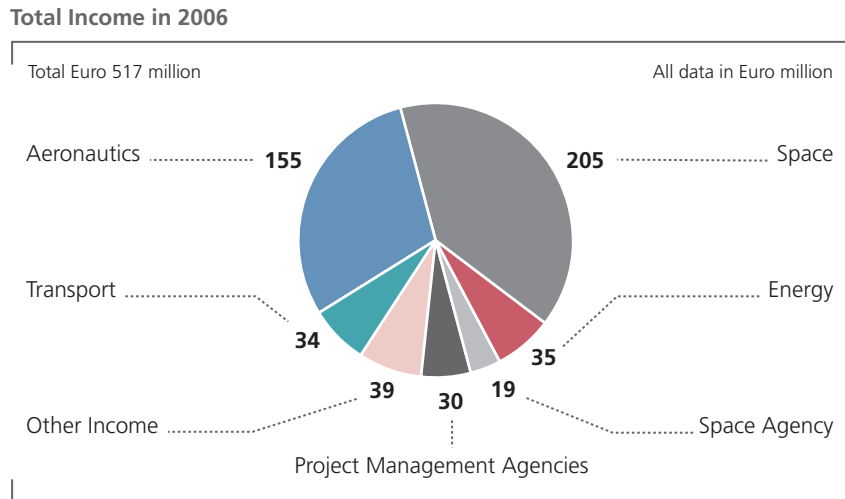
The purpose of this competence center is to introduce modern information and communication technologies into the health care sector, and to improve and disseminate them. The main focus is on neutral consultation and project management for industry and health care clientele, implementation of inter-operative solutions for integrated care and the promotion of knowledge transfers between the health care, industry, science and policy sector. (www.ztg-nrw.de)

**Geophysica EEIG in Liquidation,
Florence, Italy
5.10%**

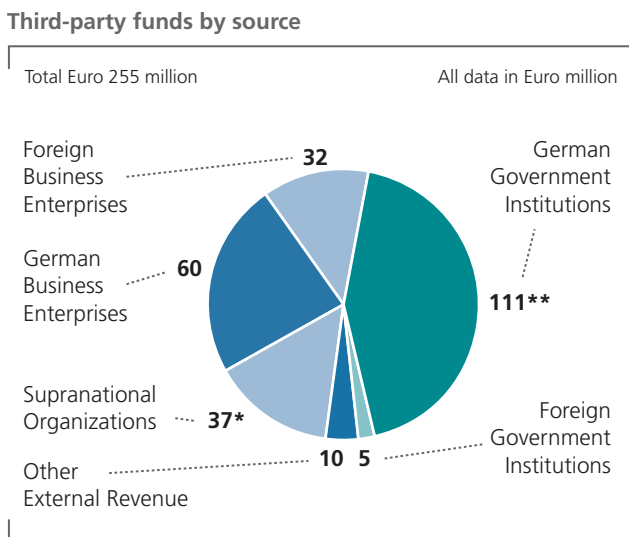
The company holds a combination of German and Italian research entities. It managed and coordinated the Russian high-altitude research aircraft operation, M55-Geophysica and offered participating European research facilities the use of the aircraft with research focus on the effects of climate change and pollution of the ozone layer. As planned, the contractual term of the company has come to an end in January 2007. The company is currently being liquidated. (www.geophysica-eeig.eu)

Use of funds

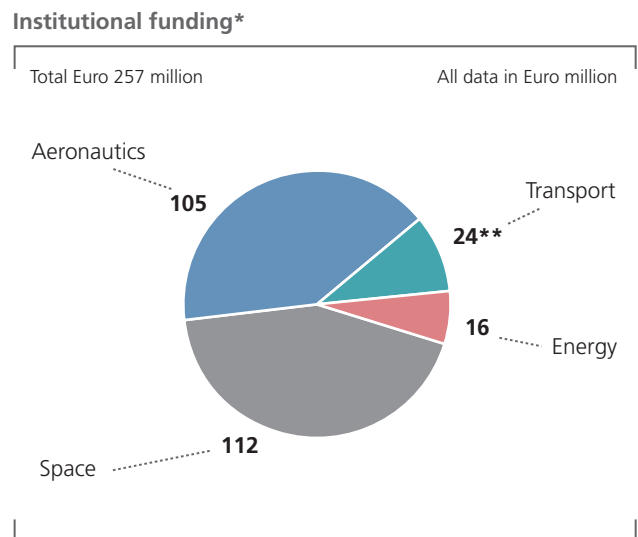
Total income in 2006 (third-party funding and basic financing)



Third-party funds by source and institutional funding in 2006



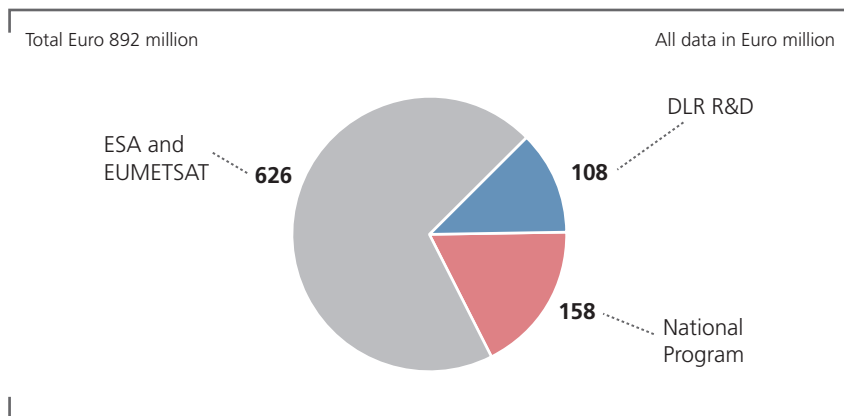
* of these: ESA 19, EU 17, Others 1
 ** of these: Project Management Agencies 47, National Government Institutions 47, Other German government R&D third-party funding 17



* without other income
 ** The majority of start-up financing for the still-expanding transport area is not included here

German public funding for space in 2006

Public funds for Space



Germany spent approx. Euro 892 million in public funds for civilian space activities in 2006. About 70% of these funds were German contributions to ESA (BMW i and BMW VBS) and EUMETSAT, about 18% went to the national space program and 12% to R&D in DLR's core area of space.

List of abbreviations

ACARE	Advisory Council for Aeronautical Research in Europe	CIRA	Italian Aerospace Research Center
ADV	German Airports Association	CNES	Center National d'Etudes Spatiales
ATI	Administrative and technical infrastructure of DLR	CONABIO	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad – The National Commission for the Knowledge and Use of Biodiversity
ATM	Air Traffic Management	CONACyT	Consejo Nacional de Ciencia y Tecnología
BDLI	German Aerospace Industries Association	COPUOS	United Nations Committee on the Peaceful Use of Outer Space
BG	Berufsgenossenschaft	CRC-ACS	Cooperative Research Centre for Advanced Composite Structures
BMBF	Federal Ministry of Education and Research	CSA	Canadian Space Agency
BMFSFJ	Federal Ministry for Family Affairs, Senior Citizens, Women and Youth	DFD	German Remote Sensing Data Center
BMG	Federal Ministry of Health	DFG	German Research Foundation
BMU	Federal Ministry for Environment, Nature Conservation and Reactor Safety	DFS	German Air Navigation Services
BMVBS	Federal Ministry for Transport, Building and Urban Development	DGAC	Direction Générale de L'Aviation Civile – french aeronautic agency
BMW	Federal Ministry for Economics and Technology	DLR	German Aerospace Center
BWB	Federal Office of Defense – Technology and Procurement	DNW	German-Dutch Wind Tunnels
CAE	Chinese Aeronautical Establishment	DQS	German Registrar for Management Systems
CERTH/CPERI	Centre for Research & Technology, Hellas/ Chemical Process Engineering Research Institute	EADS	European Aeronautic Defence and Space Company
CFD	Computational Fluid Dynamics	ECTRI	European Conference of Transport Research Institutes
CFK	carbon-fiber-reinforced plastic	EEA	European Excellence Award
CHRDI	Chinese Helicopter Research and Development Institute	EEF-Fonds	Helmholtz-Förderprogramm zur Erleichterung von Existenzgründungen aus Forschungseinrichtungen – Helmholtz Association support programme to the relief of existence foundations out of research facilities
CIEMAT	Spanish Research Center for energy, environment and technology	EFQM	European Foundation for Quality Management
		EOS	Earth observation system
		ESA	European Space Agency
		ESTEC	European Space Research and Technology Center
		EWIV	European Economic Interest Grouping
		FAA	Federal Aviation Administration
		FRP	EU Research Framework Programme
		FuE	Research and development

GAF	Society for Applied Remote Sensing	NOAA	National Oceanic and Atmospheric Administration
GARTEUR	Group for Aeronautical Research and Technology in Europe	ONERA	Office National d'Etudes et de Recherches Aérospatiales
GESA	German European Security Association e.V.	PoF	The Helmholtz Association Programme-oriented funding
GKSS	Research Centre Geesthacht GmbH	PPP	Public Private Partnership
GSOC	German space operations center	PSA	Plataforma Solar de Almería
GMES	Global monitoring of environment and security	PT	Project management agency
GNSS	Global Navigation Satellite System	QM	Quality management
GPS	Global Positioning System	ROSKOSMOS	Russian space authority
HDTV	High definition television	RWTH Aachen	University of Applied Sciences, Aachen, North Rhine-Westphalia
HGF	Helmholtz Association of National Research Centers	SAR	Synthetic aperture radar
IAC	International Astronautical Congress	SESAR	Single European sky ATM research
IBEC	IQNet Business Excellence Class	SOLLAB	Alliance of European Laboratories on Solar Thermal Concentrating Systems
ICAO	International Civil Aviation Organization	STREP	Specific Targeted Research Projects; application category under the EU RFP
ICAS	International Council of the Aeronautical Sciences	TU	Technical University
ICSU	International Council of Scientific Unions – World Data Center for Remote Sensing of the Atmosphere	TVöD	Collective agreement for the public service
IEA	International Energy Agency	TWG	Transsonischer wind tunnel Göttingen
IFEU	Institute for Energy and Environmental Research, Heidelberg	UFS	Environmental Research Station Schneefernerhaus
INACH	Instituto Nacional Antártico Chileno	UN	United Nations
INPE	Brazilian space research institute	VDI	Association of German Engineers
ISS	International space station	WMO	World Meteorological Organization
JAXA	Japan Aerospace Exploration Agency	WTR	DLR Scientific-Technical Council
JCM	Joint Committee meeting		
KARI	Korea Aerospace Research Institute		
KSC	Kennedy space Center		
LBA	German Federal Aviation Administration		
LCT	Laser communication terminal		
LIDAR	Light detection and ranging		
LLF	Large-Low-Speed Facility		
LUFO	Aeronautics Research Programme		
MESZ	Central European Summer Time		
MoU	Memorandum of understanding		
MPG	Max Planck Society		
NASA	National Aeronautics and Space Administration		
NLR	Dutch aerospace research institution		

DLR at a glance

DLR is Germany's national research center for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Transportation and Energy is integrated into national and international cooperative ventures. As Germany's space agency, DLR has been given responsibility for the forward planning and the implementation of the German space program by the German federal government as well as for the international representation of German interests. Furthermore, Germany's largest project-management agency is also part of DLR.

Approximately 5,300 people are employed in DLR's 28 institutes and facilities at nine locations in Germany: Koeln-Porz (headquarters), Berlin-Adlershof, Bonn-Oberkassel, Braunschweig, Bremen, Goettingen, Lampoldshausen, Oberpfaffenhofen, and Stuttgart. DLR also operates offices in Brussels, Paris, and Washington, D.C.

DLR's mission comprises the exploration of the Earth and the Solar System, research for protecting the environment, for environmentally-compatible technologies, and for promoting mobility, communication, and security. DLR's research portfolio ranges from basic research to innovative applications and products of tomorrow. In that way DLR contributes the scientific and technical know-how that it has gained to enhancing Germany's industrial and technological reputation. DLR operates large-scale research facilities for DLR's own projects and as a service provider for its clients and partners. It also promotes the next generation of scientists, provides competent advisory services to government, and is a driving force in the local regions of its field centers.



DLR

**Deutsches Zentrum
für Luft- und Raumfahrt e.V.**

German Aerospace Center

**Corporate Development and
External Relations**

Linder Hoehe
D-51147 Cologne

www.DLR.de